DRINKING WATER QUALITY AND ITS IMPLICATIONS FOR HUMAN HEALTH IN PUNJAB, PAKISTAN

BY

SAMINA KAUSAR
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To,

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Faisalabad

We, the supervisory committee, certify that the contents and form of thesis submitted by Miss Samina Kausar, 99-ag-1835 has been found satisfactory, and recommend that it be processed for evaluation by the External Examiner(s) for the award of degree.

Supervisory committee:

1- Chairman:  

(Dr. Ashfaq Ahmad Maann)

2- Member:  

(Dr. Muhammad Iqbal Zafar)

3- Member:  

(Dr. Tanvir Ali)
DEDEICATED

To

My Brother

(Altav Hussain Anwar)

Whose priceless love is and has been my care-taker through ups and downs of my life’s journey
ACKNOWLEDGEMENT

All acclamation and appreciation are for Almighty ALLAH the Magnificent and Merciful and His prophet Muhammad (PBUH) who’s moral and spiritual teachings enlightened my heart, mind and flourished my thoughts towards achieving highest ideas of life.

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(Samina Kausar)
ABSTRACT

Safe drinking water is a human birthright as much a birthright as clean air. However, much of the world’s population does not have access to safe drinking water. As Water and Sanitation is the neglected sector in Pakistan so, most of the households in Pakistan do not have access to safe drinking water and lack toilets and adequate sanitation systems.

This study was aimed at determining the drinking water quality influencing factors and their health outcome. It was conducted in three districts; Rawalpindi, Multan, and Toba tek singh of Punjab province and a sample of 600 married females of age group 20-60 were interviewed keeping in view that in most cultures, women are primarily responsible for the use and management of water resources, sanitation and health at the household level. Additionally, focus group discussions (FGDs) were also conducted to explore detailed information.

Univariate analysis provides simple descriptive statistics (frequencies and percentages) on a large number of questions (indicators) asked in the survey.

The main findings at bi-variate analysis depicted a significant relationship between all drinking water influencing factors (i.e. household income, family type, female’s education, type of house, number of domestic water sources, nature of drinking water source, main storage system at home, separate water storage container for drinking and cooking purposes, use of measures to improve the drinking water quality, number and structure of toilet at home, and practice of washing hands after using toilet) and health outcome. Multi-variate analysis showed the most important and contributing factors, in explaining the health outcome of households, which were the source of drinking water, family type, separate drinking water container, household income, and mother’s education. Multi-variate analysis results showed that the people having low family income had worse health outcomes than people having high family income. Additionally, mother’s years of educations were found to be positively co-related with improved family health. The results showed that the increase in number of households having separate water storage container resulted in increase in households getting suffered because of the unhygienic way of water handling.

From the focus groups discussions, it was concluded that most of the participants were using two sources (WASA/Municipal, GW) for domestic water at home in addition to this there were other sources used by the participants including water filter plants, tube wells etc. for drinking purpose. Most of the participants were not satisfied with the taste of the water as they have groused of brackish taste of ground water. Only one fourth of the participants were using measures to improve the drinking water quality. Almost every participant had separate storage covered container for drinking and cooking purposes but without faucet as a result their way of handling was unhygienic in view of the fact they dip utensil into the container for usage. Majority of the households were using single toilet. More than half of the participants were used to wash their hands every time after using toilet but in rural areas some of the participants did not take into account hand washing practice regularly as they did not put the soap in their toilet.
Keeping in view the above findings it is recommended that Govt. should work on emergent basis in the battle of drinking water shortage and NGO’S should come forward alongwith the govt. in order to make the people aware of adopting measures before drinking water usage to improve its quality.
Policy measures aimed at managing anaemia should seek to address all these factors.
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"We can put a man on the moon, but we cannot be sure we are getting safe drinking water.” (Gelt, J, 1996)

Access of pure drinking water is the basic human right, which is supported by international law and the declarations (Gleick 1999). The available data reflects that only 2.5 percent is the available fresh water out of the total volume present on the earth. However, most of it is locked up in glaciers or in the depths of groundwater aquifers. The experts opine that, by 2025, population that consists of 52 nations making half of the world's population suffer with acute / severe shortage of potable water, whereas, around 3 billion people will face water shortage (Pani Pakistan, 2007). Unlike the facilitated lifestyle of the those living in the developed world clearly contrasts with more than a half billion people living in developing or under developed areas have to face a lack of safe drinking water. Almost three billion people have to survive without any access to and availability of improper sanitation systems required for reducing contact to the diseases related to the water. These fundamental human needs seem being ignored due to the failure of the international aid community, nations and local organizations leading the human kind to the considerable, unnecessary and preventable human misery. The declaration of safe drinking water as a basic human need is very easy to be made but the guarantee of the provision of the safe drinking water to more than 1 billion people is not that much easy (Fritschel, 2002). Water, as an essential commodity for the survival and
development of human beings is a scarce good so sometimes its shortage results in crisis. Both the facts are found leading to the conclusion the attainment of the development and a dignified life is hindered because of the lack of water (Rosemann, 2005). The relation between the quality of water and health risks have already been well considered and established. It is a bitter fact that the main causes are improper quality and quantities of water as well as the other responsible factors are the poor sanitation facilities and unhygienic practices causing diseases like diarrhea, intestinal worms and hepatitis. As revealed by a study held by UNICEF, in Pakistan, 20 - 40 % of the hospital beds are used by such patients who are suffering from diseases caused by water including cholera, dysentery and hepatitis that, in fact, are a cause of one third of total death toll (Anonymous, 2006).

A research states that the supply of water and sanitation facilities all around the world, are deteriorating, increasingly and currently, operating at the fraction of its installed capacity. the poor countries with a limited access to clean water supplies and sanitation facilities seem more affected than the developing countries in Asia, Africa and Latin America as they, particularly, have to face some serious situations even in their urban areas where the greatly alarming increase is sighted in the infectious disease risks to the population most importantly among infants and the children of young age. The rural areas seem more seriously affected by such situation where there is still a need to work out the problem of water resources and improper sanitation facilities (Ahmed, 2002).

All over the world, 1.1 billion people are estimated for being suffering from lack of access to an improved water source (UN on Sustainable development, 2004; UNDP, 2006). Another problem is the unawareness or carelessness of those people who have the provision of the clean water so they make the use of water unfit for themselves due to their unsanitary handling and storage. The diarrheal illness is caused by the unsafe water, non - provision of sanitary facilities and unhygienic sources of water treatment which results in the children's death under five and counts to about 2 million deaths of children every year (UN Commission on Sustainable development, 2004). There are 1.8 million preventable child fatalities and 443 million school days loss due to water related illness. The figures become more alarming as 50 percent of all people who live in the developing
countries are facing health problems which are a result of unsafe water and inadequate sanitation (UNDP, 2006)

With the advent of 21st century, the water has become a commodity as it has become a means of profit for some and a bone of contention for many others. Water use is growing twice as fast as population, but today there is no more water than ever it has been in past (Clarke & Maude, 2003).

The out of control growth of population is leading the world towards the acute shortage of fresh water. According to an estimation of the growth rate of the population, there will be an addition of about 2.6 billion more people to the existing population on the Earth by the year 2025 which is also a threat that about two - third of that population will be facing the problem of severe water shortage, while one - third of that will be existing with total scarcity of water. As compared to the present situation, the demand level of water will increase by 56 percent. The profit caring global corporation is greatly allured by the growing contrast of the increasing demand of water and shrinking supply of it giving way to the business of selling water. Thus, with a potential of trillion - dollar, the World Bank has touted the water industry, which has made the water win the title of "the blue gold of 21st century (Clarke & Maude, 2003).

The accessibility of safe water in sufficient quantities is the fundamental right as far as human health is concerned. Diarrhea is the most important water associated health problem, while the usage of unsafe water becomes a cause of 3 to 5 million deaths per year, most commonly among young children The preventive measure taken for the decrease of diarrheal diseases in developing countries can encompass the availability of safe drinking water, independent sanitary facilities for fecal disposal and improved standards of hygiene. The emphasis, to the greater extent, is laid upon the need to reduce the biological contamination, but, in developing countries, other serious factors with regard to the water contamination are becoming serious in shape of naturally occurring chemicals in ground water and the industrial and agricultural waste (Van der Hoek, 2001). There is a linkage between issue of clean drinking water, sanitation and hygiene, because untreated or improper disposal of human waste is one of main causes of contamination of safe drinking water. If a woman stores clean water of a well into an unhygienic container, it, no longer, remains clean. If hand washing practice is not
observed properly, it can result in the loss of all those benefits which might be got from clean drinking water and sanitation facilities (Fritschel, 2002). The greatest consideration should be to dispose of the human excreta effectively and hygienically because human’s excreta are more likely to contain diarrhea pathogens. The factual position reveals that the death toll of the children reaches to 1.7 billion each year as a result of being affected by diarrhea which is directly associated with the improper water supply, sanitation facilities, which is still a dire need of 2.4 billion people (Fisher, 2004). According to a research, the provision of clean water can result in reduction of childhood diarrhea by 15 to 20 percent but the hand washing practice after using toilet can shrink it to 35 percent. This problem is most of the time obvious in urban areas, however, it is less noticeable in the condition in which the people go out into the bush, which can be regarded less noticeable but not less serious. The possibility of the interception of human waste into surface water and ground water is also dangerous as any other way of contamination (Fritschel, 2002).

1.1 Water condition in Pakistan

The water crisis of Pakistan is interlinked with many serious health, social, and political implications. A great impact of the shortages of water in Pakistan has been seen on the health of the general population (Hildebrandt et al., 2002).

A vast majority of the population of Pakistan comprising at least 135 million inhabitants are found having no accessibility to the drinkable water. The reasons for such unavailability of the drinkable water are, although, the droughts and pollution but still it is believed by many critics that the main cause behind such intense circumstances is the poor management and deficient policy for overcoming the country’s overall water crisis. In many areas of Sindh, the drinking water supplies have been dwindled and degraded due to the shortage of water, depressed quality of surface water bodies including streams, rivers and carez, loss of ground water because of the intrusion of the salt water in it and water table depression. Registration of an increase in diseases by 200% in the last two decades are related to drinking polluted water is sighted in the rest of the country; excluding all the rural areas from the public water supply system. As a result of this negligence, the people residing in rural areas have to depend upon either water pumped
from ground or in the case of far off drought stricken areas and hilly terrain, upon the surface water that is extremely contaminated (Mehdi, 2006). The Pakistan National Human Development, in 2003, and Pakistan Institute of Development Economics (PIDE) surveyed and reported that in the poor households, about 90 working days per year are lost due to poor health. Therefore, the issue of drinking water is required to be associated more strongly with extensive dialogue of poverty eradication. (CRCP, 2004)

There is no sufficient data or reliable statistics available in Pakistan about the availability of safe and sufficient drinking water that could be taken into account whereas the statistics based on the accessibility of water and field reference to the quality of water also exists. The official records of the access to drinking water fluctuate between 60 to 90 percent of households. In Pakistan, the pipe water is also contaminated due to the leakages with all types of bacteria or because of the geological conditions and insufficient purification, along with the high levels of arsenic and elevated fluoride to an abnormal extent.

As estimated by Pakistan Council of Research and Water Resources (PCRWR), the inadequacy of water supply for drinking and personal use rises up to 50 percent. This research has studied both the aspects regarding availability and quality of water and drawn out a conclusion that among 159 million inhabitants of Pakistan, only 25.61 percent have an easy access to the safe and proper drinking water. There is no doubt in the assumption that the greater number of Pakistan's population is exposed to the risks of drinking unsafe and polluted water (Zaidi, 2005).

World Bank classified Pakistan as a “water-stressed” nation. However, the most comprehensive official analysis of the circumstances, the government's economic survey for 2005-2006, reported that annual per capita water availability had fallen to 1,105 cubic meters, just above the “water-deficient” level of 1,000 cubic meters (IRIN, 2007)

Water and sanitation is stated, by Khan and Javed in 2007, as an ignored factor in Pakistan. The safe drinking water is inaccessible by the majority of the households in Pakistan along with the lack of toilets and satisfactory sanitation systems. As of 2005, approximately 38.5 million people did not have availability of safe drinking water source and approximately 50.7 million people lacked access to improved sanitation in Pakistan. If this trend keeps on going by the year 2015, 52.8 million people will be deprived of safe
drinking water and 43.2 million people will be lacking adequate sanitation facilities in Pakistan.

1.2 Importance of Water in Islam

Pakistan is an Islamic Republic, whose objective is to make its Muslim majority able “to order their lives in the individual and collective spheres in accordance with the teachings and requirements of Islam as set out in the Holy Quran and Sunnah”. Water is considered a virtual resource according to the Islamic teachings to which everyone has a right to share it fairly (Constitution of Islamic republic of Pakistan, 1973).

Water is mentioned in more than 80 verses of the Holy Quran. The link between life and water is apparently stated in several verses. It is stated as the origin of existence of every creature on Earth, the matter from which Man, the crown of creation, was created (25:54) and the Holy Quran stresses upon its centrality: “We made from water every living thing (21:30)” and that Water is the divine gift for mankind by God and therewith gave life to the earth after its death (16:65. Allah's benevolence is symbolized throughout the pages of Qur'an as the water of rain, rivers and fountains: “He sends down saving rain for them when they have lost all hope and spreads abroad his mercy (25:48)”. At the same time, the Muslims are consistently reminded of the blessings of Allah as it is Allah who gives sweet water to the people, and that He can just as easily withhold it: “Consider the water which you drink. Was it you that brought it down from the rain cloud or We? If we had pleased, We could make it bitter (56:68-70)”. In this verse, the believers are warned that they are given the duty of just being guardians of Allah's creations on Earth; they must not break the laws defined by God All the water is described as holy in the doctrine of Islam: “And you see the land dried up, but when we send down water upon it, it trembles, and swells, and grows... (22:5)” (De Chatel, 2002).

From Islamic point of view, the relationship between human beings and water is considered a part of daily social life The interests and the sustenance of all citizens of the world is made the responsibility of humans It is also believed and unconfonfected fact that water is the most valuable resource for all the living creatures. It is very well elaborated in the Holy Quran as well as in the Sunnah (practices undertaken or approved by the Prophet Muhammad and established as legally binding precedents).
“Cleanliness is half of faith, the Prophet (peace and blessings be upon him) tells his companions in one of the Hadiths (De Chatel, 2002). Islam imposes special emphasis on the attainment of ideal harmony among spiritual and physical purification. Without ablution and bathing, the physical purification can not be attained for which pure and clean water is needed. That's why the Holy Quran and the sunnah stress upon the purity and cleanliness of water. It is advised to the Muslims not to pollute water and as par the tradition of the Prophet Muhammad (PBUH), a Muslim is ordered to be economical in the use of water even if the water is got from the fast flowing river. The Prophet Muhammad (PBUH) advised to someone performing ablution while using the excessive amounts, "Do not waste water." It was then asked by Muhammad (PBUH) either the water used for ablution could also be a waste. He answered, "Even if you are taking from a big running river" and in a different narration "in anything there can be waste" (related by Abu Dawood and Ibn Majah) (Izzi, 1993: Al-Tamimi, 1991: Madani, 1989).

1.3 Importance of the Study

For the health and well being of humans, water is crucial, whereas safe drinking water is the birthright of human beings – and of same importance as his birthright for clean air. On the other hand, for most of the world's population, the safe drinking water is inaccessible. For more than one billion (one in six), the safe drinking water is insufficient, out of 6 billion people living on earth. Besides that, about 2.5 billion comprising more than 1 in three are not facilitated with proper adequate sanitation facilities. Altogether, water related illness is initiated by these shortcomings which become a cause of death to an average number of more than 6 million children per annum (about 20,000 children daily). For all nations on Earth, safe drinking water must be one of the highest preferences.

It is another “a bitter truth” that today contaminated water becomes a cause of death for more people than those who die of cancer, AIDS, wars or accidents. It is vitally important that the disease - causing germs and toxic chemicals must be eradicated from the water that is to be used for the purpose of human drinking to avoid the threat to human life, TWAS, 2002.
The diarrheal illness caused by poor water quality has grown much higher in Pakistan. National Conservation Strategy survey conducted in 1992 exclaims that, in Pakistan, water borne diseases make up 40 percent of the communicable diseases. World Health Organization has declared in another report that water - borne bacteria and parasitic environment cause 25 - 30 percent admittance in hospitals. It is also stated by World Conservation Union (IUCN), that water borne diarrhea and dehydration cause the 60 percent of the infant deaths in Pakistan because diarrhea is the most common of all the reasons for the mortality among children (US Embassy News, 2006). Water and sanitation being the most neglected area in Pakistan results in the inaccessibility of safe drinking water in most of the households while absence of lavatories and improper sanitation facilities are also amongst the most highlighted problems. These poor people are not only facing financial issues, but also confronting the insufficiency of basic needs including education, health, hygienic water supply and sanitation facilities ( Khan and Javed, 2007).

This study has basically been aimed at determining the drinking water quality influencing factors and their health outcomes with the opinion that the findings will be of great help to the policy makers in Pakistan to formulate the policies for the efficient management of limited freshwater resources and its quality matters.

**OBJECTIVES**

The point of focus of this study is to address the following objectives.

- To explore the socio-economic characteristics of the respondents.
- To look into the awareness level of the respondents about the fresh water resources.
- To identify the drinking water quality influencing factors and their health outcomes.
- To suggest policy recommendations for policy makers to formulate the policies for the efficient handling of limited freshwater resources and its quality.
**Introduction**

Given below is a brief outline of the topics discussed in this thesis:

- Introduction
- Review of literature
- Methodology
- Results and Discussion
- Summary, Conclusion and Suggestions

Firstly, chapter one introduces core research problem. Furthermore, the importance of the study is also kept under discussion in the same chapter. Afterwards, in order to explain the importance of the present research, some international and national studies regarding drinking water quality influencing factors, are discussed, in explaining the health outcome. The research problem and hypothesis arising from the body of knowledge developed during previous research are discussed under the same chapter. Chapter three
Introduction

describes the methods used in the present study to collect data. Results (uni- variate, bi- variate, and multi- variate) are discussed under the chapter four. Findings from the FGDs are presented in chapter five along with the water sample results. Finally, chapter six comprised of the conclusion about the hypothesis and then gave recommendation on the basis of the study findings.
CHAPTER-II

REVIEW OF LITERATURE

A lot of literature has been reviewed on the factors that influence the quality of drinking water and implications of these factors on human health. The most relevant literature related to the present study i.e., domestic water sources, storage facilities, sanitation facilities, drainage facilities, and hygiene practice has been reviewed under the following headings:

2.1 Domestic water sources
2.2 storage facilities
2.3 sanitation facilities
2.4 drainage facilities
2.5 hygiene practice
2.5.1 Use of measures
2.5.2 Hand washing
2.6 Socio-economic characteristic
2.7 Theoretical Framework
2.7.1 Germ theory
2.7.2 Theory of planned behavior

The management of the quality of drinking water is not focused upon both in rural and urban areas of Pakistan. Evidence has been provided by different studies about the drinking water being contaminated by the faecal contamination in most of the areas of Pakistan. At places the quality of ground water is deteriorating because of the natural accumulation of subsoil contaminants or to anthropogenic actions. Often, the end result of the poor bacteriological drinking water quality is diarrheal illness (Aziz, 2005). A raise in the nitrates level in ground water, due to increased fertilizers use, has been observed at different places like Islamabad, Gujar khan, Faisalabad and many other areas in the southern Punjab (Aziz, 2001).


2.1 Domestic water sources

More than One billion people were found to be dependents on rivers, water courses or other unsafe sources for the provision of drinking water (WHO, 1999). In the same context, it is reported that just the announcement of safe drinking water as a fundamental human right is very easy but its acquisition and provision to more than 01 billion people is not that simple. Millions of women in Africa and Asia, daily before dawn, start their duty of fetching water for their families which consume many of their working hours. For the collection of water from a river, water courses or well might cost possibly a walk for miles, but still the water carried to home by the people does not guarantee it as a source of life and good health for their dependents rather a means of poor health and even death. The health problems linked with contaminated water are immense. Diarrheal diseases are the reason behind the death of 2.1 million people out of those 3.4 million killed annually by water-concerned illness (Fritschel, 2002).

People in the villages of Pakistan are receiving water for drinking, bathing, and washing clothes from such sources which are highly contaminated with pesticides like-a stagnant rainwater pond, or a mud-covered irrigation and drainage canal. This is the situation faced in the villages of rural Punjab, every day. But the life of people, especially women and children, has been changed quite a lot due to Punjab rural water supply and sanitation sector project, as their job was to go and get water each day for their families. Thus far, the impressive results of this project include approximately 90% reduction in water related illness, an average increase in the family income of 24%, and up to 80% enhance in the school enrollment of children (ADB, 2007).

The water supplied to the area including the residences of the top bureaucracy and judiciary members has been found contaminated with bacteria and other harmful factors. Also the water supply from the main tube well of the same area found contaminated, which means that the entire locality is consuming water that is unfit for consumption. The water samples taken from the main tube well and other places were found unhealthy for human consumption. In Faisalabad, the underground water has become brackish and unhealthy for human consumption, as a result tap water supplied by WASA has been used by the citizens for daily use. Due to the old, rusty, and leaky supply network of
WASA, sewage gets mixed into drinking water of large numbers of areas. In addition to this, the condition of pumping stations is also very poor (Gilani, 2005; Naz, 2006). Kahlown and Tahir (2001) have assessed the quality of bottled/mineral water. Twenty-one available brands were collected as samples for the analysis of microbiological indicators. Only 10 brands out of 21 (47.62%) were found out to be fit for drinking purpose with regard to their microbiological quality excluding the 11 brands which were found unsafe for human health. As bottled mineral water is considered clean and safe as compared to highly contaminated tap water, so it is much popular in Lahore, Anonymous (2006) reported that as said by recent scientific study, extensive utilization of mineral water could be a source of cancer. There is a continuous release of Antimony into the bottled drinking water and according to researchers, its small dose can make a person feel ill. Violent vomiting and even death may possibly be the result of its consumption in larger quantities. A test of Ground water and bottled mineral water, in Canada, was conducted. Two parts per trillion (ppt) of antimony were found in ground water while 160 ppt of antimony in bottled water when opened soon after it was bottled and 630 ppt when opened after six months. An experiment of same type was conducted at a German bottling plant in Europe based on 48 brands of plastic bottled water and the ground water. The antimony that was found in water before being bottled was four ppt while 360 ppt was contained by the new bottle and 700 ppt of antimony was found in the bottle if opened after three months. This level is lower to a great extent than standard of six parts per billion of antimony as provided by international environment agencies. According to the viewpoint of scientist, exposure to antimony adds to the risk of cancer. So far, the ratio of antimony which could have harmful effects on human health has not been determined exactly, but its high dose can be a cause of vomiting and cancer (Anonymous, 2006; Ali, 2006).

A recent report by Panni Pakistan provide this data that approximately 70 percent of Pakistan’s population do not have availability of clean water and a majority of people in metropolitan cities drank contaminated water. Contamination and shortage of water along with its pollution were the main water linked issues threatening Pakistan. According to the Pakistan social and living standards measurement survey 2004-05, “70 percent people were not enjoying the fundamental human rights like provision of water and the
accessibility of clean drinking water”, as said by report. Water contamination and shortage were observed in more than 20 towns and cities, also, at the same time, three canals and rivers- including the Lahore canal- were reported to have turned into dirty drains. The report quoted that above 70 percent of the citizens in Lahore use contaminated water (Waqar, 2006). According to a study, conducted by Tahir (1989), on pollution in water supply systems of Rawalpindi and Islamabad city, 25% samples were found unsafe with regard to the ratio of nitrates and lead as 75%. Out of 53 samples from both cities, the fit for drinking purpose were just 34 samples. As far as the sources were concerned, the percentages that were acceptable were 34% for tap water, 0% for cistern, 60% for tube well and 100% for tank water.

The awareness level of the respondents on the issues related to water, assessment of their perception on the quality of drinking water and the identification of measures taken at domestic level to improve the quality of drinking water along with determination of sustainable water practices were investigated through a study. The quality of water supplied to the house was rated by the greater part of respondents (70%) as poor while extremely poor by 16%. The major problems pinpointed by the respondents included, color, odor and taste of their tap water. This was the reason for most of the respondent to take additional precautions for the improvement of the drinking water’s quality (Aini et al., 2007). Similarly, one of 30 small rural areas in Malawi Kamanganjulu, a safe drinking water project was commenced. As a result of this project, cholera and diarrhea was seen to be reduced to a considerable extent. Before the project was introduced, safe drinking water was not accessible to more than 70% of its inhabitants and one of their four children did not reach the age of five even (Fisher, 2004).

2.2 Storage Facilities

Uncontaminated water supply is critically essential to health, but, for the maintenance of children’s health, the quantity of water is even more important (WHO/UNICEF, 2000). The links between the quality of water and the risks to health are well known. In the same way, an association between improper quantity and the quality of domestic water and the illness such as diarrhea and hepatitis is also very evident. It is revealed by a study held by UNICEF that 20 - 40% of the beds in Pakistani hospitals are used by the patients who
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+suffer from diseases related to water such as cholera, dysentery and hepatitis, that are mainly the cause of the one third of overall deaths (Anonymous, 2006).

A healthy life is guaranteed by the provision of enough or sufficient water (Ensink et al., 2002). Varied studies stated that the quality and quantity of water affected the transmission of water - related illness and improved the health in general (Lewin et al., 1997). The link between the quality of water and diarrhea fluctuated due to the level of the water availability so the quantity of water has a more vital impact on the improved health than the quality of water (Van der Hoek, et al., 2001). Quality of the water depends upon the point of source and the point of use. The most important intervention for the reduction of diarrhea in Pakistan is to increase the availability of water in the house by managing a household connection and a storage facility. Those families, using larger quantities of water and having main storage system at home, received greater benefits because of increased water availability. Water consumption in larger quantities, for hygiene and other reasons, do have an impact on health. In case of those people who have availability of less water for them, the water quality and diarrhea have a different level of association. This exhibits that additional health can be obtained only if adequate quality of good quality drinking water is taken in so the effect of the water quantity was much evident for the prevention of diarrhea which was largely interceded through behavior to hygiene. (Lewin, et al., 1997; Van der Hoek, et al., 2001 Jensen et al., 2004; Esrey et al., 1991; Ensink et al., 2002;)

Contamination of drinkable water has also been observed during storage. Keeping in view the study of the quality of water, progressive contamination of water during distribution and storage was observed complied with the maximum coli form counts inside the storage containers at household level. Researchers in Peru explained that patients most probably bloned to the households, where the stored uncontaminated drinking water was dipped out by using the palms of the hands and any utensils, than healthy control subjects. In another study, the drinking water into which hands were introduced was strongly associated with illness because hands which have been used for washing and scooping might have been the carriers of any disease (Rice and Johnson, 1991; Swerdlow et al., 1992; Ries et al., 1992)
A survey conducted by Mintz et al (1995) reported that drinking water, in different areas of the developing world, is obtained from the unprotected sources and then stored in household storage vessels. Drinking water may be contaminated at both the stages: source or the storage. A two-component prevention strategy is described by the researchers and one of these components let an individual to accumulate the water in closed vessels with narrow mouth for safe storage. It empowers the households and communities lacking potable water to save themselves from waterborne pathogens and helps in reducing the waterborne diarrheal disease. Similarly, it is suggested in recent study by Tuttle et al (1995) in Zambia, that hands or any object that is put into the stored water became a cause of contamination because it was observed that in patients’ homes, stored water was dipped out while it was poured in the homes of healthy people. In this investigation, healthy subjects used narrow mouthed container for water storage; whereas infected people used an open mouthed container into which hands could be easily inserted.

Different investigations showed that there was a significant correlation between the diarrheal diseases and the degree of contamination of hands. Investigations in a refugee camp in Malawi, found that the examination of water samples showed that those households who stored water in a covered container with faucet, there was 69 percent reduction in faecal coli form of water and diarrheal diseases are sighted decreasing 31 percent in children under the age of five among the group which has using the improved buckets (Lindskog et al., 1998; Roberts et al., 2001). It is found out by another survey that the households using a narrow - necked water vessel or reservoir medium with a spout had the lowest diarrheal rate (28.8/1,000 subjects/month) instead of observing lack of access to piped water in their homes (Semenza et al., 1998).

Researchers in Bangladesh determined the importance of diarrhea transmission. According to them there was no significant relationship between quality of drinking water and the diarrheal diseases rather they found that faecal contamination leading to diarrheal incidence was highly correlated to contamination of hands. Similarly investigation in Niger pointed out that the dirty hands in comparison with the consumption of drinking water were more responsible for the faecal contamination of the people (Henry and Rahim, 1990; Julvez et al., 1998)
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Study in the southern Punjab suggested a relationship between the bacteriological drinking water quality and diarrheal diseases. The children younger than 5 years in 200 households were monitored weekly basis with regard to their diarrheal episodes, drinking water sources and drinking water quality. No association was found between the childhood diarrhea and the number of Escherichia coli in the drinking water sources (the public domain) but against it, a possible trend was observed related to the number of E. coli in the containers used for the household storage (the domestic domain) and diarrhea. Even though the water source was of good quality, the level of contamination was still high in the household water containers (Jensen et al., 2004). Likewise, a study in Calcutta declared an association between water contamination in household storage and transmission of diarrheal illness (Deb et al., 1982). The diarrheal frequency and severity among persons infected with HIV in Africa was also reduced with the use of safe water storage system at home. Overall, safe water storage system was related to a 20% decrease in diarrhea episodes (p=0.0469) and 26% less days with diarrhea (p=0.055). As far as the HIV infected persons were concerned, the safe water storage mediums were associated with the decrease of 25% in diarrhea episodes (p=0.015) and 33% less days with diarrhea (p=0.021) (Lule et al., 2005).

2.3 Sanitations Facilities

There is a strong association between quality of water and health threats. The insufficiency of the quantity and quality of water used at domestic level along with the poor sanitation facilities are linked with the illness caused by diarrheal (Anonymous, 2006 Half of the developing world comprising 2.6 billion people are not facilitated with even a simple improved latrine reported by World Health Organization (Macan-Markar, 2006). The diarrheal morbidity can be reduced by the introduction of improved sanitation by 37.5% (WHO, 2004).

The factors responsible for the transmission of diarrhea, cholera, typhoid and several parasitic infections are the lack of sanitation and poor hygiene (WHO, 1997). In developing countries, more than 2.2 million people mostly including children, have to meet their death due to the diseases associated with the non availability of safe drinking
and improper sanitation (Nokes and Bundy, 1993). The world's largest cause of illness is the lack of sanitation facilities (UNICEF, 2007).

According to Van der Hoek et al. (2001), one of the risk factors for diarrhea is the lack of toilet at home so having toilet helped to combat with the water related diseases. So investigators suggested the safe disposal of faecal material to reduce the diarrheal diseases among people especially among children. (Curtis et al., 2000). In the same perspective, EMB (1996) reported that the sanitary toilets are not provided to almost 20 percent of household in Philippines which increases the health risks and problems initiating the disease caused by water in form of persistence of diarrhea as a leading killer of children in the country. Likewise, FWR (2000) looked into the sanitation facilities and hygienic behavior of the people in South Africa seeing that the the most of the respondents replied that the toilets were cleaned by them regularly However, the observations have revealed that the toilets were in a very bad condition and extremely dirty in most of the cases. The dichotomy between the saying and doing of the respondents indicated that the respondents were well aware of the need of cleanliness in general and of toilets specifically, but they did not act upon and the ultimate outcome is ill health.

A randomized survey was carried out in a refugee community of Malawi where the repeated outbreaks of cholera and diarrhea were experienced due to contamination of drinking water at home. It was found that among all age groups which possessed a latrine in a house was associated with fewer diarrheas. The visible faeces in the house latrine were significantly associated with an increased diarrheal incidence in children. Laterine ownership was generally protective (Roberts et al., 2001).

2.4 Drainage Facility (Distribution system)

It is, however, crucial that water distribution should ensure drinking water of being high quality. The maintenance and protection of the drinking water distribution systems including pipes, pumps, valves, storage tanks, reservoirs, meter fittings and other hydraulic appurtenances is necessary to be observed because the vast majority of physical infrastructure for water supplies was represented by all the above mentioned devices and thus, formulates the primary management challenge form both operational and public.
health standpoint (WSTB, 2006). The various studies indicate that the piped well water provided by the municipal management is unsafe because of improperly maintained pipes, low pressure and intermittent delivery (WSTB, 2006; Swerdlow et al., 1992; Ries et al., 1992). Likewise, the epidemiological data supports the hypothesis that diarrhea present in the piped water group could be due to cross-contamination among the municipal water supply and sewer i.e. due to pipes leakage and a lesser amount of water pressure. Diarrhea was found to lesser extent in home-chlorination group than the piped water group, which indicates the distribution system as a cause of disease spread (Semenza et al, 1998).

It is not hidden fact that the present water supply system in Pakistan is not much satisfactory. The old rusty pipelines are generally leaky, so much so, the water supply pipes are lied parallel to the sewage pipes which result mixing of sewage water and contaminating the drinking water, a big alarming problem, grounds for prevalence of ulcer, acute dehydration, cholera, diarrhea, problems regarding intestines and so on. (WWF, 2007) .An official report consisting of survey of Multan city revealed that such contaminated water carries such types of virus and bacteria equally in public water supply plus sources of water causing chronic water borne diseases like gastroenteritis and hepatitis in city areas owing to ex-filtration/in-filtration of sewage water through leaky water supply piping. According to Nishtir hospital, Multan, more than 295 deaths were due to water borne diseases in addition to the registered 46166 cases of chronic diseases, 5921 cases in civil hospital and 7689 cases in municipal dispensaries regarding this. In different cities of Punjab, citizens are dependent on the tap-water, supplied by WASA, for daily consumption because underground water has become brackish and unhealthy for human use for the last many years. Seeing that supply network of WASA has become old and rusty, the potable water in many areas is being mixed with sewage. As a result the deaths and mostly the gastroenteritis cases were reported where the victims and patients used tap-water supplied by the Water and Sanitation Agency (WWF, 2007; Naz, 2006).

Similarly, another cross-sectional study was carried out, in nine poor urban areas of Salvador city, with children, in Brazil. Amongst these nine areas, three got advantage from sewerage and drainage, 3 from better drainage only, and 3 from none of these. Therefore, the children under study were from 3 different groups keeping in view their
sanitation facilities. Comparison among the groups provided an idea that, with better sanitation facilities, the occurrence of infection was less. The results showed significant association between intestinal as well as stomach infections and sewerage plus drainage (Moraes et al., 2004).

Malick et al (1998) carried out the drinking water quality analysis in Karachi city. Results shown by the analysis were that coli form bacteria were present in the distribution lines which pointed towards the contamination of water due to surrounding sewerage rusty and leaky pipelines. Secondly, the fecal coli form presence in the water of branch lines, being consumed by the residents, confirmed the sewage mixing into drinking water lines making it unhealthy.

ADB (2007) highlighted the importance of sanitary latrines and underground sewer lines. According to that, both the health and property of residents were at risk without latrines and proper drainage system. Abdul Qadir, a resident of Orangi in 1975, narrated that he still keeps those days in mind when they used to keep their doors closed just because of the awful smell.

Muhammad Salam, a resident of informal settlement in Karachi, permits his children to play out in the street without being worried. He was happy because the street where he was living was a concrete-paved street, and underneath his street was a sewerage line which collects wastewater efficiently, from all of the houses in that area.

According to Salam, he has no worries that his kids will fall in foul-smelling dirty water. With the help of the Orangi pilot project (OPP), Salam along with his street neighbors planned to handle the most critical issue prevailing in their community. As a result, they had a clean street in addition to an up to date sanitation system of latrines and sewer lines. Likewise, the same issue was faced by the residents of Banshighat in Kathmandu, Nepal. They had a network of open drains giving out foul smells which fall into the river, nearby, containing waste water from different areas around the city in addition to this social group. The whole garbage is also dumped here into these drains due to the non-provision of the means of waste removal. Mostly river banks are used by the people for defecation. Although some households have latrines but those latrines, at the end, fall into the river. Such circumstances threaten to the health particularly of small children,
constantly, in banshighat, with diarrhea as a routine part of their lives (Anonymous, 2002).

Malik and Waheed uz Zaman (1996) reported that sporadic cases of hepatitis take place, in Pakistan, all through the year. It is reported by Akram (1975) that in Pakistan, epidemics of acute viral Hepatitis (AVH) out broke as early as the 1950s and 1960s. An outbreak of AVH was observed in 1972 in an army battalion which was having a field exercise. About 250 cases of acute viral hepatitis were reported in three weeks, and all of the infected persons shared a common source of drinking water i.e untreated river water. Also recently, some of the mini-epidemics have been stated in Pakistan and are emerged due to faecal contamination in water supply system. Pakistan is facing an endemic HEV infection which may possibly be a cause of acute viral hepatitis in many cases. Inadequate supply of safe water is basically the determinant of HEV epidemicity in urban areas. The urban areas with an irregular supply of running tap water also experience the low pressure in the water pipes between supply times and the leakage of water contaminated by faecal matter in the regular pipes. (Malik and Waheed uz Zaman, 1996; Malik, 1988)

2.5 Hygiene Practice

2.5.1 Use of Measures

Many investigators told us that using different measures to improve water quality at the domestic level can avoid water related health problems. Different studies (Blake et al., 1993) have reported that the families which use boiled drinking water at home observe a lower risk of cholera particularly and diarrhea at common level. In another study, (Mujica et al., 1994) it is also observed that if the drinking water is acidified by using the citrus fruit juice it can help to combat against water borne disease in general and cholera in particular.

A great emphasis has been given by researchers to purify drinking water right after its collection (Point-of-use disinfection) because in case of less developed countries, mostly the drinking water is collected from such sources which are not safe. So, it is quite better to use measures, soon after the collection of drinking water, to improve its quality and
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it’ll empower the households to fight against water borne diseases (Mintz et al., 1995). In a study in Peru investigators highlighted the numerous factors which were related to cholera transmission. According to these researchers, the unboiled drinking water is said to be the cause of the largest proportion of cases. So, the people drinking boiled water found protected against these diseases. (Rice and Johnson, 1991). Similarly another study in Peru showed that cholera was associated with unboiled drinking water. A statistical record of a hospital shows the culture survey exhibiting 79% to 86% of diarrheal cases were cholera. In fifty cases of patients and hundred matched controls explained that cholera was interrelated with unboiled drinking water. (odd ratio [OR], 3.9; 95% confidence interval [CI], 1.7-8.9) (Ries et al., 1992).

According to a cross-sectional survey design held among the urban inhabitants of seremban town, it is determined that the awareness level of respondents on the issue regarding water, reflects their perception of the quality of drinking water with a view of the identification of undertaken measures by households to improve the quality of drinking water. As per the perception of respondents, they mostly, took measures to improve the quality of water that was poor when got from the tap. About 85% purchased water filters for domestic use, 41% preferred to boil the water and some 17% bought the water packed in bottles. The concern for health and the idea of the poor quality of tap water were the reasons for purchasing water. More or less a quarter of respondents having water filters pointed out the convenience as these respondents did not have to boil water. (Aini et al., 2007)

A case study in Uzbekistan pinpointed the association between home chlorination and low rate of diarrheal illness. Researchers conducted the interview of inhabitants belonging to 240 households which including 120 with and 120 without the access to MS. Inhabitants of 62 households who lacked pipe water were educated about the chlorination of drinking water at home. All the subjects studied were monitored biweekly for self-reported diarrheal illness. Lowest diarrheal rate was observed among the home chlorination intervened (28.8/1,000 subjects/month) (Semenza et al., 1998). The 1993 epidemic of hepatitis which resulted in 4000 cases in Islamabad and Rawalpindi was related to the pollution of the raw water source and improper water treatment (Dil, 1997).
During early 1990’s, an explosive water borne outbreak of hepatitis E virus (HEV) took place in Islamabad. According to a survey, a total of 3,827 patients of severe hepatitis were documented out of 36,705 individuals with an attack rate (AR) of 10.4%. Before the epidemic, an operational breakdown occurred in a water treatment plant. The main supply of water for the plant was drained from an extremely polluted stream. The Highest AR (16.3%) was observed in the areas where the source of drinking water was exclusively from the purification plant, followed by ARs of 12.4% and 5.3% for those receiving 50% and 30% or less of their water supply from the treatment plant, respectively, while the lowest AR (1.8%) was observed in the neighboring areas that did not receive water from this source. (Abdur Rab et al., 1997)

As per a cross-sectional survey of 226 HIV+ men, 47% of the respondents reported to be suffering from diarrhea. The victims of diarrhea were found among those who drank bottled water instead of those using boiled or filtered drinking water. Overall, at least one water treatment was always or often used by 47% of respondents. Among 37% of the respondents conscious about drinking water, 62% suffered from diarrhea, 70% used at least one water treatment always or often. The notable association between the concern with drinkable water and the treatment of water along with between the drinking water and diarrhea suggests the consciousness that drinking water is a potential pathway of transmission for the spread of diarrheal diseases. (Eisenberg et al., 2001)

A Study in a refugee camp of Malawi told us about the significant contribution of drinking water contamination, at household level, to diarrhea. Proper chlorination is a cheap and effective method for the protection of water quality. The people who didn’t adopt any measure to get better the drinking water quality were at threat of getting diarrheal illness as compared to those who adopted measures before using water. (Roberts et al., 2001)

A An objective survey was held over a period of 16 months in a suburban community of a middle class facilitated with a single water filtration plant. A total of 1400 family units were chosen and randomly categorized in four groups (350 in each group) i.e., a) tap water; b) tap water collected from a continuously purged tap ; c) bottle plant water; d) purified bottled water (treated tap water through reverse osmosis or spring water). The group using the purified water served as the baseline; the group using tap water observed
having gastrointestinal illness among 14% of the whole group and 19% in the tap-valve group. Children were the most affected victims with an increase by 17% in the tap group and 40% in the tap-valve group. While no incidence of gastrointestinal illness was found increasing in the group using bottled water. The information collected suggested that 13-40% of the gastrointestinal illness were an outcome of the tap water meeting current standards and that the water distribution system was observed to be partly responsible for such diseases. (Pierre et al., 1997).

Researchers’ introduced home drinking water disinfection in Karachi unlawful resident settlements to assess its effect on diarrhea. In 2000, households that received bleach and a container had a 73% lower occurrence of diarrhea than controls. In 2001, households that received bleach and a container had a 71% lower occurrence of diarrhea. (Luby et al., 2001)

Researchers reported that the effective factors for the reduction of diarrheal illnesses were found to be water, sanitation and hygienic interventions as well as their combinations. While on the other hand, use of precautions to improve the quality of water is the most important intervention in reducing diarrheal illness. Use of measures to get better the drinking water quality was found to be more effective than previously thought (Fewtrell et al., 2005). Similarly another study depicted that there is a strong relationship between diarrheal illness and drinking unboiled water (p<0.05, odds ratio 2.8). The study illustrated that the families who were not boiling their water were at the risk of getting diarrheal diseases. (Swaddinwudhipong et al., 1998).

### 2.5.2 Hand washing

According to the researchers, hands are the primary factor of water contamination (Roberts et al., 2001), therefore, the frequency of diarrheal illness can be decreased up to 35% by just washing the hands at critical times. (WHO, 2004; Macan-Markar, 2006). Similarly, the risk of diarrheal diseases can be reduced by washing hands with soap upto 42-47% and millions of lives can be saved by the interventions to promote hand washing practices. There is a need to measure the impact of hand washing by designing more and better designed o majority of the households (75%) diarrhea (Curtis, 2003)
FWR (2000) explored the hygienic behaviors in a research project in South Africa wherein the greater part (75%) of the households did not have hand washing services in their toilets. Of the people who did have such services, half (50%) used soap and water, and half (50%) used water only. Merely 16.67% of the respondents thought it necessary to wash their hands on a regular basis in order to stay healthy. The greater part (83.33%) did not think it essential to wash their hands regularly. In the same context, researchers suggested that the most effective means for the reduction of diarrheal diseases particularly in the children are the safe disposal of faecal material and proper hand washing after dealing with adult and child stools. (Curtis et al., 2000). Many studies have revealed that, on 42% of occasions, child carers washed their hands with soap after changing a dirty nappy while the hand washing practice was not observed by one of the five toilet users. (Curtis, 2003)

2.6 Socio-economic characteristics

IANGWE (2004) in most of the societies, women are primarily liable for the use and management of water resources, sanitation and health at the household level. Over the years, women have gathered an extraordinary stock of environmental wisdom, as they bring water to home, educate their children regarding hygiene and have proper understanding about the impact of improper sanitation on health. In a countrywide survey the occurrence of diarrhea was lowest seeing that the mother had pursued secondary or higher level education, though a primary education did not show the way to lower diarrheal occurrence (NIPS, 1992). These results also supported the idea of Esrey and Habicht (1998) that the family health was dependent on mother’s education. According to them results of piped water and toilet on newborn mortality was reliant on whether or not mothers were educated. The author illustrated that literate mother protected their newborns particularly in unsanitary surroundings and when piped water was introduced; they used it more efficiently to do better hygiene for their newborns. Similarly, mother years of education were often found to be positively associated with better child health in developing societies (Glewwe 1999). Investigators explored low socio-economic status as one of the risk factors for diarrhea (Van der Hoek et al., 2001).
World Bank (1999) pointed up that poverty and worse health were interlinked. Deprived people had ill health outcomes than well off people. In the same way, Pritchett and Summers (1996) supported the same study that low income and poverty also the reason of worse health. Households with high income, having more chances to improve the drinking water quality e.g. water treatment & hygiene practices etc which had great impact on health status.

FWR (2000) also mentioned another factor of Poor health which was lack of toilet and the reason put forward not to have a toilet was the lack of money for the construction of lavatory / toilet. Likewise, researchers found out that presence of toilet helped to combat with the diarrheal illness. (Van der Hoek, 2001; Roberts et al., 2001).

Khan et al (2007) found the relationship of arsenic-contaminated drinking water with family attributes. Numbers of family members (P < 0.001) as well as sleeping rooms (P < 0.001) in the families were considerably related to arsenic contaminated drinking water. The respondents having 6 years or more education had 23% lower risk of arsenic contaminated drinking water (OR = 0.77, 95% CI = 0.61–0.96) as compared to those with no education. Results revealed that comparatively rich people are at lower risk of arsenic contaminated drinking water as compared to poor ones. Socio-economically rich people are expected to be well educated and much health aware as compared to poor people. In the same context, the outcomes showed that the family economic status and mother education are among the major determinants of diarrheal illness. There is a significant relationship between diarrheal illness and access to water, sanitation services and hygiene practices. Accordingly, the programs comprising of maternal hygiene education, provision of facilities and awareness regarding environmental health have to be strongly put into practice so as to reduce the high occurrence of babyhood diarrhea (Boadi and Kuitunen, 2005).

**CONCLUSION**

Extensive research work has been carried out on drinking water quality influencing factors and their implications for human being health. However the present research called attention to look into the drinking water quality influencing factors (domestic water sources, nature of drinking water source, storage facilities, sanitation and drainage factors, and hygiene practice) and their health outcome (suffered or not suffered).
Keeping in view the existing literature, researchers revealed that there are well-known links between water quality and health risks. Most of the people relied on rivers, watercourses and other unhealthy surface supplies for drinking use, threat to their life. Furthermore, Researchers accounted that water, sanitation, and hygiene are the key factors in reducing diarrheal illness. Whilst on the other hand, adoption of measures to get better drinking water quality is the important factor in reducing diarrheal illness.

2.7 Theoretical Framework

Theoretical perspective defines theoretical framework. It can be regarded just a theory but it can also be more generalized as a base for the understanding of something. Typically, the kinds of variables are defined by the theoretical framework and are looked at by the researchers (Borgatti, 1996).

Two different types of theory that attempt to explain why some people lead healthier lives than others.

Germ theory (John Snow- 1854)
Planned behavior theory (Ajzen-1991)

2.7.1 Germ Theory

- People believe that diseases are spread spontaneously or else they were known to be caused by evil spirits or bad air viz miasma.(Wikipedia, 2007)
- Miasma is defined as a poisonous vapor or mist that is substantially filled with tiny particles from decomposed substance (miasmata) that could be said to be a cause of illness and is recognized by its nasty, foul and bad smell (which, obviously, spreads out due to the decomposed material).
- The miasmic theory of disease commenced in the middle ages and continued to be believed till mid 1800s. An important follower of the miasmic theory was Dr. William Farr. He believed that the main medium of the spread and transmission of cholera was air. Another promoter of this theory was, Florence Nightingale (1820-1910), a nurse, who was renowned for improving the hospital sanitary conditions and making hospitals fresh-smelling.
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- The miasmatic theory relied on reading that; poor sanitation result resulting in foul smells was associated with diseases and that the improvement in sanitation resulted in disease reduction.

- In 1854, the disapproval of miasmic theory with regard to the transmission of cholera was given by John Snow following an epidemic in Soho, central London.

- Eight years after the death of John Snow, in 1866, the medical opinion changed regarding germ theory of cholera and its waterborne transmission. Farr, in 1866, wrote a comprehensive report which was basically relied on his extensive knowledge of statistics. He used death rates for the justification of his conclusions and publicly accepted that water was the most significant mean of transmission, not miasma as stated earlier.

- Dr. John Snow, in the 1854, was forced to believe that the cause of the disease was the germs that were traced in the public drinking water while everyone else doubted miasma for being the cause of it. (ACC, 2007; Harari & Legge, 2001)

- Dramatic evidence was given to the world by Snow while proving that widespread sickness was caused by contaminated drinking water that provided a help to stop the outbreak.

- The germ exists in water which is polluted by the waste of the diseased people. Before the people were familiar with the use of chlorine disinfectants to destroy germs in public drinking water, tens of thousands of people were sickened and killed yearly by waterborne diseases.

- The poor sanitary conditions of cities, in which sewerage water most of the times mixed with the water used for drinking purposes making these areas breeding nurseries for the diarrheal diseases.
John Snow high lights the above mentioned social factors in his Germ theory which are the major cause of water borne diseases. These social factors;

- Source of drinking water
- Un Sanitary conditions
- Mixing of waste water into drinking water
- Use of measures
- Un hygienic condition, gives birth to the germ which resulting in water borne diseases and these all five social factors are the major drinking water interventions. And these interventions are the base of my research work.

Concept of miasma theory was evolved by John Snow, saying that most of the infectious diseases are caused by germs. According to him disease is associated with contaminated drinking water, unhygienic conditions, which indicates the cleanliness to avoid diseases. Now-a-days, Pakistan is also facing such dire conditions including, poor sanitation, and unhygienic conditions, deteriorating water quality and increasing water borne diseases. The water quality and health risks are linked together on established footing. A study held by USAID shows an estimation of the child death up to 250,000 caused by the water borne diseases in each year in Pakistan (USAID, 2006). These diseases are responsible for human losses as well as sustainable economic losses. Dirty-water diseases are called
the water-borne diseases; primarily caused by the water contamination by human, animals or chemical waste materials. It has been shown, worldwide, that over 12 million deaths are caused by the water-borne diseases in a year. The responsible factors for this death toll are mainly poor sanitation facilities; unsafe and unhealthy drinking, washing and cooking water (Hinrichsen, 1998).

2.7.2. Theory of Planned Behavior

- People’s perceptions, their beliefs, motivations and so on, obviously have an impact on their behavior in general and specifically, their health behavior.
- Theory of planned behavior attempt to enlighten that how our health behavior can be affected by our beliefs and opinions.
- The theory of reasoned action (Ajzen and Fishbein, 1980), an earlier model, is said to be extended and developed in the form of the theory of planned behavior (Ajzen, I. 1991).

Fig: 2.2

Figure 1b show how the different factors interact in the theory of planned behavior.

- Intention to behave determines actual behavior and is itself determined by
  - attitude towards the behavior,
  - subjective norm, and
  - Perceived behavioral control.

These three factors can influence each other – for example,

- Other people’s attitudes can influence the degree to which a person feels confident about behavior change.
Review of Literature

- Similarly the degree of confidence a person feels about behavior change can affect his or her viewpoint about the outcomes of the behavior change.
- Hence, perceived behavioral change not only affects the intention to behave,
- But also can have a direct impact on whether the behavior is actually carried out. (Harari & Legge, 2001)

Conceptual Framework

A conceptual framework is to be defined as a combination of broad ideas and principles derived from the relevant fields of enquiry and used to formulate a subsequent presentation (Reichel and Ramey, 1987). A conceptual framework, if clearly articulated, is potential of being useful as a mean to scaffold research and hence to assist a researcher to make the subsequent findings meaningful. Such a framework should be looked forward to as a point of commencement to reflect about the research and its context. (Guba and Lincoln, 1989).

The assumptions, principles and rules, with regard to their theoretical structure, hold together the ideas comprising broad concept (BusinessDictionary.com, 2007-09).

A graphic outline of the conceptual framework

The main variables i.e., Background, Independent, and Dependent Variables of this study were shown below in the figure along with the anticipated relationship between these variables:
Conceptual Framework

**Independent Variables**
*Drinking Water Quality influencing factors*
- No. of Sources of Water
- Nature of Sources Water
- Physical parameters of Water (color, taste and odor)
- Drainage Facilities
- Sanitation Facilities
- Hygiene Practice
- Storage Facilities

**Background Variables**
*Social Economic Characteristics*
- Female Education
- Household Income
- Family Type
- Occupation

**Dependent Variable**
- Health Outcome

---

*Fig. 2.3*

The working Hypothesis of this study is;

1. **Awareness regarding the water condition in Pakistan**
   Awareness level regarding the water quality is associated with health outcome.

2. **No of domestic water sources**
   More number of water sources at home is associated with health outcome.

3. **Nature of sources**
   Nature of drinking water source is associated with health outcome.

4. **Physical parameters of drinking water**
   Taste, color and odor of drinking water is associated with health outcome.

5. **Drainage Facilities**
   Drainage facilities are associated with health outcome.

6. **Sanitation Facilities**
   Sanitation facilities are associated with health outcome.
7. Hand washing
   Hand washing after using toilet is associated with health outcome.
8. Use of measures
   Health outcome and use of measures are associated.
9. Main storage system
   Storage facility at home is associated health outcome.
10. Have separate drinking water container other than main storage system
    Separate drinking water container other than main storage system is associated with health outcome.
11. Respondent’s Education
    Education of the respondent is associated with health outcome.
12. Household Income
    Household income is associated health outcome.
13. Family type
    Family type is associated with health outcome.

In this study, all the factors have been pinpointed which affect the drinking water quality and ultimately these risk factors influence our health. It is hypothesized that people having better socio-economic conditions hold better opportunity to have more number of domestic water sources, adopt different measures to improve the drinking water quality, have improved storage and sanitation facilities, and are much conscious about their health. Education of the respondent and male head of the family, type of the family, type of house, age of the respondent and the household income are the socio-economic factors discussed in this study. Because socio-economic characteristics plays a key role in determining the drinking water quality, like Khan et al (2007) found the association of drinking water quality with socio-economic characteristics of the household, number of each family unit and rooms in the houses were the determinants related to drinking water quality. Likewise, researches indicated that the significant/notable determinants of diarrheal illness as pointed out in various researches are household economic status and poor education of mothers. A significant link has been pointed out between diarrheal cases and both the mother education and household income (Boadi and Kuitunen, 2005; Khan et al, 2007).
In the present study the variables relating to socio-economic characteristics were operationalized as given below;

- Household Income
- Respondents education
- Education of male head of the household
- Family type
- House type

In addition to the socio-economic factors, there are the other drinking water quality influencing factors counting source of domestic water; both number and the nature of water sources, storage facilities, sanitation/drainage facilities, and hygiene practices including hand washing after using toilet and adopting different measures for the improvement of the quality drinking water. Numbers of water sources at domestic/household level and storage facilities are associated to diarrheal illness because the availability of water and storage facilities at home is important factors in reducing diarrheal illness. Different researches gave an idea that the quality of water is, comparatively, more important than the quality of it for the assurance of human health keeping in view the relationship between the quality of water and diarrhea varied by the availability of water. So, water quantity has a more important impact on improved health than water quality (WHO/UNICEF 2000; Lewin et al., 1997; Van der Hoek, et al., 2001). Nature of drinking water source is significantly related to diarrheal illness. Therefore, the safe source of drinking water is associated with improved health. But unfortunately, both GW and surface water quality in Pakistan is deteriorating day by day because of the subsoil contaminants or to anthropogenic activities which occur naturally which results in high diarrheal and other water related illness (Aziz, 2005; Aziz, 2001). Possession of main storage system is also one of the factors that play an important role in reducing diarrheal illness. Likewise, researchers revealed that those families, using larger quantities of water and having main storage system at home, received greater benefits because of increased water availability (Van der Hoek, et al., 2001)

Variables relating to the domestic water sources and storage facilities were operationalized as under;
Domestic Water sources

- Number of sources (all types of domestic water sources)
- Nature of the sources used for drinking purposes
- Physical parameters of drinking water (taste, color and odor)

Storage Facilities

- Main storage system at home
- Periodical cleanliness of the main storage system
- Separate storage container for drinking/cooking purposes
- Whether the container covered or not

Lack of sanitation and drainage facilities is the largest cause of diarrheal illness all over the world, also mentioned by (UNICEF, 2007; WHO, 2004). According to the researchers (Van der Hoek et al., 2001; Curtis et al., 2000; Roberts et al., 2001), toilet possession is generally protective seeing that lack of toilet at home is the key factor causing diarrheal illness, thus safe disposal of fecal material is appreciably related with better health. Furthermore, the lack of toilet at home, improper cleanliness is also one of the factors for diarrheal illness. Also this fact is supported by FWR (2000) that improper cleanliness of toilet is also amongst the reasons of diarrheal illness.

Variables related to the sanitation and drainage facilities were operationalized into:

Sanitation Facilities

- Number of toilet at home
- Structure of toilet
- Cleanliness of toilet

Drainage Facilities

- Mixing of sewerage water into drinking water (Distribution system)

One of the assumptions of this study is the consciousness of households regarding hygienic practice. If people are used to practice hand washing after using toilet they were getting less suffered from diarrheal illness, also mentioned by researchers (Curtis et al., 2003) that cleaning hands with soap was the key factor to reduce diarrheal illness among
people. The second important hygiene practice that was carried out in this study was the adoption of measures to enhance quality of the drinking water. Adoption of measures to enhance the quality of drinking water is significantly associated with improved health. Many investigators highlighted that using different measures to enhance the drinking water quality at the household level can avoid diarrheal illness to a larger extent. A study (Blake et al., 1993) has reported that the families who boil drinking water were at lower threat of diarrheal illness. Germ theory by John Snow also supported the idea that adoption of measures to enhance the drinking water quality is strongly associated with improved health. Variables relating to the hygiene practice were operationalized as mentioned below;

**Hygiene Practice**

- Hand washing practice
- Adoption of measures to enhance the drinking water quality
CHAPTER III

MATERIALS AND METHODS

3.1. Introduction

The contents of this chapter comprise of the methodological aspects of collection and analysis of information. The materials and methods serve as a milestone for a researcher to complete the procedure of collection, analysis and interpretation of data. The blueprint design is selected for the research which makes a researcher able to find out the solutions to the problems confronted throughout the research (Nachmias and Nachmias, 1992). Here, in this chapter, sampling procedures, size of sample, interviewer’s selection and training, techniques of statistics used for the analysis of data like Alpha Reliability test of Cronbach, Univariate analysis, Bivariate analysis and Multivariate analysis like binary logistic regression model are provided. Hence, the prime objective of this chapter is the explanation of various tools and techniques employed for the collection of data, its analysis and interpretation.

3.2 Study Area at Glimpse

It seems a compulsion to discuss a short outline of the study area at varied points so as the reader might be able to have a crystal clear image and comprehension of the research design and methods employed for the study prior to contemplating on varios tools and techniques employed for the present effort.

3.2.1 Pakistan

Pakistan has a population of 153.45 million (NIPS, 2005). The prominent city of Pakistan is Karachi while the capital is Islamabad. There are four provinces in Pakistan known as Baluchistan, Khyber Pakhtunkhua, Punjab and Sindh and FATA (Wikipedia, 2009).
3.2.2 Punjab: The Study Province

By far, Punjab province of Pakistan is the most populous and prosperous region providing an agricultural base to the country and is the home to the Punjabis and different other groups of varied cultures. Lahore is the capital of Punjab. The Punjab originates from the Persian words Pañj, meaning "five", and Āb meaning "water". Hence, Punjab is said to be the land of the five rivers naming Indus, Ravi, Sutlej, Chenab and Jhelum.

The estimated population of the Punjab province was 86,084,000 in 2005 (Wikipedia, 2009). Punjabi is the major language here. Punjabis are a heterogeneous group consisting of various tribes and communities.

3.2.3 Districts:

Punjab, Pakistan is consist of 35 districts.

Fig. 2.4 Map of districts

1. Attock
2. Bahawalnagar
3. Bahawalpur
4. Chakwal
5. Bhakkar
6. Dera Ghazi Khan
7. Faisalabad
8. Gujranwala
9. Gujrat
10. Hafizabad
11. Jhang
12. Jhelum
13. Kasur
14. Khanewal
15. Khushab
16. Lahore
17. Layyah
18. Lodhran
19. Mandi Bahauddin
20. Mianwali
21. Multan
22. Muzaffargarh
23. Narowal
24. Nankana Sahib
25. Okara
26. Pakpattan
27. Rahim Yar Khan
28. Rajanpur
29. Rawalpindi
30. Sahiwal
31. Sargodha
32. Sheikhupura
33. Sialkot
34. Toba Tek Singh
35. Vehari
3.3. Research Design

A cross-sectional survey held to analyze 600 married females (20-60 yrs) to look into the drinking water quality influencing factors and their health results in three of the districts included Toba-Tek Singh, Multan and Rawalpindi located in Punjab, Pakistan. Respondents were chosen proportionally from above mentioned districts (see table-3.1) to analyze the given population size (Population census Organization, 2005) by using the formula.

\[ n_k = n \times N_k / N \]

Where \( n \) and \( N \) indicates the total sample sizes and population; and \( n_k \) and \( N_K \) symbolize the sample sizes and population of \( k^{th} \) district.

The key objective of this survey was to find out drinking water quality influencing factors (no. of sources of domestic water, nature of sources of drinking water, taste and color of drinking water, main storage system at home, separate storage container for drinking purposes, no. and structure of toilet at home, drainage facility at locality, washing hand after using toilet, and use of precautions for the improvement of the quality of drinking water and their health outcome. In addition to this, Focus Group Discussions (FGD) was also held for further information.

3.3.1 Sampling

A cross-sectional study was carried out in Punjab province. With the population of 86,084,000 million people, Punjab is regarded as the most populous province of Pakistan in 2005 (Wikipedia, 2009).

Both the urban and rural areas of above stated three districts were selected as the study grounds. Multistage sampling method was applied to select the study area (Appendix – 1). Initially, three of the districts, Toba Tek Singh, Rawalpindi, and Multan were chosen using purposive sampling technique keeping in view the current water condition in these districts (PCRWR, 2005). At second step, one tehsil was chosen from each one of the districts by means of simple random selection. At third step, randomly, two urban and two rural union councils were chosen (table-3.1). At the fourth stage, for the selection of households, both the urban and rural areas were chosen randomly. The detail of
allocation of sample size focusing on the above mentioned districts by the use of proportion allocated technique is specified in the table 3.1.

Out of selected urban and rural localities, married females of age 20 – 60 years were interviewed from the selected household. A representative sample of 600 females was interviewed the same as talked about by Fitz-gibbon and Morris (1987). A well structured schedule for the interviews was formulated focusing the research objectives and theoretical framework of the study for data collection and surmise the conclusions.

Table 5.1: District-wise distribution of the respondents

<table>
<thead>
<tr>
<th>District Name</th>
<th>Population</th>
<th>Union Council</th>
<th>Locality/Village</th>
<th>Respondents per Locality/Village</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toba-Tek-Singh</td>
<td>1,621,593</td>
<td>2 – Urban</td>
<td>3 – Colonies</td>
<td>20 – Respondents from each colony</td>
</tr>
<tr>
<td>(Total Tehsils = 3)</td>
<td>20% (120)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 – Rural</td>
<td>3 – Villages</td>
<td>20 – Respondents from each village</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multan (Total Tehsils = 4)</td>
<td>3,117,000</td>
<td>2 – Urban</td>
<td>4 – Colonies</td>
<td>29 – Respondents from each colony</td>
</tr>
<tr>
<td>Multan Cantt, Multan Sadar, Shujaabad,</td>
<td>38.5%(232)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 – Rural</td>
<td>4 – Villages</td>
<td>29 – Respondents from each village</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rawalpindi (Total Tehsils = 6)</td>
<td>3,363,911</td>
<td>2 – Urban</td>
<td>4 – Colonies</td>
<td>31 – Respondents from each colony</td>
</tr>
<tr>
<td>Gujar Khan, Kahuta, Kotlisattian, Murree, Rawalpidi, Taxila)</td>
<td>41.5%(248)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 – Rural</td>
<td>4 – Villages</td>
<td>31 – Respondents from each village</td>
</tr>
</tbody>
</table>

Source: Population Census Organization, 2005

3.3.2 Pre-Testing:

For the assurance of the validity and accuracy of the interviewing schedule, a pretesting was done. The objective of this pretesting was to examine the sensitivity level of the questions and to testify the comprehension level of the respondents based on their ability to understand the questions for answering them completely. Moreover, it is also essential to recognize the time required to carry out an interview? The workability of the research tools was checked with the help of pretesting. Pretesting had been a helping hand for the check tools. The doubt faced throughout this trial and error phase was corrected on revision carefully and the interviewing schedule modification was observed very carefully (Goode and Hatt, 1983).
As pretesting, forty five interviews were conducted in this regard. Some ambiguities were found in this process. As a result of this pretesting, a few questions were identified to be changed so they were rephrased in the final interviewing session. The survey was held for the assurance of the generalizations of the findings of research to the larger population of Pakistan.

3.3.3 Interview Administration:

Five to six female post-graduate students from Agriculture University FSD were hired to conduct the interviews. The involvement of female interviewers also helped to keep the chauvinistic approach away of responses to sex of interviewers. The interviewers were specially trained to learn how to conduct the interviews or surveys before going to the field particularly by group discussions and 05 day practice (2 – 3 hours a day). They were also instructed to develop a comfort level with the interviewee, to communicate the importance of study to the respondents in their interest and to use the same language that is used by the respondents (Nachmias and Nachmias, 1992). Finally, they were said to conduct the interviews to each other as component of their training.

3.3.4 Data Collection:

The most sensitive nature of human beings is dealt with by the social scientists. In such surveys, it is very important while having the development of the measurement instrument that all the dimensions of the quality of data and of human nature should be given appropriate attention.

Researcher produced a female team of interviewers (Section 3.3.3) to gather data from the respondents, using “survey” methods. Prior to data collection, the team members were trained for it. For the collection and compilation of data, an interviewing schedule i.e., well structured comprising of open ended and close ended questions was formulated keeping in view the objectives of the research. After the approval of the supervisor, the researcher proceeded to her districts for pre-testing.

3.3.5 Data Editing:

Researcher checked and edited all of the interviewing schedules on the same day at end of the interview. This was done to make sure its completeness as well as precision,
because it could not be very easy to access any interviewee at later stage. The researcher proceeded with the cleaning procedure for the entries by examining against the coding sheet otherwise the original copy of the interviewing schedule with regard to the data clearance from illegal codes, inconsistencies and improbabilities through editing by computer. Once it was factualized that data was cleaned and error free, it was entered in computer for further analysis.

3.3.6 Some Aspects to get better Data Quality:
This section explains some of the possible issues, taken into account in this study as recommended by Goode and Hatt (1983), for design plus administration of interviewing schedule. All of this was done to improve the data quality i.e., the sensitivity of the queries, the co-relation of the questions, checks regarding reliability, coding scheme and the time used to administer the interviewing schedule. Much Care was taken for interviewer selection and training of the interviewers.

3.3.7 Development of interviewing schedule:
The development of the interviewing schedule is a difficult job in social science research. The structure of the sentences must be focused carefully so that the consistent, reliable and true responses can be acquired in addition to a good cooperation level of respondents. It is more and more reported in a social science research that the questions should not be puzzling. Each question should be constructed to determine a single piece of information. Validity may be vulnerable if the respondent experience embarrassment while responding a question. Maximum care was taken for avoiding the sensitive or embarrassing questions, at the designing stage of the interviewing schedule, keeping in mind the cultural ideology of the people. The vitality of the sequence of the questions to get hold of a fairly reasonable level of the respondents' cooperation can not be overstressed. A strategic shifting from easy toward difficult questions was implemented.

3.3.8 Field experience:
The instantly changing attitude and behavior of human beings is the main concern of social sciences. It is fairly necessary for the interviews to maintain the record of the activities throughout interview in a covert or overt style. The fieldwork could be
influenced by the occurrence of any major or minor incidence. The useful information was provided by the body language, gestures and postures, explanation of events and comment made by the other household members of the respondents. The research team in fact admired the hospitality they received from the respondents who did not let them to leave with no refreshment or completion of interview. All the field work had been a pleasant experience for all the members of the research team.

3.3.9 Validity of Instrument

Validity is described as the exactness of the measure in reflecting the concept which is supposed to be calculated or the extent to which, and how well, a concept is measured. The importance of validity of instrument had never been neglected in scientific study. Validity concentrates on the critical issues of the "crucial relationship between concept and indicator Validity has been measured by face and content validity in the present case (Cronbach and Paul, 1955; Rehman and Younas, 2002). Validity of the content is the degree to which the objects on the instrument represent the content that the instrument is designed to assess or measure the content (Phillips, 1976; Rusin, 1983). Supervisor, Dr. Ashfaaq Ahmad Maann, Professor/ Chairman Department of Rural Sociology and Dr. Farooq Tanvir; Associate Professor were discussed with to enhance the ‘face’ & ‘content’ validity of the research tools. To avoid any possible error at the time of questioning, the questions were translated in Urdu.

3.3.10 Reliability of the Instrument

One of the important points of focus for any researcher is to be positive that the accurate information is provided by the respondents. Secluded from the competence of the interviewer, the instrument itself plays an essential role in getting trustworthy information. Reliability stands for the homogeneity, equivalence and stability of a measure for a repeated number of times and subjects. The reliability of the instrument lies in yielding the same results even if conducted for a number of times and subjects. Cronbach (1951) narrated that the reliability of a measurement depends upon its degree of being consistent and not being varied over time (stability) and its degree that the
Materials and Methods

similar fundamental measurement procedure employed in varied context simultaneously resulting in the same results (equivalence).

Cronbach’ alpha coefficient was measured by using the SPSS computer software. The alpha coefficient value described by Cronbach was 0.823 displayed a good reliability level for the instrument.

3.3.11 Coding

The extremely useful approach for accuracy, saving time and effort offered during data processing and analysis is the pre-coding of the responses. Therefore, in the interviewing schedule every item was pre-coded and after that the data were entered into the computer for its analysis. Attention was also given to make it concrete that the coded categories exhaustive equally exclusive. Some questions regarded as open ended that were inquired in the survey, were coded after administering the interviewing schedule.

3.4 Focus Group Discussion

Quantitative (survey methods) and qualitative (focus group discussions - FGDs) data collection are, equally extensively used in the research of social science. The complementary nature of these two methods jointly with the application of the triangulation approach in the present study is planned to increase the reliability and validity of data (Smith, 1981; Suyono et al, 1981; Stycos, 1981; Manzoor, 1991).

Family Welfare Center (FWC) was selected as the venue where FDGs were carried out with married females in selected district of the study area. Family Welfare Worker was approached in order to help out in conducting FGDs because these workers are very interactive and well known in their areas.

To make the first move in discussion, the researcher introduced herself along with explaining the purpose of the discussion, which was research and learning. It was made understandable to each and every one participant that their views would be appreciated.

For FGDs, first of all suitable participants were identified and invited for discussions at an agreed place and time. During this study, numbers of participants were seven to nine. The discussions were kept for the period of one and half to two hours. Refreshment was served at the end of each discussion.
3.5 Data Analysis

The SPSS/PC+ 16.0 were chosen for the analysis of data. The first obtained figures were the frequency distributions of the variables for which cross tabulated; the Chi-square, Phi test significance were opted for use. Multivariate (BLR) was carried out too, for the assessment of the relative importance of each of the independent variables in association with the dependant variables.

3.5.1 Frequency Distribution

The codification and preparation of data for the automatic processing has been done for making it ready for analysis. The construction of frequency distributions is set as the first task to examine the pattern of responses for every independent or dependent variable selected for investigation. A frequency distribution of a sole variable, at times, referred to as a Uni variate frequency distribution is the observation of frequency in each category of a variable

For the construction of a frequency distribution, the categories of the variables are simply listed by the researchers who count the number of observations in each. It standardizes the Uni-variate frequency distribution.

3.5.2 Bi-variate Analysis:

A vital step for the explanation and test of the research hypothesis is the investigation of a bi - variate relation. The relationship of the two variables indicates that the distributions of two variables are inter-linked. In other words, the variable as described by one variable is scheduled in such a way that its changing value is not randomly distributed in relation to the other variables. The contextual quality of bi - variate relationship shows the problem arising depending upon the fact is the relationship real or has been arisen by chance. The chi - square test is used for the confirmation of the validity of a bi - variate relationship. This is a statistical test which is used in a broader spectrum to know the probability (or the significance level) that the relationship between two variables has been arisen coincidentally. This calculation is made by comparing the notified frequencies in each cell in a contingency table with those that would happen if there was no connection between two variables. These are said to be the expected frequencies. The chi square test
value is dependent upon the difference between two variables. The difference between the expected and observed frequencies makes up the value of chi square test. Generally, the vitality of the relationship is tested by the establishment of a null hypothesis in which it is supposed that there is no difference and no commonality between two variables. With reference to the chi-square value as well as the level of significance, a confirmation or rejection is made. The level of significance is primarily, an acceptable risk that the null hypothesis might be an assumption of such a false inference. The level of significance that is usually taken is 0.05 or 5 percent. A relationship is helped to be explained by having a chi-square test but it does not check the strength of a relationship. The strength is concerned with the degree or the extent of a relationship between the variables.

### 3.5.2.1. Phi test

The Phi test is valued to show the strength and direction of the relationship between independent and dependent variables. Calculations were made by using the formula.

The phi coefficient is a measure of the degree of association between two binary variables. This measure is similar to the correlation coefficient in its interpretation.

**Formula for the phi coefficient**

The formula for Phi is

\[
\phi = \frac{ad - bc}{\sqrt{efgh}}
\]

### 3.6. Analysis of Qualitative Data

The vital issues reported by the participants were presented in form of “descriptive statements” and supported by applicable quotations. Each issue out of discussion is concluded by an interpretation of the comments made.
CONCLUSION

Data collection, data processing, and data analysis are the main and important methodological procedures. Interviewing schedules (Quantitative) and FGDs (Qualitative) guides were the research tools used to gather data. The reliability of the data was tested by conducting the Alpha test. The data regarding quantities was analyzed and researched at Uni-variate, Bi-variate and multiple levels. The level of significance was assessed by using the chi-square and the strength of association was assessed by the application of Phi test. Whereas, to assess the relative significance of each of the independent variables in relation to dependent variable, multivariate analysis (B LR) was carried out.
CHAPTER-IV

RESULTS AND DISCUSSION

This chapter comprises of the presentation of data collected in the light of objectives of this survey in addition of the analysis of data, explanation and argumentation on the derivation of results of pertinent conclusions and the structuring of relevant suggestions. The most important steps in a scientific research are the analysis and interpretation of data. The attainment of generation and prediction was not possible without these steps that are the target of every scientific research. The characteristics and perceptions of the respondents have provided a base for drawing the generalizations and conclusions. Hence, this chapter presents all the levels required for data analysis. It consists of following three sections;

- Section I: Quantitative analysis
- Section II: Qualitative analysis
- Section III: Water sample tests results

Section I : Quantitative analysis

I. Uni-variate analysis
II. Bi-variate analysis
III. Multi-variate analysis

1. UNIVARIATE ANALYSIS

Uni-variate analysis provides simple descriptive statistics (frequencies and percentages) on a large number of questions (indicators) asked in the survey. These indicators were classified into two categories i.e., socio- economic factors and other drinking water quality influencing factors

Conceptualization

Conceptualization defines particular terms in research to explain the meaning to the readers clearly. Conceptualization is a difficult process in social sciences in comparison with other disciplines because sometimes the similar concepts are in use with different meanings by the researchers. The concepts use in present study is as follows.
A. Drinking Water Quality Influencing Factors

- Sources of domestic water
Water Source is a point from which it is obtained. In this study, different water sources were categorized as WASA, canal bank, hand pump, electric pump, tube well, well and commercial water etc.

- Adoption of measures to enhance the quality of drinking water
Measures are used to remove undesirable chemicals, biological contaminants from contaminated water. The purpose is to get water fit for drinking.

- Storage & Consumption
To store water, water tanks are used which varies in terms of design and construction materials. Different materials are used to make a water tank e.g., plastics, fiber glass and concrete.

- Sanitation and Drainage
"Sanitation is the provision of facilities and services for the safe disposal of human wastes. It also refers to the maintenance of hygienic conditions through services, for instance, wastewater disposal.

- Hand Washing
Hand-washing is a way to avoid infection. It involves washing hands with soap. Regular cleaning of hands, before and after specific activities, is a best way to avoid getting ill.

- Awareness regarding the current water condition
In this study, respondent’s awareness level was checked regarding the current water condition in Pakistan.

B. Socio-Economic Characteristics

- Marital Status
In this research, marital status is operationalized in following categories; married, separated, divorced and single.

- Family Type
Family represents a group of people coming from a common ancestry, affinity or sharing the same residence (Wikipedia, 2009). The present study discusses three types of families, described as nuclear and joint and extended family.

- **Respondent’s Education**

Education is defined as number of years of schooling completed by the respondent, respondent husband in an institution like school, college or university. The education categories in this study illiterate, primary, middle plus matric, intermediate, graduate and above.

- **Occupation**

Occupation may be defined as the specific activity with the market value, an individual continually pursues for the purpose of obtaining a steady level of income (Ahmad, 1958). Occupational categories are as follows, housewife, govt. employee, unemployed and others.

- **Household Income**

Income means the total gross earning from all sources. In this study, household income is characterized as low, medium and high income group.

<p>| Table 6.1: Distribution of the respondents according to place of residence |
|---------------------------------|----------------|--------------|</p>
<table>
<thead>
<tr>
<th>Locality</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban</td>
<td>300</td>
<td>50.0%</td>
</tr>
<tr>
<td>Rural</td>
<td>300</td>
<td>50.0%</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

The data presents in table 4.1.1 depicts that both urban and rural areas without any discrimination and proportion of population size are equally represented in this study.

**Sources of domestic water**

Enough water is a necessity to guarantee healthy life. More the number of sources much will be the quantity of water available. As researchers (Van der Hoek *et al.*, 2001) concluded that the water quantity had a more important impact on improved health.
Table 6.1.1: Distribution of the respondents according to the number of sources of domestic water

<table>
<thead>
<tr>
<th>Number of sources</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>72</td>
<td>12.0</td>
</tr>
<tr>
<td>Two</td>
<td>381</td>
<td>63.5</td>
</tr>
<tr>
<td>&gt; Two</td>
<td>147</td>
<td>24.5</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table shows that majority of the respondents i.e., 63.5% were using two sources of water for their domestic use, because, having one source was not enough to meet their water needs. Also the reason of using more than one source of water at home was that water from their main source was not fit for drinking and cooking purposes, while 24.5% of the respondents had more than two sources of water at their homes. These were the respondents who were very careful for their health, and, of comparatively high family income. We can also say that they had better socio-economic status and could easily afford more than two sources. Table 4.8.15 also shows that 42% respondents were those having monthly household income amounting to Rs.16,000/- and above. This figure showed that more than half of such respondents could afford more than one or two sources of water at homes. Contrary to this, only 12% respondents were using only one source of domestic water as these respondents belonged to low socio-economic status and couldn’t afford more number of sources. In addition to this, they had another opinion that only one source of water could be enough to meet their water needs. These respondents reported that they had got facility of 24 hours water supply at their homes, whereas, most of them were depending on Hand Pumps as their main water supply source.

Table 6.1.2: Distribution of the respondents according to main source of domestic water

<table>
<thead>
<tr>
<th>Main Source</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>WASA/MS</td>
<td>129</td>
<td>21.5</td>
</tr>
<tr>
<td>EP</td>
<td>345</td>
<td>57.5</td>
</tr>
<tr>
<td>HP</td>
<td>126</td>
<td>21.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Information presented in table- 4.1.2 portrays that more than half of the respondents i.e. 57.5% were using EP as a main source of their domestic water. According to them, the reason to use the EP was to get water whenever they needed it because supply of WASA/MS Water was limited to specific timings i.e., three times a day, while, in most of
the areas its timing was limited to only two hours a day, so it became difficult to manage
the domestic needs of water resulting static life even to meet with the basic needs of it.
Therefore, having EP besides other possible source could suffice to meet with the
domestic needs of water due to the reason that the control of the EP was in the hands of
household. According to 21.5% and 21.0% of the respondents, the two main sources of
domestic water were WASA/MS and HP respectively. Out of 21%, more than half of the
respondents were using only HP as water source because they had no other option to use
as table- 4.1.1 shows that 12% of the respondents were using only one source of domestic
water at their home. Those respondents, who were using WASA/MS, were also using EP
because of facing water shortages at home due to limited supply from WASA/MS.
However; WASA/MS was the main source because they found it cheaper as compare to
EP. They understood that EP was bit expensive than WASA/MS, as according to their
viewpoint, the electricity bill forced them to use only the EP when its need is acute.

<table>
<thead>
<tr>
<th>Main source of drinking</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>WASA/MS</td>
<td>112</td>
<td>18.7</td>
</tr>
<tr>
<td>EP</td>
<td>87</td>
<td>14.5</td>
</tr>
<tr>
<td>HP</td>
<td>82</td>
<td>13.7</td>
</tr>
<tr>
<td>T.Well</td>
<td>109</td>
<td>18.2</td>
</tr>
<tr>
<td>Others</td>
<td>210</td>
<td>35.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.1.3 shows that a sizable percentage of the respondents i.e. 35.0% were using
different sources of water for drinking & cooking purposes. These sources included water
filter plants installed by local govt, water courses, commercial water and purchased water
from vendors/tankers. There was a different trend prevailing in different areas. In rural
areas, people used water courses as drinking water source, because, according to them,
ground water (GW) is of brackish taste and not fit for drinking and cooking in those
areas. Also mentioned by Naz (2006) that GW in different cities has turned into brackish
and misfit for human use. So they had to depend on other sources for drinking and
cooking purposes. While in urban areas, households relied on water filter plants and
water from vendors for drinking and cooking purposes. Some of the people also groused
that WASA/MS water was unsafe because of very old and poorly managed water
distribution system. WASA/MS network has become old and rusty; sewage gets mixed in the potable water in many areas (Naz, 2006; WWF, 2007). As a result of that poor distribution system, people used to keep trust on water filter plants installed by the government for drinking. In addition to these sources, people also used to collect water from tube wells (18.2%) and very less number of households purchased commercial water due to it being very expensive and not within the reach of every one to afford it. But in some areas people were using GW (HP and EP) for drinking purposes. These, 28.2% respondents reported that GW was sweet in taste and, so, some household were of such thinking of having bore of 130-150ft. deeper in the earth to obtain best quality of drinking water, also illustrated by some of the participants during FGDs. However, some people also relied on WASA/MS for drinking purposes because they had their own view point that this source of water was better than GW as there were lot of minerals in it. According to them, WASA/MS water is of pleasant taste (Sweet/tasteless).

Table 6.1.4: Distribution of the respondents according to Satisfaction level regarding taste of drinking water

<table>
<thead>
<tr>
<th>Taste of drinking water</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>G. Satisfied</td>
<td>130</td>
<td>21.7</td>
</tr>
<tr>
<td>Somewhat Satisfied</td>
<td>385</td>
<td>64.2</td>
</tr>
<tr>
<td>Not at all</td>
<td>85</td>
<td>14.2</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Above table- 4.1.4 illustrates that 21.7% respondents reported that they were greatly satisfied with taste of their drinking water through the source of water filter plants and tube wells for the purpose of drinking other than the main domestic water sources, whereas 64.2% respondents were somewhat satisfied because sometimes they faced the problems of unpleasant taste because of mixing of sewerage water into their drinking water through the source of WASA/MS and of bad quality of GW there as table- 4.1.6a shows that 41.5% of the respondents highlighted that GW was not of a good quality and was undrinkable, also mentioned by different participants during FGDs. However, 14.2% stated that they were not at all satisfied with taste of their drinking water because majority of them were using GW. Similarly, this fact is also supported by Naz (2006) that GW in different cities has become brackish and unfit for human consumption.
Table 6.1.5: Distribution of the respondents according to Satisfaction level regarding the color of drinking water

<table>
<thead>
<tr>
<th>Satisfaction level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.Satisfied</td>
<td>436</td>
<td>72.7</td>
</tr>
<tr>
<td>Somewhat</td>
<td>164</td>
<td>27.3</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table- 4.1.5 depicts that majority of the respondents (72.7%) were greatly satisfied with the color of the drinking water supplied from their source. And approximately, one third of the respondents were somewhat satisfied with the color of drinking water. According to them, the reason of unpleasant color of their water was mainly dust and the mixing of sewerage water into their drinking water through seepage and old leaky pipes.

Table 4.1.6a: Distribution of the respondents according to ground water quality

<table>
<thead>
<tr>
<th>Ground Water Quality</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>351</td>
<td>58.5</td>
</tr>
<tr>
<td>No</td>
<td>249</td>
<td>41.5</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.1.6b: Distribution of the respondents according to the reasons of bad quality GW (n=249)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Sewage</td>
<td>111</td>
<td>44.6</td>
</tr>
<tr>
<td>Lot of minerals(brackish taste)</td>
<td>138</td>
<td>55.4</td>
</tr>
<tr>
<td>Total</td>
<td>249</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>351</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

*351 respondents were satisfied with their GW quality

It is shown from the above table that according to 58.5% of the respondents, GW is drinkable in their locality and 41.5% of the respondents enlightened that GW was not of a good quality and was undrinkable. Similarly, it is indicated by Aziz (2001) that ground water was not of good quality, at various cities of Pakistan, as the increase of nitrates levels due to heavy use of fertilizers.

Afterwards, on exploring the reasons, more than half percent of the respondents i.e. 55.4% told us that lot of minerals (brackish taste) were the major reasons. Similarly, Naz (2006) reported that GW in different cities has become brackish and unfit for human consumption. While 44.6% respondents told us that domestic sewage was the main
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reason of bad quality of GW. So these were the determinants according to the respondents due to which GW was not fit for drinking and cooking purposes.

Table 6.1.7: Distribution of the respondents according to falling of water table

<table>
<thead>
<tr>
<th>Water table decreasing</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Aware</td>
<td>515</td>
<td>85.8</td>
</tr>
<tr>
<td>Somewhat Aware</td>
<td>85</td>
<td>14.2</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 6.1.7 reveals that a majority of the interviewees i.e., 85.8 percent were fully aware of the fact that water table was decreasing day by day because majority of these respondents had GW as a main source of domestic water at their homes, as shown in table- 4.1.3 that 78.5% of the respondents were using GW (EP and HP) as a main source of their domestic water. And only 14.2% of the respondents told that they were somewhat aware of the fact that water table is decreasing day by day due to their least concern to GW sources either they were educated or not. Their firsthand experience played much more important role as compared to other factors.

Use of Measures

Health incidences related to water can be avoided by adopting measures to improve water quality. Different researches have stated that those families where persons boiled drinking water were at lower risk of diarrheal illness (Blake et al., 1993; Rice and Johnson, 1991).

Table 4.2.1a: Distribution of respondents according to adoption of measures to improve drinking water quality

<table>
<thead>
<tr>
<th>Measures</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>157</td>
<td>26.2</td>
</tr>
<tr>
<td>No</td>
<td>443</td>
<td>73.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.2.1a describes that 26.2% respondents adopted measures to improve the quality of drinking water because they were much concerned about their health. While 73.8% respondents were not using any of the measures to enhance quality of drinking water
because of, mainly less awareness of such measures, also, because of their less household income and so, they did not feel much conscious of their health and, resultantly, did not wish to spend extra money for the measures like filtration etc. This percentage also included those respondents who were not regularly taking water improvement measures and did it only when they got ill, this fact is also clear from the discussion during FGDs.

Table 4.2.1b: Distribution of the respondents according to different measures to improve drinking water quality (n=157)

<table>
<thead>
<tr>
<th>Measures</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtration</td>
<td>20</td>
<td>12.7</td>
</tr>
<tr>
<td>Boiling</td>
<td>70</td>
<td>44.6</td>
</tr>
<tr>
<td>F&amp;B</td>
<td>39</td>
<td>24.8</td>
</tr>
<tr>
<td>Others</td>
<td>28</td>
<td>17.8</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>443</td>
<td></td>
</tr>
</tbody>
</table>

*443 respondents were not using any measure to improve drinking water quality

Table 4.2.1b demonstrates that 44.6% respondents take measure of improving the quality of drinking water by boiling it, because boiling is the cheapest measure to improve water quality at household level and almost everyone can adopt it while other measures like filtration etc were costly to some extent and not easy to afford them. Besides, 24.8% respondents adopted both filtration and boiling measures for improving water quality, these were the respondents having more concern to the quality of drinking water used by them. According to them, the drinking water quality was bad to such extent that it wasn’t drinkable without using any measure. Aini et al (2007) in his research highlighted the measures adopted by the households to improve drinking water quality. According to them, some of the households were boiling water before using it and few were purchasing water filters in order to improve the quality of drinking water.

Health outcome

Safe water is of utmost importance for human health. According to different researches, provision of clean drinking water can reduce diarrhea by 15-20% (Fritchel, 2002).
Table 4.3.1: Distribution of the respondents according to their awareness level regarding the health risks due to bad quality water

<table>
<thead>
<tr>
<th>Awareness level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Aware</td>
<td>551</td>
<td>91.8</td>
</tr>
<tr>
<td>Somewhat Aware</td>
<td>49</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

It can be summarized from the above table that a majority of the interviewees i.e. 91.8% were fully aware of the fact that the bad quality water damages human health as they were facing water related issues nowadays. Table 4.7.1 also gave us an idea that majority of respondents (86.1%) were agreed with the fact that Pakistan is now facing serious water shortage problems. This was the reason that people were fully aware of water related problems especially water quality and water related illness (diarrheal illness). While contrary to this, only 8.2% respondents were somewhat aware of the fact that bad quality water affects human health in some manner.

Table 4.3.2a: Distribution of the respondents whether they suffered or not due to water

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>246</td>
<td>41.0</td>
</tr>
<tr>
<td>Not suffered</td>
<td>354</td>
<td>59.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

As shown in the table 4.3.2a, 59% of the respondents told that none of their family members suffered due to bad quality of water. Actually these were using good quality water sources like tube well, water filter plants or some of them were using water quality improvement measures regularly.

On the other hand, according to table 4.3.2a, 41% respondents told that their family members suffered due to bad quality of water used for drinking purposes. A survey conducted by UNICEF found that 20-40% of the beds in the hospitals of Pakistan are used by patients mostly suffering from water borne diseases such as diarrhea, dysentery, cholera and hepatitis etc (Anonymous, 2006). On further probing about the implications they were facing, 58 out of 246(23.6) households reported that they oftenly faced problems like cramps in their abdomen/stomach. Whereas 46 out of 246(18.7) households rarely faced this problem. Thirty nine (39) out of 246(15.9) household’s
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oftenly faced loose motions/watery motions while 51 out of 246 (20.7) were rarely facing this problem. Vomiting problem was oftenly faced by 25 out of 246 (10.2) while 32 out of 246 (13.0) households rarely faced this problem. Bloody stool and constipation were also the problems people were facing as shown in table 4.3.2b.

Table 4.3.2b: Distribution of the respondents according to the health problems due to bad quality water intake

<table>
<thead>
<tr>
<th>Health problems</th>
<th>Often</th>
<th>Rare</th>
<th>Never</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cramps in abdomen/ Stomach</td>
<td>58</td>
<td>23.6</td>
<td>46</td>
<td>18.7</td>
</tr>
<tr>
<td>Loose Motions/Watery Motions</td>
<td>39</td>
<td>15.9</td>
<td>51</td>
<td>20.7</td>
</tr>
<tr>
<td>Vomiting</td>
<td>25</td>
<td>10.2</td>
<td>32</td>
<td>13.0</td>
</tr>
<tr>
<td>Bloody stools</td>
<td>15</td>
<td>6.1</td>
<td>14</td>
<td>5.7</td>
</tr>
<tr>
<td>Constipation</td>
<td>17</td>
<td>6.9</td>
<td>29</td>
<td>11.8</td>
</tr>
<tr>
<td>Missing N.A</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*354 households did not have any health problem related to drinking water

Table 4.3.2c: Distribution of respondents according to “from where they get treatment” (n=246).  

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Govt. Hospital</td>
<td>120</td>
<td>126</td>
<td>246</td>
</tr>
<tr>
<td>Private Clinic</td>
<td>79</td>
<td>167</td>
<td>246</td>
</tr>
<tr>
<td>Health worker</td>
<td>67</td>
<td>179</td>
<td>246</td>
</tr>
<tr>
<td>Hakeem</td>
<td>56</td>
<td>190</td>
<td>246</td>
</tr>
<tr>
<td>At home</td>
<td>68</td>
<td>178</td>
<td>246</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>354</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*354 households were not getting treatment as they did not have any water related problem

Afterwards, on asking whether they got treatment on getting suffered or not, the majority of households out of 246 i.e. 72.3% were using treatment through different health outlets as shown in table- 4.3.2c Whereas 120 (246) and 79 (246) households were getting treatment from govt. hospitals and private clinics respectively regarding problems they were facing due to water. Mostly households were going to govt. hospitals because it was comparatively economical for them. While 68 out of 246 households were using traditional tips at home like using tea with saunf (aniseed) etc passing from generation to generation mentioned by some of the participants during FGDs.
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Table 4.3.3a: Distribution of the respondents according to the effect on their social relation due to above mentioned health problems

<table>
<thead>
<tr>
<th>Effect on social relation</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>98</td>
<td>16.3</td>
</tr>
<tr>
<td>No</td>
<td>502</td>
<td>83.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.3.3b: Distribution of the respondents according to the reasons affecting social relations (n=98)

<table>
<thead>
<tr>
<th>Reasons</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach problems</td>
<td>86</td>
<td>87.8</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>12.2</td>
</tr>
<tr>
<td>Total</td>
<td>98</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>502</td>
<td></td>
</tr>
</tbody>
</table>

*502 households did not have affected social relations

Table 4.3.3a represents that 16.3 percent were the respondents who told us that bad quality drinking water at their homes affected their social relations. So it shows that bad quality drinking water is one of the factor due to which the people relationship became suffered.

And when we asked those 98 (16.3%) respondents about the major reasons behind the affected social relationship, then, according to table 4.3.3b, most of them i.e., 87.8% respondents told us that stomach problems due to bad quality drinking water were the major reason of affecting social relations among people. While the rest of the respondents conveyed the different reasons like falling hairs/white hairs, skin problems etc. behind the affected social relations among people.

Storage and consumption

Different studies showed that the association between water quality and diarrhea varied by the level of water availability, so water quantity had a more impact on improved health than water quality and the water availability depends on presence or absence of main storage system. (Van der Hoek et al., 2001; Jensen et al., 200).
Table 4.4.1a: Distribution of the respondents according to the main Storage system at home

<table>
<thead>
<tr>
<th>Storage System at home</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>132</td>
<td>22.0</td>
</tr>
<tr>
<td>Overhead Concrete</td>
<td>216</td>
<td>36.0</td>
</tr>
<tr>
<td>Overhead fiber glass</td>
<td>54</td>
<td>9.0</td>
</tr>
<tr>
<td>Overhead drums</td>
<td>198</td>
<td>33.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.4.1a depicts that less than half i.e., 33.0% have overhead plastic drums at their homes instead of overhead concrete storage system with the slight difference of 36.0%. Mostly people kept using concrete tanks at home because of the trend prevailing in past but nowadays trend is changing with time which can also be depicted from the results. Similarly Focus group discussion also supported this that most of the participants were using plastic drums. The main reason to use plastic drums was its easy handling rather than overhead concrete storage system because the cleanliness and maintenance of concrete storage is harder than other systems at home. Another factor that forced the households to use overhead plastic drums, was the cost, because, having plastic drums was cheap rather than having overhead concrete storage system. So now days households prefer to have overhead plastic drums instead of overhead concrete water storage system, also mention by participants, during FGDs. In the above table, 22.0% respondents had no main storage system at their homes because some of those respondents have got pumps both EP and HP. So according to them they had no need to have storage system at home as they had 24 hours water supply and got water whenever they needed. While only 9.0% respondents used overhead fiber glass storage tanks at home.

Table 4.4.1b: Distribution of the respondents according to the periodical cleaning of storage system (n=468)

<table>
<thead>
<tr>
<th>Periodical cleaning of storage system</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once in a year</td>
<td>228</td>
<td>48.7%</td>
</tr>
<tr>
<td>Never</td>
<td>240</td>
<td>51.3%</td>
</tr>
<tr>
<td>Total</td>
<td>468</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*132 households did not have main storage system at their home
When we talk about the periodical cleaning of water storage system then table 4.4.1b reflects that almost half of the households (51.3%) never cleaned their storage system because they were not much conscious of periodical cleaning of storage system which can affect drinking water quality that ultimately affects their health. Whilst a sizable percentage i.e., 48.7% households cleaned their storage system but only once in a year. These were the households who were fully aware regarding the importance of storage system cleanliness. Because they knew that storage system was an important factor which can really contaminate the water and due to this practice they can avoid diarrheal illness.

### Table 4.4.1c: Distribution of the respondents according to problems in their storage system (n=468)

<table>
<thead>
<tr>
<th>Problems</th>
<th>Yes</th>
<th></th>
<th>No</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f</td>
<td>%</td>
<td>f</td>
<td>%</td>
<td>f</td>
<td>%</td>
</tr>
<tr>
<td>Fungus</td>
<td>277</td>
<td>59.2</td>
<td>191</td>
<td>41.0</td>
<td>468</td>
<td>100.0</td>
</tr>
<tr>
<td>Dust</td>
<td>209</td>
<td>44.7</td>
<td>259</td>
<td>55.3</td>
<td>468</td>
<td>100.0</td>
</tr>
<tr>
<td>Leakage</td>
<td>61</td>
<td>13.0</td>
<td>407</td>
<td>87.8</td>
<td>468</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td></td>
<td></td>
<td>132</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*132 households did not have main storage system at their home*

The above table depicts that majority of the respondents 277 of 468 i.e., 59.0% were facing fungus problems in their storage system at home while dust is second most problem faced by the respondents of 209 (468) i.e., 44.7%. In addition to this, only 13.0% respondents were facing leakage problem in their main storage system.

### Table 4.4.1d: Distribution of the respondents according to their satisfaction level about the hygienic condition of their storage system

<table>
<thead>
<tr>
<th>Satisfaction level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>G.Satisfied</td>
<td>250</td>
<td>53.4</td>
</tr>
<tr>
<td>Somewhat satisfied</td>
<td>162</td>
<td>34.6</td>
</tr>
<tr>
<td>Not at all</td>
<td>56</td>
<td>12.0</td>
</tr>
<tr>
<td>Total</td>
<td>468</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>132</td>
<td></td>
</tr>
</tbody>
</table>

*132 households did not have main storage system at their home*

The above table illustrates that majority of the respondents i.e. 53.4% were greatly satisfied with the hygienic conditions of their water storage system and 34.6% respondents were somewhat satisfied with the hygienic condition of their storage system. While only 12.0% of the respondents were not at all satisfied with the hygienic condition of their water storage system. The respondents those were somewhat or not at all satisfied
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with the hygienic condition of their water storage system reported us that they were agreed with the fact that there should be regular periodical cleaning of their storage system to avoid health risks. In spite of this, they didn’t do this practice regularly because it is hard to clean and maintain storage system as 36.0% were having concrete storage system, shown in table- 4.4.1a.

Table 4.4.2: Distribution of the respondents according to the type of pipelines from where they get water

<table>
<thead>
<tr>
<th>Type of Pipelines</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron Pipe</td>
<td>466</td>
<td>77.7</td>
</tr>
<tr>
<td>Plastic</td>
<td>134</td>
<td>22.3</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.4.2 portrays that most of the respondents (77.7%) had iron pipe lines at their homes and plastic pipelines i.e., 22.3%.

Table 4.4.3a: Distribution of the respondents according to the separate water storage container for drinking

<table>
<thead>
<tr>
<th>Separate water storage for drinking</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>420</td>
<td>70.0</td>
</tr>
<tr>
<td>No</td>
<td>180</td>
<td>30.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.4.3b: Distribution of the respondents, whether they cover their storage container or not

<table>
<thead>
<tr>
<th>Covered or not</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>403</td>
<td>96.0</td>
</tr>
<tr>
<td>No</td>
<td>17</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>420</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>180</td>
<td></td>
</tr>
</tbody>
</table>

*180 respondents were not having separate storage container for drinking/cooking purposes
Table 4.4.3a shows that a vast majority of the respondents (70.0%) used a separate water container for drinking purposes. According to these respondents, there were two major reasons for using separate water container other apart from the main water storage system i.e., use of separate drinking water source other than main domestic water source, using different measures to improve the drinking water quality, also shared by participants in focus group discussion. While a sizable percentage of the respondents i.e., 30% were not using separate drinking water container.

After asking the respondents either they had separate water container or not at their homes, it was explored that some of these separate water containers were covered. It is clear from table- 4.4.3b that a large proportion of the respondents i.e. 96.0% used to cover their drinking water container while only 4.0 % did not cover their containers.

Table 4.4.4:  Distribution of the respondents whether they are Conscious about the use of water or not

<table>
<thead>
<tr>
<th>Conscious About use of water</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatly</td>
<td>314</td>
<td>52.3</td>
</tr>
<tr>
<td>Somewhat</td>
<td>210</td>
<td>35.0</td>
</tr>
<tr>
<td>Not at all</td>
<td>76</td>
<td>12.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table indicates that more than half of the respondents i.e., 52.3% reported that they were greatly conscious about the use of water because often they had to face water shortages at home. However, few of them realized that it was against Islamic teachings to waste water, so as a result, they were very conscious about the usage of water and avoided its wastage. Besides, 35.0% of the respondents were somewhat conscious about the use of water and 12.7% respondents were not at all conscious about the use of water. One of the major reasons of not being conscious about the use of water was to maintain proper hygiene that could not be maintained by limited use of water, reported by respondents. Besides, ablution was also one of the reasons, told by the respondents, to use more water because people mostly wasted water during this practice to make their body clean (paak) as also reviewed in FGDs.
Table 4.4.5: Distribution of the respondents whether they teach their family about saving water or not

<table>
<thead>
<tr>
<th>Teaching children about water saving</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully taught</td>
<td>322</td>
<td>53.7</td>
</tr>
<tr>
<td>To some extent</td>
<td>233</td>
<td>38.8</td>
</tr>
<tr>
<td>Not at all</td>
<td>45</td>
<td>7.5</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.4.6: Distribution of the respondents according to their main motive behind saving water

<table>
<thead>
<tr>
<th>Motive behind saving water</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage</td>
<td>Frequency</td>
</tr>
<tr>
<td>Saving cost</td>
<td>367</td>
<td>61.2</td>
<td>233</td>
</tr>
<tr>
<td>Save water resources</td>
<td>207</td>
<td>34.5</td>
<td>393</td>
</tr>
<tr>
<td>Islamic point of view</td>
<td>348</td>
<td>58.0</td>
<td>252</td>
</tr>
</tbody>
</table>

Table- 4.4.5 illustrates that majority of the respondents (53.7) fully taught their children about the proper use of water means and not to waste it rather save it. However, 38.8% respondents didn’t teach their children fully but to some extent. While only 7.5% respondents didn’t teach their children at all. While table- 4.4.6 portrays that there were several reasons behind the fact that why respondents taught their children about the practice of not wasting water rather saving it. Mostly told reasons were saving cost of high bills [367 (600) i.e. 61.2%] and second most told reason was the importance of saving water in Islam [348 (600) i.e. 58.0%]. It is supposed that water is the most valuable resource needed by all living being. Link between life and water is thrashed out in a number of verses of Holy Quran. This is well acknowledged in Holy Quran as well as in Sunnah (De Chatel, 2002). Besides, third most told reason was the saving of water resources because Pakistan is already running acute shortage of water resources.
Table 4.4.7: Distribution of the respondents according to the measure they adopt to save water

<table>
<thead>
<tr>
<th>Adoption of saving water measures</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Opening</td>
<td>83</td>
<td>13.8</td>
</tr>
<tr>
<td>Proper Maint.</td>
<td>487</td>
<td>81.2</td>
</tr>
<tr>
<td>Other</td>
<td>30</td>
<td>5.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

After knowing that whether the households were conscious or not about the usage of water, then we explored the different measures used by them to save water at home. Table- 4.4.7 illustrates the different measures adopted by households including the proper maintenance of their distribution and storage system to avoid leakage, half opening of tap and others. The most adopted measure was proper maintenance of distribution and storage system told by 81.2% respondents while 18.8% respondents adopted different measures to save water at their homes like half opening of tap and turn on the tap according to the need and then soon after turn off the tap etc.

**Sanitation and Drainage**

Lack of sanitation facilities is the world's largest cause of illness (UNICEF, 2007). Similarly, according to WHO (2004), improved sanitation reduces diarrhea morbidity by 37%. Researchers (Van der Hoek *et al.*, 2001) concluded that lack of toilet at home is one of the risk factors for diarrheal diseases. So, for improved health, toilet is an important factor. In the same context, Curtis *et al* (2000) suggested that safe disposal of fecal material is required to reduce the diarrheal diseases among people.

Table 4.5.1: Distribution of respondents according to the number of toilets

<table>
<thead>
<tr>
<th>Number of toilets</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>323</td>
<td>53.8</td>
</tr>
<tr>
<td>2</td>
<td>186</td>
<td>31.0</td>
</tr>
<tr>
<td>3 and more</td>
<td>91</td>
<td>15.2</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Results and Discussion

Table 4.5.2: Distribution of the respondents according to the structure of toilet at home

<table>
<thead>
<tr>
<th>Structure of Toilets</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacca</td>
<td>379</td>
<td>63.2</td>
</tr>
<tr>
<td>Semi pacca</td>
<td>221</td>
<td>36.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

According to table 4.5.1, lesser number of respondents i.e. 15.2% had three or more than three toilets at home while most of the respondents had single toilet at home i.e. 53.8%. Respondents were asked about structure of toilet at their homes. According to the table 4.5.2 it was clear that more than half of the respondents (63.2%) had pacca toilet at their homes and 36.8% respondents had semi pacca toilets at their homes.

Table 4.5.3: Distribution of the respondents according to the problems related to their toilets

<table>
<thead>
<tr>
<th>Problems</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improper cleanliness</td>
<td>134</td>
<td>22.3</td>
</tr>
<tr>
<td>Leakage of pipelines</td>
<td>61</td>
<td>10.2</td>
</tr>
<tr>
<td>Others</td>
<td>56</td>
<td>9.3</td>
</tr>
<tr>
<td>Nothing</td>
<td>349</td>
<td>58.2</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

After knowing the number and structure of toilet, we explored problems faced by respondents related to their toilets. Table 4.5.3 shows that amongst those, having problems related to the toilets, improper cleanliness was the major problem faced by the respondents, because of much usage (22.3%). The improper cleanliness, visible faeces in the toilet, was one of most important problems related to the toilet. (Robert et al., 2001). Similarly, in table 4.5.1, mostly respondents (53.8%) were having single toilet at their home, so it indicated that proper cleanliness of the toilet is hard to maintain when the whole family is using a single toilet. Leakage of pipelines in their toilets was told by 10.2% respondents while, fungus and improper construction of toilet were the other reasons.
Table 4.5.4: Distribution of the respondents according to the proper drainage system in their locality

<table>
<thead>
<tr>
<th>Drainage system</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>406</td>
<td>67.7</td>
</tr>
<tr>
<td>No</td>
<td>194</td>
<td>32.3</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Information presented in table 4.5.4 describes that 67.7% of the respondents reported that they had proper drainage system in their locality because of pacca and covered and almost one third of the respondents (32.3%) reported that they had improper drainage system in their locality. During FGDs, participants illustrated that Gutter blockage and overflow of gutters were the major reasons of improper drainage system. They faced such problems especially in rainy season.

Table 4.5.5: Distribution of the respondents according to the mixing of sewerage into their drinking water

<table>
<thead>
<tr>
<th>Sewerage mixing with drinking water</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>172</td>
<td>28.7</td>
</tr>
<tr>
<td>No</td>
<td>428</td>
<td>71.3</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.5.5 portrays that a majority of the respondents had reported that sewerage water was not mixing with drinking water as it is shown in table 4.5.4 and that majority of the respondent i.e., 67.7% had proper drainage system in their locality and 28.7% groused that they faced the problem of mixing of sewerage water into their drinking water specially in rainy season as table 4.5.4 shows that almost one third 32.3% respondents had improper drainage system in their locality because of old and leaky distribution system. Old rusty pipelines are generally leaky, so much so, the water supply pipes are laid parallel to these sewage pipes which results in mixing of sewage water into the drinking water (WWF, 2007).
Table 4.5.6: Distribution of the respondents regarding the steps taken by NGO & Govt. to improve the water quality

<table>
<thead>
<tr>
<th>NGO &amp; Govt. working to improve quality</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>146</td>
<td>24.3</td>
</tr>
<tr>
<td>No</td>
<td>454</td>
<td>75.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.5.6 depicts that a vast majority of the respondents i.e., 75.7% reported that nothing was done by any NGO or Govt. to enhance the quality of drinking water in their locality while 24.3% respondents told that Govt had taken steps to get better quality of drinking water at their locality like the installation of water filter plants as table 4.1.4 also mentions some of the respondents who were using water filter plants, installed by the Govt., as a source of water for the purpose of using for drinking and cooking purposes as they considered it of good quality.

Hand Washing

It is not the hidden fact that washing hands is necessary in order to stay healthy. The practice of cleaning hands at critical times can lower down the diarrheal illness (WHO, 2004; Maccan-Markar, 2006; Curtis, 2003).

Table 4.6.1: Distribution of the respondents according to their awareness level about the necessity of hand wash with soap after toilet

<table>
<thead>
<tr>
<th>Awareness level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully</td>
<td>536</td>
<td>89.3</td>
</tr>
<tr>
<td>Somewhat</td>
<td>64</td>
<td>10.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 4.6.2a: Distribution of the respondents according their practice of hand wash after using toilet

<table>
<thead>
<tr>
<th>Hand wash after toilet</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>554</td>
<td>92.3</td>
</tr>
<tr>
<td>No</td>
<td>46</td>
<td>7.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.6.1 depicts that most of the households (89.3%) were fully aware of the fact that it is necessary to clean hands with soap after the use of toilet while few of them i.e., 10.7% respondents were somewhat aware of the fact that hands should be cleaned with soap after the use of toilet. After recognizing the awareness level of the interviewee regarding the importance of cleaning hands with soap after the use of toilet especially after defecation, we discovered (Table 4.6.2a) that a clear majority of the respondents i.e., 92.3% cleaned their hands with soap after the use of toilet especially after defecation. Contrary to this, only 7.7% respondents did not clean their hands with soap after the use of toilet. One most important factor, told by the respondents, due to which they were not habitual of the cleaning hands with soap after the use of toilet, was the absence of soap within their toilet. FGDs also ratified above discussion.

Table 4.6.2b: Distribution of the respondents according to their timings of hand wash with soap (n=554)

<table>
<thead>
<tr>
<th>Timings</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Every time</td>
<td>369</td>
<td>66.6</td>
</tr>
<tr>
<td>Sometime</td>
<td>115</td>
<td>20.8</td>
</tr>
<tr>
<td>Rarely</td>
<td>70</td>
<td>12.6</td>
</tr>
<tr>
<td>Total</td>
<td>554</td>
<td>100.0</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>46</td>
<td></td>
</tr>
</tbody>
</table>

*46 households were not washing hands with soap

After that we asked that how many times they cleaned their hands after using toilet i.e. either they used to wash their hands every time, sometimes or rarely. Table 4.6.2b reveals this fact that two third of the (66.6%) households used to clean their hands every time after use of toilet and 20.8% households used to clean their hands
sometimes after use of toilet. Whereas 12.6% households used to clean their hands rarely after use of toilet because these households didn’t have proper place for soap and towel in their toilets. This fact became clearer during FGDs.

**Awareness regarding current water situation**

lack of safe drinking water can cause many health problems. The water scarcity in Pakistan had a huge impact on health (Hildebrandt and Jennifer, 2002).

**Table 4.7.1: Distribution of the respondents according to their opinion about the serious problem of drinking water resources in Pakistan**

<table>
<thead>
<tr>
<th>Serious problem of drinking water resources in Pakistan</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.Agree (S.A)</td>
<td>296</td>
<td>49.3</td>
</tr>
<tr>
<td>Agree(A)</td>
<td>221</td>
<td>36.8</td>
</tr>
<tr>
<td>Undecided</td>
<td>83</td>
<td>13.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.7.1 shows the respondents’ awareness level concerning the fact that Pakistan is facing severe water shortage now days. According to the above table, clear majority of the respondents i.e., 86.1% [S.A(49.3%) & A(36.8%)] were agreed with the fact that Pakistan is now facing a serious issue of limited water resources especially drinking water resources. Most told reasons by participants, during FGDs, were frequent load shedding which showed that Pakistan is facing limited water resources now-a-days. Additionally, the media also played an important role in generating awareness. Conversely, only 13.8% were undecided whether Pakistan is facing or not a serious water shortage problem now-a-days.
Table 4.7.2: Distribution of the respondents according to their opinion about the top most reason of water shortage

<table>
<thead>
<tr>
<th>Reasons of water shortage</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>209</td>
<td>34.8</td>
</tr>
<tr>
<td>Careless</td>
<td>118</td>
<td>19.7</td>
</tr>
<tr>
<td>Lack of Planning</td>
<td>167</td>
<td>27.8</td>
</tr>
<tr>
<td>Mismanagement</td>
<td>59</td>
<td>9.8</td>
</tr>
<tr>
<td>Other</td>
<td>47</td>
<td>7.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Afterwards the top most important reasons behind this water shortage were investigated. According to table 4.7.2, almost one third of the respondents (34.8%) told us that growing population was the top most reason for this water shortage because our resources are very limited to meet the need of all population. So according to them more water resources should be generated keeping in view the increasing population. While, according to the more than one fourth of the respondents (27.8%) lack of proper planning is the top most reason for this water shortage which was followed by the careless behavior about the use of water, told by 19.7% respondents. Lesser rains were the other top most reason mentioned by only 7.8% respondents.

Table 4.7.3: Distribution of the respondents the according to the fact that water Shortage is creating problem

<table>
<thead>
<tr>
<th>Water Shortage creating problem</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.Agree</td>
<td>314</td>
<td>52.3</td>
</tr>
<tr>
<td>Agree</td>
<td>226</td>
<td>37.7</td>
</tr>
<tr>
<td>Undecided</td>
<td>60</td>
<td>10.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>
### Results and Discussion

#### Table 4.7.4: Distribution of the respondents according to the problems emerging because of water shortage

<table>
<thead>
<tr>
<th>Problems</th>
<th>Yes</th>
<th></th>
<th>No</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
<td>Frequency</td>
<td>Percent</td>
</tr>
<tr>
<td>Drought</td>
<td>365</td>
<td>60.8</td>
<td>235</td>
<td>39.2</td>
<td>600</td>
<td>100.0</td>
</tr>
<tr>
<td>Electricity problems</td>
<td>315</td>
<td>52.5</td>
<td>285</td>
<td>47.5</td>
<td>600</td>
<td>100.0</td>
</tr>
<tr>
<td>Hygiene problems</td>
<td>248</td>
<td>41.3</td>
<td>352</td>
<td>58.7</td>
<td>600</td>
<td>100.0</td>
</tr>
<tr>
<td>Wars over water</td>
<td>68</td>
<td>11.3</td>
<td>523</td>
<td>88.7</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.7.3 shows that a vast majority of respondents i.e., 90% [S.Agree (52.3%), Agree (37.7%)] were agreeing with the fact that shortage of water is creating a serious problem for us. And only 10% respondents were unable to decide whether water shortage is creating problems or not.

From table 4.7.4 we came to know that respondents of 60.8% and 52.5% have reported that drought and electricity were the problems emerged due to the limited water resources respectively. However, according to 41.3% respondents, maintenance of proper hygiene was one of the major problems as a result of water shortage because in their viewpoint, quantity of water was an essential element to keep a person clean and healthy as Islam says cleanliness is the half belief, while only 11.3% respondent had their opinion that water was an extremely important factor than anything else so in near future wars will be fought over water rather than over oil.

#### Table 4.7.5: Distribution of the respondents according to their opinion whether this water shortage can be solved or not

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>466</td>
<td>77.7</td>
</tr>
<tr>
<td>Undecided</td>
<td>99</td>
<td>16.5</td>
</tr>
<tr>
<td>Disagree</td>
<td>35</td>
<td>5.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100</td>
</tr>
</tbody>
</table>
It is estimated from table 4.7.5 that most of the respondents i.e., 77.7% were strongly agreed with the fact that this shortage of water problem can be solved and 16.5% were disagreed that this problem can be solved. Some of the participants, during FGDs, also gave us different way outs for the solution of this problem. Some of the participants discussed the construction of dams as a way out of this shortage. Some participants also reported that people must be careful in using water. Whereas, only 5.8% were those respondents who were disagreed that this shortage can be solved because these respondents had their view that man can't do anything in this regard but only God can do it, as reviewed by participants during focus group discussion.

Table 4.7.6: Distribution of the respondents according to their opinion about the steps taken by government to resolve this shortage.

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Frequency</th>
<th>Valid Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly Agree</td>
<td>19</td>
<td>3.2</td>
</tr>
<tr>
<td>Undecided</td>
<td>35</td>
<td>5.8</td>
</tr>
<tr>
<td>Disagree</td>
<td>546</td>
<td>91</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100</td>
</tr>
</tbody>
</table>

The above table- 4.7.6 shows that according to a large proportion of the respondents, 91%, govt was not taking any steps for resolving the problem of water shortage which is increasing day by day and due to which Pakistan is now passing through her murky days. Contrary to this, only 5.8% and 3.2% respondents were undecided or strongly agreed with the fact that govt was taking some steps (e.g. installation of water filter plants and awareness generating campaigns about proper water usage through media reviewed by participants, during FGDs), respectively.

Table 4.7.7: Distribution of the respondents according to their opinion about contribution of family in water saving

<table>
<thead>
<tr>
<th>Opinion</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agree</td>
<td>298</td>
<td>49.7</td>
</tr>
<tr>
<td>Undecided</td>
<td>190</td>
<td>31.7</td>
</tr>
<tr>
<td>Disagree</td>
<td>112</td>
<td>18.6</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 4.7.7 depicts that 49.7% respondents were agreed with the fact that it is the responsibility of both family and government. According to them, this is the time when everyone had to participate to tackle this problem as Pakistan is now facing a serious water problem. While almost one third of the respondents (31.7%) were unable to decide whether an individual can contribute or not in this regard. On the other hand, 18.6% respondents had the view that only the government can resolve this serious problem because an individual can’t do anything in this regard. Therefore, it is fully the responsibility of the government.

Table 4.7.8a: Distribution of the respondents according to their experience of serious water shortage at home

<table>
<thead>
<tr>
<th>Serious water shortage at home</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>362</td>
<td>60.3</td>
</tr>
<tr>
<td>No</td>
<td>238</td>
<td>39.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.7.8a represents that majority of the respondents, 60.3% faced water shortage at home because of frequent load shedding and limited supply on the part of WASA/MS. According to the sizable percentage (39.7%) they didn’t face water shortage at home because they had more number of sources and also storage system at home for enough water storage. Some of them told us that they had 24 hours water supply at their homes as they had water HP as a result they didn’t face water shortage.
Table 4.7.8b: Distribution of the respondents according to how often they experienced water shortage (n = 362)

<table>
<thead>
<tr>
<th>Recurrence rate</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequently</td>
<td>136</td>
<td>37.6</td>
</tr>
<tr>
<td>Sometimes</td>
<td>131</td>
<td>36.2</td>
</tr>
<tr>
<td>Rarely</td>
<td>95</td>
<td>26.2</td>
</tr>
<tr>
<td>Total</td>
<td>362</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*238 households did not experiencing water shortage at home

Table 4.7.8b represents that approximately one third (37.6%) of the households frequently experienced water shortage at home and some of them (36.2%) faced water shortage sometimes. Those who were facing water shortage frequently mostly relied on WASA/MS water or collected water from different places. WASA/MS timings were three times per day but most of the respondents reported that WASA/MS supply was irregular i.e. once or twice a day. As table 4.1.2 shows that 21.5% had WASA/MS as main water source at home. Another most important reason of facing shortage was absence of main storage system at home as shown in table 4.1.13a, i.e. 22.0%. However, 26.2% respondents told that usually they didn’t face water shortage but very rare because they had their own pumps both hand and electrically operated. They actually experienced water shortage problem, only at the time of load shedding and boring issue.
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Table 4.7.8c: Distribution of the respondents according to their opinion about the reasons of water shortage at home (n = 362)

<table>
<thead>
<tr>
<th>Reason</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>Percentage</td>
<td>Frequency</td>
</tr>
<tr>
<td>Electricity failure</td>
<td>286</td>
<td>79.0</td>
<td>76</td>
</tr>
<tr>
<td>Problems in water supply</td>
<td>101</td>
<td>27.9</td>
<td>261</td>
</tr>
<tr>
<td>Lesser rains</td>
<td>21</td>
<td>5.8</td>
<td>341</td>
</tr>
<tr>
<td>Falling of water table</td>
<td>94</td>
<td>26.0</td>
<td>268</td>
</tr>
<tr>
<td>Others</td>
<td>9</td>
<td>2.5</td>
<td>353</td>
</tr>
<tr>
<td>Missing N.A</td>
<td>238</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*238 households did not experiencing water shortage at home

The above table- 4.7.8c explains that greater part of the respondents i.e. 79.0% [286(362)] told us that they had to face water shortage at home mainly due to electricity problem. While 27.9% [101(362)] and 26.0% [94(362)] respondents reported us that they faced water shortages mainly due to problem in water supply system and falling of water table, respectively. People who were facing problem in water supply system usually got water from WASA/MS with limited timings (three times a day but in most areas water timings were only once or twice a days). The respondents, who were facing falling of water table problem mostly, had EP/HP or both at home. This fact became clearer during FGDs.

Socio-economic characteristics

The demographic features regarding socio economic characteristics of households have diverse effects on their health. These Characteristics include age, education, marital status, family type, household income, house type and occupation. As Van der Hoek et al (2001) also explored that low socio economic status is one of the risk factors for diarrheal illness.
Table 4.8.1: Distribution of the respondents according to their age group

<table>
<thead>
<tr>
<th>Age group</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 30</td>
<td>174</td>
<td>29.0</td>
</tr>
<tr>
<td>31 – 40</td>
<td>203</td>
<td>33.8</td>
</tr>
<tr>
<td>41 – 50</td>
<td>164</td>
<td>27.3</td>
</tr>
<tr>
<td>&gt; 51</td>
<td>59</td>
<td>9.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table 4.8.1 shows that one third of the respondents’ (33.8%) were from age group of 31 – 40 years old and 29% of the respondents were came from age less than 30 years old that was followed by 27.3% and 9.8% respondents belonged to age of 41 – 50 years old age group and more than 51 years old age group, respectively.

Table 4.8.2: Distribution of the respondents according to their marital status

<table>
<thead>
<tr>
<th>Marital status</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>573</td>
<td>95.5</td>
</tr>
<tr>
<td>Divorced/widowed</td>
<td>27</td>
<td>4.5</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.8.2 depicts that a vast majority of the respondents were married i.e., 95.5%. However, 4.5% were divorced or widowed.

Table 4.8.3: Distribution of the respondents according to their relationship with male head of the household

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wife</td>
<td>354</td>
<td>59.0</td>
</tr>
<tr>
<td>Daughter</td>
<td>24</td>
<td>4.0</td>
</tr>
<tr>
<td>Daughter-in-law</td>
<td>194</td>
<td>32.3</td>
</tr>
<tr>
<td>Other</td>
<td>28</td>
<td>4.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.8.3 depicts that 59.0% respondents were wives of the heads of the household and 32.3% were daughters-in-law of the heads of the household. However, 4.0% were the
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daughters of the heads of the household whereas 4.7% had different relationship with the male heads of household i.e., sisters, mothers or Bhabis.

Family Type

Family represents a group of people coming from a common ancestry, affinity or sharing the same residence (Wikipedia, 2009). The present study discusses two types of families, described as nuclear family and joint family. Most commonly, the nuclear family consists of a father, mother and their children (Wikipedia, 2009). Joint family is also called a complex family. Parents and their young ones and their families, most of the times live under a single roof. This type of family contains a multiple generations in a (Wikipedia, 2009).

<table>
<thead>
<tr>
<th>Family type</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nuclear</td>
<td>253</td>
<td>42.2</td>
</tr>
<tr>
<td>Joint</td>
<td>347</td>
<td>57.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table 4.8.4 shows that 57.8% respondents lived in joint family system and 42.2% lived in nuclear family.
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Table 4.8.5: Distribution of the respondents according to male group living

<table>
<thead>
<tr>
<th>Male group living</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;=3</td>
<td>346</td>
<td>57.7</td>
</tr>
<tr>
<td>4-5</td>
<td>210</td>
<td>35.0</td>
</tr>
<tr>
<td>6=&gt;</td>
<td>44</td>
<td>7.3</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.8.5 shows that 57.7% respondents reported as three or less than three males living in their homes followed by 35.0% respondents, according to them, four to five males were living in their homes.

Table 4.8.6: Distribution of the respondents according to female group living

<table>
<thead>
<tr>
<th>Female group living</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;=2</td>
<td>186</td>
<td>31.0</td>
</tr>
<tr>
<td>3-4</td>
<td>317</td>
<td>52.8</td>
</tr>
<tr>
<td>5=&gt;</td>
<td>97</td>
<td>16.2</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Above table 4.8.6 shows that 52.8% respondents reported as three to four females were living at their homes followed by 31.0% respondents who said that two or less than two females were living at their homes.

Table 4.8.7: Distribution of the respondents according to child group living

<table>
<thead>
<tr>
<th>Child group</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>106</td>
<td>17.7</td>
</tr>
<tr>
<td>1-2</td>
<td>136</td>
<td>22.7</td>
</tr>
<tr>
<td>3-5</td>
<td>234</td>
<td>39.0</td>
</tr>
<tr>
<td>6+</td>
<td>124</td>
<td>20.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

According to 39.0% respondents, three to five children were living at their homes as shown by above table- 4.8.7. While 22.7% and 20.7% respondents, reported that one to two children and 6 or more children were living in their homes, respectively, while only 17.7% respondents told that they had no child.
Table 4.8.8: Distribution of the respondents according to their house structure

<table>
<thead>
<tr>
<th>House structure</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kacha</td>
<td>31</td>
<td>5.2</td>
</tr>
<tr>
<td>Pacca</td>
<td>317</td>
<td>52.8</td>
</tr>
<tr>
<td>Semi-Pacca</td>
<td>252</td>
<td>42.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.8.9: Distribution of the respondents according to their house ownership

<table>
<thead>
<tr>
<th>House ownership</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owned</td>
<td>479</td>
<td>79.8</td>
</tr>
<tr>
<td>Rented</td>
<td>106</td>
<td>17.7</td>
</tr>
<tr>
<td>Others</td>
<td>15</td>
<td>2.5</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.8.8 portrays that 52.8% respondents had pacca houses and 42.0% respondents were having semi pacca houses while on the other hand only 5.2% respondents had kacha houses. After knowing the house type, for the next important question about the ownership of the house, table 4.8.9 shows that majority of the respondents of percentage 79.8% had their own houses and 20.2% respondents did not have their own houses rather than they used to live in rented, govt. or relatives’ houses.

Table 4.1.45 & 4.1.46 represents the distribution of respondents regarding their education level and male head’s education level, respectively.
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Table 4.8.10: Distribution of the respondents according to their education

<table>
<thead>
<tr>
<th>Female education</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>253</td>
<td>42.2</td>
</tr>
<tr>
<td>Primary</td>
<td>29</td>
<td>4.8</td>
</tr>
<tr>
<td>Middle +Matric</td>
<td>103</td>
<td>17.2</td>
</tr>
<tr>
<td>Intermediate</td>
<td>42</td>
<td>7.0</td>
</tr>
<tr>
<td>Graduate&gt;</td>
<td>173</td>
<td>28.8</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table 4.8.10 shows that 42.2% respondents were illiterate as fifty percent of our data is from rural background and this data also emphasized to have a look on study area’s where literacy rate is very low especially among females {Literacy Ratio (10+) Multan: 32.28%, Rawalpindi: 59.18%} (PCO, 2005) and more than one fourth of the respondents (28.9%) were graduated and above. This figure shows the ongoing trend of higher education among females. On the other hand, a sizeable percentage of the respondents (24.2%) were middle to intermediate (i.e.17.2%+7.0%). However, only 4.8% respondents had primary qualification.

Table 4.8.11: Distribution of the respondents according to the male head education

<table>
<thead>
<tr>
<th>Male head education</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illiterate</td>
<td>144</td>
<td>24.0</td>
</tr>
<tr>
<td>Primary</td>
<td>22</td>
<td>3.7</td>
</tr>
<tr>
<td>Metric</td>
<td>155</td>
<td>25.8</td>
</tr>
<tr>
<td>Intermediate</td>
<td>153</td>
<td>25.5</td>
</tr>
<tr>
<td>Graduate</td>
<td>126</td>
<td>21.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The table 4.8.11 portrays that 25.8% and 25.5% male heads were Matric and Intermediate respectively. While 24.0% and 3.7% of male heads were illiterate and primary, respectively. The above table also mentioned that 21.0% were graduated or above.

Occupation may be defined as the particular activity with the market value which a person continually pursues for the objective of achieving a steady level of income.
(Ahmad, I. 1958). Occupation is one of the important features which give us an idea about the family status.

Table 4.8.12: Distribution of the respondents according to their occupation

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housewife</td>
<td>540</td>
<td>90.0</td>
</tr>
<tr>
<td>Govt. Employ</td>
<td>26</td>
<td>4.3</td>
</tr>
<tr>
<td>Others</td>
<td>34</td>
<td>5.7</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table 4.8.12 shows the occupation of the respondents. So data in the Table 4.8.12 depicts that most our respondents were housewives i.e. 90%.

Table 4.8.13: Distribution of the respondents according to the male head occupation

<table>
<thead>
<tr>
<th>Male head occupation</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>187</td>
<td>31.2</td>
</tr>
<tr>
<td>Govt. employ</td>
<td>51</td>
<td>8.5</td>
</tr>
<tr>
<td>Unemployed</td>
<td>20</td>
<td>3.3</td>
</tr>
<tr>
<td>Other</td>
<td>342</td>
<td>57.0</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The above table 4.8.13 shows that, according to the majority (57.0%) of the respondents, their household heads had different occupations including labor, agriculture, landlord and private employee. While 31.2% respondents reported that their male heads were doing their own business but on small scale for instance shop keepers and hawkers etc. However, only 8.5% and 3.3 % respondents reported that their household heads were Govt. employees and unemployed respectively.
Table 4.8.14: Distribution of the respondents according to the earning group living

<table>
<thead>
<tr>
<th>Earning group</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>152</td>
<td>25.3</td>
</tr>
<tr>
<td>2</td>
<td>323</td>
<td>53.8</td>
</tr>
<tr>
<td>3</td>
<td>105</td>
<td>17.5</td>
</tr>
<tr>
<td>4+</td>
<td>20</td>
<td>3.3</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The information presented in table 4.8.14 unveil that More than half of the respondents i.e. 53.8% reported that they had two earning member at their homes. While 25.3% and 17.5% respondents reported that they had only one to three earning members at their homes. On the other hand, only 3.3% respondents reported that they had four or more than four earning members.
Table 4.8.15: Distribution of the respondents according to the household income

<table>
<thead>
<tr>
<th>Household income (Rs. in thousands)</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;5000</td>
<td>82</td>
<td>13.7</td>
</tr>
<tr>
<td>6-10</td>
<td>100</td>
<td>16.7</td>
</tr>
<tr>
<td>11-15</td>
<td>166</td>
<td>27.7</td>
</tr>
<tr>
<td>16-20</td>
<td>209</td>
<td>34.8</td>
</tr>
<tr>
<td>21-25</td>
<td>40</td>
<td>6.7</td>
</tr>
<tr>
<td>&gt;26000</td>
<td>3</td>
<td>.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>600</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

Household income also plays very important role for a healthy life. Above table- 4.8.15 indicates that 30.4% households belonged to low income group while 62.5% households belong to medium income group. And only 7.2% households fall into high income group.

**Conclusion:**

The information revealed at the Uni-variate level of analysis was interesting and useful. This chapter provides simple descriptive statistics (frequencies and percentages) on a large number of questions (indicators) asked in the survey. These indicators were classified into two categories i.e., socio-economic factors and other drinking water quality influencing factors. Socio-economic characteristics including education (respondent and male head of the household), family type, house type, and household income. In addition to this, drinking water quality influencing factors are number and nature of domestic water sources, storage facilities, sanitation facilities and hygiene practice (adoption of measures to get better drinking water quality).
II. BI VARIATE ANALYSIS

To analyze the relationship between two variables simultaneously, Bi-variate analysis is used. This mode of analysis determines whether the values of the dependent variables tend to coincide with those of the independent variables. So, the method of assessment of association between two variables is called “Bi-variate statistical technique”.

This chapter looks into drinking water quality influencing factors and their health outcome keeping in view the relationship between dependent variable (health outcome; suffered or not suffered) and independent variables (no. of sources of domestic water, nature of source of drinking water, physical properties of drinking water, use of measures to improve the drinking water quality, storage system at home, sanitation facilities, drainage facilities, hand washing, and socio-economic characteristics). The results are concurrently presented and discussed as follows;

Table 4.2.1: Relationship between number of domestic water sources at home and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>One</th>
<th>Two</th>
<th>More than two</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>49</td>
<td>163</td>
<td>34</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>68.1%</td>
<td>42.8%</td>
<td>23.1%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>23</td>
<td>218</td>
<td>113</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>31.9%</td>
<td>57.2%</td>
<td>76.9%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>72</td>
<td>381</td>
<td>147</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 41.695, P ≤ 0.0001 \(\text{Phi}=0.264, P \leq 0.0001\)

Table 4.2.1 portrays that those households who were using one source of fresh water at their homes were more likely to suffer i.e., 68.1% while those household who were using two or more than two sources at their homes were less likely to become suffer. Statistical value also showed highly significant and strong relationship between the independent variable (number of sources at home) and dependent variable (health outcome). The chi square \(p=0.000(41.695)\) and phi \(p=0.000(0.264)\) both showed a highly significant relationship between the number of sources at home and health outcome.
Number of the water sources can play a vital role in controlling the water related illness because quantity can be an important factor that affects the health as shown in different studies that high-quality drinking water gives additional health benefits simply when adequate quantity of water are accessible as the effect of water quantity on diarrheal illness was to a great extent mediated through sanitation and hygiene activities (Hoek et al., 2001; Esrey et al. 1991). Likewise, a study by Curtis et al., (2000) over again emphasized the importance of having enough water available at domestic level.

Graph 4.2.1 shows the relationship between the number of sources of domestic water and health outcome.

### Table 4.2.2: Relationship between Sources of drinking water at home and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>WASA/MS</th>
<th>EP</th>
<th>HP</th>
<th>T. Well</th>
<th>Others</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>60</td>
<td>56</td>
<td>55</td>
<td>21</td>
<td>54</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>53.6%</td>
<td>64.4%</td>
<td>67.1%</td>
<td>19.3%</td>
<td>25.7%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>52</td>
<td>31</td>
<td>27</td>
<td>88</td>
<td>156</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>46.2%</td>
<td>35.6%</td>
<td>32.9</td>
<td>80.7%</td>
<td>74.3</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>112</td>
<td>87</td>
<td>82</td>
<td>109</td>
<td>210</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 91.570, P ≤ 0.0001, Phi=0.391, P ≤ 0.0001
According to the above 4.2.2 table, it is obvious that those households who were using a variety of drinking water sources, i.e., water filter plants, purchase water from vendors and commercial water (NESTLE) etc at homes were less suffered [25.7% (54(210))] as compare to those households who were using GW [E.P{64.4%(56(87))} & H.P{67.1%(55(82))}] and WASA/MS [53.6%(60(112))] as their drinking source seeing that they had the complaint of mixing of sewerage water into their drinking water in addition to unpleasant taste (brackish). These results are supported by WWF report (2007) and Naz (2006) that rusty and leaky pipelines result in mixing of sewerage water into drinking water, causing widespread diarrheal illness. While those who were using tube well source for drinking purpose were become less suffered i.e., 19.3% [21(109)] while 80.7% [88(109)] households using tube well were not suffered from diarrheal illness. Chi square [p=0.000(91.570)] and phi [p=0.000(0.391)] gave us an idea about the highly significant and strong relationship between the independent variable (nature of the drinking water sources) and dependent variable (health outcome). Nature of the sources of drinking water is as important as the number of sources at home because the safe source of drinking water causes less diarrheal illness. And from the above table it can be concluded that tube wells (because of deep boring) and water filter plants are the safe source of drinking water than other mentioned sources.
Results and Discussion

Above graph 4.2.2 depicts the association between the drinking water source and health outcome.

**Table 4.2.3: Relationship between taste of drinking water and health outcome**

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>G. satisfied</th>
<th>Somewhat satisfied</th>
<th>Not at all satisfied</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>22</td>
<td>174</td>
<td>50</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>16.9%</td>
<td>45.2%</td>
<td>58.8%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>108</td>
<td>211</td>
<td>35</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>83.1%</td>
<td>54.8%</td>
<td>41.2%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>130</td>
<td>385</td>
<td>85</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 45.117, P ≤ 0.0001  Phi= 0.274, P ≤ 0.0001

Table 4.2.3 makes it clear that those households who were greatly satisfied with the taste of their drinking water became less suffered while majority of those who were somewhat and not at all satisfied with the taste of drinking water became suffered. As chi square [p=0.000(45.117)] and Phi [p=0.000(0.274)] both showed that taste of drinking water and health outcome are associated. Taste is one of the physical properties which show the quality of the water. In the same context, researchers highlighted those factors which affect drinking water quality. Respondents, in this study, specified color, taste and odor as the main problems with their drinking water. Most of them (70%) rated the quality of water supplied to the house as poor. Due to this bad quality, most took measures to upgrade its quality to prevent health risks (Aini et al., 2001).
Graph 4.2.3 portrays the relationship between taste of drinking water and health outcome.

### Table 4.2.4: Relationship between color of drinking water and health outcome

<table>
<thead>
<tr>
<th></th>
<th>G. Satisfied</th>
<th>Somewhat Satisfied</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>135</td>
<td>111</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>31.0%</td>
<td>67.7%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>301</td>
<td>53</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>69.0%</td>
<td>32.3%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>436</td>
<td>164</td>
<td>600</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 66.426, P ≤ 0.0001 Phi = -0.333, P ≤ 0.0001

The above table 4.2.4 shows that 67.7% were getting ill. These were the households who were somewhat satisfied with color. Amongst those who were greatly satisfied, 31.0% were getting ill and 69.0% didn’t become suffer. Both Chi square (p=0.000) and Phi (p=0.000) value showed that independent variable (color) and dependent variable (health outcome) were significantly correlated. Color is also one of the physical properties that affect drinking water quality and ultimately health. In the same context, Aini et al (2001) pinpointed the factors which affect drinking water quality. Taste color, and odor, the main problems with drinking water, specified by the respondents. Most of them (70%) rated the quality of water supplied to the house as poor. Due to this bad quality, mostly respondents took measures to improve its quality to prevent health risks.
Above graph depicts the relationship between the color of drinking water & health outcome.

**Table 4.2.5: Relation between use of measures to improve the drinking water quality and health outcome**

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>46</td>
<td>200</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>29.3%</td>
<td>45.1%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not Suffered</td>
<td>111</td>
<td>243</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>70.7%</td>
<td>54.9%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>443</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 12.035, P ≤ 0.0001, Phi= -0.142, P ≤ 0.001

From the above 4.2.5 table it is concluded that almost 50 percent of those households who were not using measures [200(45.1%)] to improve the drinking water quality, suffering from diarrheal illness while majority of households [111(70.7%)] those adopted measures were not suffering from diarrheal illness. Chi Square (12.035, p ≤ 0.0001) and Phi value (-0.358, p ≤ 0.0001), both values showed the significant association between the independent variable (use of measures) and dependent variable (health outcome). Different studies have reported that the families who boil drinking water at home were at lower risk of diarrheal illness (Blake et al., 1993; Rice and Johnson, 1991).
Graph 4.2.5 shows the association between the adoption of measures to enhance the drinking water quality & health outcome.

**Table 4.2.6: Relationship between the awareness regarding the use of bad quality water and health outcome**

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Fully aware</th>
<th>Somewhat aware</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>197</td>
<td>49</td>
<td>246</td>
</tr>
<tr>
<td>35.8%</td>
<td>100.0%</td>
<td></td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>354</td>
<td>0</td>
<td>354</td>
</tr>
<tr>
<td>64.2%</td>
<td>.0%</td>
<td></td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>551</td>
<td>49</td>
<td>600</td>
</tr>
<tr>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq=76.783, P ≤ 0.0001, Phi= -0.358, P ≤ 0.0001

Above table 4.2.6 draws attention to the information that those households went through ill-health, where respondents had low level of awareness regarding the affect of bad quality water on health [100% {49(49)}]. Whereas, table 5 also showed that out of those 551 respondents who were fully informed, less number of households [35.8%{197(551)}] were suffering. Chi square (p= 0.000) is reflecting the significant association between the awareness level regarding the affect of bad quality and its health outcomes. Phi values (p= 0.000) also confirmed this association. Awareness regarding drinking water quality plays a significant role in preventing diarrheal illness (FWR, 2000).
Similarly in another study, researchers found that households, where respondents having awareness regarding drinking water quality, was more concern regarding their health and mostly respondents used to adopt different measures to enhance the quality of drinking water for avoidance of diarrheal illness (Aini et al, 2001).

Above graph depicts the relationship between the awareness regarding the use of bad quality water and health outcome.

### Table 4.2.7: Relationship between the main Water storage system at home and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>No Overhead concrete</th>
<th>Overhead fiber glass</th>
<th>Overhead drums</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>79 59.8%</td>
<td>59 27.3%</td>
<td>5 9.3%</td>
<td>103 52.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>53 40.0%</td>
<td>157 72.7%</td>
<td>49 90.7%</td>
<td>95 48.0%</td>
</tr>
<tr>
<td>Total</td>
<td>132 100.0%</td>
<td>216 100.0%</td>
<td>54 100.0%</td>
<td>198 100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 68.540, $P \leq 0.0001$  Phi= 0.338, $P \leq 0.0001$

Above table 4.2.7 shows that more than fifty percent of those households having no storage at home were getting much suffered than those having storage system of any type. Out of those having storage system, plastic drum users were getting more ill than those with overhead concrete and overhead fiber glass tanks. So storage system plays an important role in health. Statistical results, both Chi-square (68.540, $p \leq 0.0001$) ad Phi values (0.338, $p \leq 0.0001$) also showed a highly significant relationship between independent variable (main water storage system) and dependent variable (health outcome). Different studies supported that main storage tank is the guarantee to healthy
life and absence of water storage facility is one of the factor for diarrheal illness (Ensink et al 2002; Hoek et al, 2001; Jensen et al, 2004).

Graph 4.2.7: Relationship between the main Water storage system at home and health outcome

Graph 4.2.7 portrays the association between the main water storage system at home and health outcome.
Table 4.2.8: Relationship between the Separate drinking water container and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>112</td>
<td>134</td>
<td>246</td>
</tr>
<tr>
<td>26.7%</td>
<td>74.4%</td>
<td></td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>308</td>
<td>46</td>
<td>354</td>
</tr>
<tr>
<td>73.3%</td>
<td>25.6%</td>
<td></td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>420</td>
<td>180</td>
<td>600</td>
</tr>
<tr>
<td>100.0%</td>
<td>100.0%</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 118.901, P ≤ 0.0001 Phi = -0.445, P ≤ 0.0001

Table 4.2.8 shows that those respondents with separate drinking water container were getting less suffered i.e., 26.7% than those with no separate container (74.4%). Those households who although have separate drinking water container but even then getting disease (26.6%), the reason were the improper way of handling and wide-necked container as also evident from focus group discussion, which signify that they were not using faucet rather used to dip utensil into water container. Results are also supported by a study that container with a faucet contain can reduce the number of diseases. Hands brought into water container through scooping, water may have been a mean of contamination during dipping utensil (Swerdlow et al, 1992; Ries et al, 1992; Rice and Johnson, 1991).

Chi sq. (p=0.000) and Phi values (p=0.000) both showed significant relationship between separate storage container for drinking water and health.

Above Graph shows the relationship between the separate drinking water container and health outcome.
Results and Discussion

Table 4.2.9: Relationship between the number of toilets and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>One</th>
<th>Two</th>
<th>3 and +</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>156</td>
<td>72</td>
<td>18</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>48.3%</td>
<td>38.7%</td>
<td>19.8%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>167</td>
<td>114</td>
<td>73</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>51.7%</td>
<td>61.3%</td>
<td>80.2%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>323</td>
<td>186</td>
<td>91</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics  
Chi-Sq= 24.453, P ≤ 0.0001  
Phi= 0.202, P ≤ 0.0001

Toilet is the major factor that plays a key role in order to control the diarrheal illness. Different studies showed that lack of a toilet is the major risk factor for diarrheal illness (Van der Hoek et al.2001; EMB, 1996; Roberts et al. 2001). Similarly table- 4.2.9 also depicts that 80.2% household having three or more toilets were getting less suffered [18 of 91(19.8%)] than those having two [72 of 186 (38.7%)] and single toilets [156 of 323 (48.3%)] at their homes. And almost 50% of respondents having single toilet at their home were getting suffered. Both Chi square [p=0.000 (24.453)] and Phi [p=0.000 (0.202)] showed that number of toilet at home and health are significantly correlated.

During focus group discussion, respondents shared that it was hard to maintain toilet cleanliness due to sharing of single toilet by whole family which can lead to ill health. Other studies also supported this fact that improper cleanliness of toilet was significantly associated with increased diarrheal incidences especially among children (FWR, 2000; Roberts et al. 2001).

Graph 4.2.9 portrays the association between the number of toilets at home and health outcome.
Table 4.2.10: Relationship between the structure of toilet and health outcome

<table>
<thead>
<tr>
<th>Suffered/not suffered</th>
<th>Pacca</th>
<th>Semi pacca</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>108</td>
<td>138</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>28.5%</td>
<td>62.4%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>271</td>
<td>83</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>71.5%</td>
<td>37.6%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>379</td>
<td>221</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 66.505, P ≤ 0.0001, Phi = -0.333, P ≤ 0.0001

Majority of the respondents (71.5%) having pacca toilets at their homes were less suffered from diarrheal illness (pait ki beemariyaan) while those having semi pacca toilet at their home, majority of them (62.4%) became suffered from diarrheal illness. FWR (2000) looked into the sanitation facilities and hygiene behavior of the people in South Africa seeing that the majority had some form of toilet in the yard. Observation revealed that in the majority of the cases these toilets were in a very bad state and very dirty because of improper construction of their toilet which in turn led to ill health. Likewise, lack of sanitation facilities (presence or absence of toilet at home and structure of toilet) is the world’s largest cause of diarrheal illness (UNICEF, 2007).

Both Chi square and Phi values i.e., p=0.000 showed the independent variable (structure of toilet) is associated with dependent variable (health outcome).

Graph 4.2.10: Relationship between the structure of toilet and health outcome

Above graph 4.2.10 depicts the relationship between the structure of toilet and health outcome.
Results and Discussion

Table 4.2.11: Relationship between the mixing of sewerage water into drinking water and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>82</td>
<td>164</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>47.7%</td>
<td>38.3%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>90</td>
<td>264</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>52.3%</td>
<td>61.7%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>172</td>
<td>428</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 4.440, P ≤ 0.022
Phi= 0.086, P ≤ 0.035

Table 4.2.11 gives an idea that those households with complaint of sewerage mixing were becoming more suffered i.e. 47.7% (82 of 172) than others having no complaint. Mostly these people were using WASA water and distribution system was very old, rusty and leaky, so sewerage water was mixing into drinking water as also reviewed by the participants during focus group discussion. Whereas those reporting, sewerage water was not mixing, did not suffered i.e., 61.7% (264 of 428). Statistics [Chi sq (p=0.022) and Phi (p=0.035)] showed significant relationship between both sewerage mixing and health outcome. Moraes et al (2004) in his cross sectional study concluded that the sewerage and drainage can have a significant effect on diarrheal illness.

In another study, Semenza et al (1998) supported the hypothesis that diarrhea in group using water running in pipes could be an attribute of cross contamination between the water supplied by municipal committee and sewer because of the frayed pipes and the less water pressure. Leaked pipes pose threats to general public’s health. The mixing of sewerage water at leakage points, due to intermittent supply, caused major diarrheal illness (WWF, 2007).

Graph 4.2.11: Relationship between the mixing of sewerage water into drinking water and health outcome

Above graph shows the relationship between the mixing of sewerage into drinking water and health outcome.
Table 4.2.12: Relationship between washing hands with soap and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Yes</th>
<th>No</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>220</td>
<td>26</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>39.7%</td>
<td>56.5%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>334</td>
<td>20</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>60.3%</td>
<td>43.5%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>554</td>
<td>46</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 4.962, P ≤ 0.020, Phi = -0.091, P ≤ 0.026

Table 4.2.12 shows that those respondents who didn’t use to wash hands after toilet became suffered 56.5% (26 out of 46) than those who used to wash hands after toilet use, 39.7% (220 out of 554). Statistical value, both Chi and phi values (4.962, p ≤ 0.020 and -0.091, p ≤ 0.026) also showed that there is a strong relationship between independent variable (hand washing) and dependent variable (health outcome). As according to WHO (2004), the practice of cleaning hands at critical times can lessen the diarrheal illness by up to 35 percent. Washing hands after contact with stool was the most effective mode to reduce diarrheal illness especially among children (Curtis et al., 2000; Curtis, 2003).

Above graph 4.2.12 depicts the association between washing hands with soap and health outcome.
Table 4.2.13: Relationship between timings of washing hands with soap and health outcome

<table>
<thead>
<tr>
<th>Suffered/not suffered</th>
<th>NA</th>
<th>Every time</th>
<th>sometime</th>
<th>rarely</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>26</td>
<td>112</td>
<td>59</td>
<td>49</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>56.5%</td>
<td>30.4%</td>
<td>51.3%</td>
<td>70.0%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>20</td>
<td>257</td>
<td>56</td>
<td>21</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>43.5%</td>
<td>69.6%</td>
<td>48.7%</td>
<td>30.0%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>369</td>
<td>115</td>
<td>70</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 51.260, P ≤ 0.0001 Phi = 0.292, P ≤ 0.0001

Above table 4.2.13 highlights that majority of respondents (69.6%), who were washing hands with soap every time after using toilet didn’t suffer than those who used to rarely wash their hands with soap after using toilet (30.0%). So the statistical values showed that there is a significant relationship between independent variable (frequency of hand washing with soap) and dependent variable (health outcome). Results are also supported by WHO (2004), according to which, cleaning hands at critical times can lessen odds of diarrheal illness up to 35 percent. Similarly, Curtis et al (2000) also reported that cleaning of hands after having contact with stools was the most effective mean to lower the water related illness.

Table 4.2.13 portrays the association between timings of washing hands with soap and health outcome.
Table 4.2.14: Relationship between the problem of facing water shortage at home and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Yes (53.3%)</th>
<th>No (21.8%)</th>
<th>Total (41.0%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>195</td>
<td>51</td>
<td>246</td>
</tr>
<tr>
<td>Not suffered</td>
<td>171 (46.7%)</td>
<td>183 (78.2%)</td>
<td>354 (59.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>366 (100.0%)</td>
<td>234 (100.0%)</td>
<td>600 (100.0%)</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq = 58.490, P ≤ 0.0001, Phi = 0.312, P ≤ 0.0001

Different studies showed that sufficient quantity of water is guarantee to healthy life (Van der Hoek et al., 2001; Esrey et al. 1991). According to the above 4.2.14 table, more than half of the households experiencing water shortage at home were becoming ill while contrary to this only less than one-fourth of the households, not experiencing water shortage, were becoming ill. The relationship between drinking water quality and diarrheal illness varied due to the availability of the water quantity. Hence, the water quantity has more important impact on improved health than water quality (Van der Hoek et al. 2001; WHO/UNICEF, 2000).

Chi sq (p=0.000) and Phi (p=0.000) both showed a significant relationship between water quantity and health outcome.

Graph 4.2.14: Relationship between the problem of facing water shortage at home and health outcome

Graph 4.2.14 portrays the relationship between the problem of facing water shortage at home and health outcome.
Results and Discussion

Table 4.2.15: Relationship between the respondent’s education and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Illiterate</th>
<th>Primary</th>
<th>Middle &amp; Matric</th>
<th>Intermediate</th>
<th>Graduation and above</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>124 (49.0%)</td>
<td>14 (48.3%)</td>
<td>36 (35.0%)</td>
<td>23 (54.8%)</td>
<td>49 (28.3%)</td>
<td>246 (41.0%)</td>
</tr>
<tr>
<td>Not suffered</td>
<td>129 (51.0%)</td>
<td>15 (51.7%)</td>
<td>67 (65.0%)</td>
<td>19 (45.2%)</td>
<td>124 (71.7%)</td>
<td>354 (59.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>253 (100.0%)</td>
<td>29 (100.0%)</td>
<td>103 (100.0%)</td>
<td>42 (100.0%)</td>
<td>173 (100.0%)</td>
<td>600 (100.0%)</td>
</tr>
</tbody>
</table>

Statistics: Chi Sq= 23.686, P ≤ 0.0001 Phi= 0.199, P ≤ 0.0001

An educated mother, who is aware of various issues of drinking water like, hygiene and sanitation practices which ultimately affects human health, plays a key role to educate their family. Also supported by IANGWE (2004), in most of the cultural settings, the management of water resources, primarily, is considered to be the responsibility of women along with the administration, sanitation, hygiene and health at household level and education of children in matters related to hygiene for the understanding of the impact of poor sanitation on health.

Above table 4.2.15 illustrates that 253 out of 600 respondents were illiterate. Amongst those, almost fifty percent respondents reported that households were suffering from diarrheal illness and similar trend was followed where mothers were educated up to primary level. Similar results were shown by a nationwide survey of NIPS (1992) where it was reported that the better educated mothers (who followed secondary or higher level of education) were found good at taking measures against the prevalence of diarrhea. However, the mothers educated till primary level were not seen prone to take steps to decrease the prevalence of it.

While 173 respondents were having graduation or above level, out of them, a majority of respondents i.e. 71.7% reported that their households were not suffering from diarrheal illness. This depicted the impact of female education on family’s health and with the increase in education, health status become improved.

These results also supported the idea of Esrey & Habicht (1998) that the family health was dependent on mother’s education. The literacy of mothers and the effects of toilets and piped water were interdependent with regard to the infant mortality as survey by Esrey. The young children particularly in unsanitary environment with no or less toilets were protected by literate mothers and that with the introduction of piped water, the
Results and Discussion

effective use of it was practiced for the attainment of better hygienic conditions for their infants. Similarly, mother years of education were often found to be positively inter-related with an improved health of children in the countries which are still developing (Glewwe 1999; Boadi and Kuitunen, 2005).

Table 4.2.15 depicts the association between the respondent’s education and health outcome.

Graph 4.2.15: Relationship between the respondent’s education and health outcome

0 10 20 30 40 50 60 70 80
Illiterate Primary Middle and Matric Intermediate Graduation and above
Suffered Not suffered

Respondent’s education
Health outcome

Table 4.2.15 depicts the association between the respondent’s education and health outcome.
Results and Discussion

Table 4.2.16: Relationship between the type of family and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Nuclear</th>
<th>Joint</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suffered</td>
<td>81</td>
<td>165</td>
<td>246</td>
</tr>
<tr>
<td></td>
<td>33.8%</td>
<td>45.8%</td>
<td>41.0%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>159</td>
<td>195</td>
<td>354</td>
</tr>
<tr>
<td></td>
<td>66.3%</td>
<td>54.2%</td>
<td>59.0%</td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
<td>360</td>
<td>600</td>
</tr>
<tr>
<td></td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 8.692, P ≤ 0.002 \(\Phi= -0.120, \ P ≤ 0.003\)

Number of people is an important factor for a healthy life because more number of people can be a factor of poor hygiene. Above table- 4.2.16 indicates that approx. fifty percent (165 out of 360) of the households, living in joint family, were getting suffered. Family type is an important factor affecting household’s health status. Household living in a joint family as compared to nuclear family has poor socio-economic status and this factor greatly influences the health of the households. In the same context, results are also supported by khan et al., (2007) who reported that number of family members in the household were positively associated with contamination of drinking water.

Statistical results [Chi sq (8.692, \(P≤ 0.002\) and Phi (-0.120, \(P ≤ 0.003\))] also showed significant relationship between independent variable (family type) and dependent variable (health outcome).

![Graph 4.2.16: Relationship between the type of family and health outcome](image)

Above graph 4.2.16 shows the association between the type of family and health outcome.
Table 4.2.17: Relationship between the household income (Rs. in thousands) and health outcome

<table>
<thead>
<tr>
<th>Health outcome</th>
<th>Low income group</th>
<th>Medium income group</th>
<th>High income group</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;5000</td>
<td>6-10</td>
<td>11-15</td>
<td>16-20</td>
</tr>
<tr>
<td>Suffered</td>
<td>60</td>
<td>82</td>
<td>52</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>73.2%</td>
<td>82.0%</td>
<td>31.3%</td>
<td>21.5%</td>
</tr>
<tr>
<td>Not suffered</td>
<td>22</td>
<td>18</td>
<td>114</td>
<td>164</td>
</tr>
<tr>
<td></td>
<td>26.8%</td>
<td>18.0%</td>
<td>68.7%</td>
<td>78.5%</td>
</tr>
<tr>
<td>Total</td>
<td>82</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Statistics: Chi-Sq= 154.963, P ≤ 0.0001 Phi= 0.508, P ≤ 0.0001

Table 4.2.17 draws attention to, majority of households having less than <Rs.5000 income level (60 out of 82(73.2%) and Rs.6000-10,000 [82 out of 100(82.0%)]) were getting suffered as compare to medium income level [96 out of 375(25.6%)] and high income level [7 out of 43 (16.3%)]. As the level of income increased, the cases of diarrheal illness decreased and vice versa. Pritchett & Summers (1996) also supported the above results, that low income caused ill-health. As Families with high income have more chances to improve the drinking water quality for instance, water treatment & hygiene practices etc which had great impact on household’s health status. Both Chi-Sq and Phi statistics showed the significant relationship between the household income and health outcome.

FWR (2000) also mentioned a factor of Poor health which was lack of toilet and the weak financial condition of a family was found as a hindrance for the construction of toilets for a family. Furthermore, World Bank (1999) also illustrated that poverty viz weak financial conditions were found directly linked with ill-health. In comparison with better-off/well off people, the health conditions were found worse among the poor people.
Above table 4.2.17 shows the association between the household income and health outcome.
CONCLUSION

The mode of Bi-variate analysis is used for analyzing the relationship between two variables simultaneously in order to determine whether the values of the dependent variables tend to coincide with those of the independent variables. In other words, this mode is used for the exploration of the concept of association among two variables. The association is based, actually, on whether the two variables go together (co-varied) or remain independent. So, the method of assessment of association between two variables is called “bi-variate statistical technique”.

From Bi-Variate analysis, it is concluded that water quantity had a more important impact on improved health than water quality and it depends on presence or absence of storage system. It is obvious from the results that families who boiled drinking water were at lower risk of water related illness. Also that drinking water into which hands or any object put into the container became a cause of contamination. The practice of cleaning hands is necessary in order to stay healthy. . It is obvious from the bi-variate analysis that families with higher income were less likely to be suffered than those having low household income. Furthermore, it is quite evident that family health was dependent on mother’s education in view of the fact that the educated mothers try to save their families from illness Therefore, the above mentioned factors are the important drinking water quality influencing factors. Hence, if these are not properly managed, then people become suffer from water related illness.

However, the limitation of Bi-Variate findings was that only one independent and dependent variable was introduced in the analysis which can make the results spurious. Therefore, Multi-Variate analysis was carried out to see the comparative significance of each drinking water quality influencing factors in order to know the health outcome of household.
**Results and Discussion**

Bi Variate analysis of independent variables with health outcome

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Independent Variables</th>
<th>p- values</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Chi- Square</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Phi</td>
</tr>
<tr>
<td>1</td>
<td>Number of Sources of fresh water at home</td>
<td>0.000 (41.695)</td>
</tr>
<tr>
<td>2</td>
<td>Source of drinking water</td>
<td>0.000 (91.570)</td>
</tr>
<tr>
<td>3</td>
<td>Taste of drinking water</td>
<td>0.000 (45.117)</td>
</tr>
<tr>
<td>4</td>
<td>Color of drinking water</td>
<td>0.000 (66.426)</td>
</tr>
<tr>
<td>5</td>
<td>Awareness about the bad quality water can damage health</td>
<td>0.000 (76.783)</td>
</tr>
<tr>
<td>6</td>
<td>Use of measures</td>
<td>0.000 (600.000)</td>
</tr>
<tr>
<td>7</td>
<td>Main storage system at home</td>
<td>0.000 (68.540)</td>
</tr>
<tr>
<td>8</td>
<td>Separate storage container for cooking/drinking purposes</td>
<td>0.000 (118.901)</td>
</tr>
<tr>
<td>9</td>
<td>Number of toilet at home</td>
<td>0.000 (24.453)</td>
</tr>
<tr>
<td>10</td>
<td>Mixing of sewerage water with drinking water</td>
<td>0.022 (4.440)</td>
</tr>
<tr>
<td>11</td>
<td>Structure of toilet</td>
<td>0.000 (124.372)</td>
</tr>
<tr>
<td>12</td>
<td>Washing hand after using toilet</td>
<td>0.020 (25.447)</td>
</tr>
<tr>
<td>13</td>
<td>Timings of washing hands with soap</td>
<td>0.000 (51.260)</td>
</tr>
<tr>
<td>15</td>
<td>Ever faced water shortage at home</td>
<td>0.000 (58.490)</td>
</tr>
<tr>
<td>16</td>
<td>Household income</td>
<td>0.000 (34.775)</td>
</tr>
<tr>
<td>17</td>
<td>Respondent’s education</td>
<td>0.000 (23.686)</td>
</tr>
<tr>
<td>18</td>
<td>Type of Family</td>
<td>0.002 (8.692)</td>
</tr>
</tbody>
</table>
III. Multivariate Analysis

Binary (or binomial) logistic regression (BLR) is a regression form, used when the dependent is a dichotomy and the independents are of any type. Logistic regression can be used to predict a dependent variable on the basis of continuous and/or categorical independents and to determine the percent of variance in the dependent variable explained by the independents; to rank the relative importance of independents; to assess interaction effects; and to understand the impact of covariate control variables. The impact of predictor variables is usually explained in terms of odds ratios.

Binary logistic regression analysis was performed using SPSS software. Health outcome (Suffered or not suffered) was used as dependent variable with source of drinking water, type of family, separate water storage container, household income and respondents education as independent variables. Out of 600 cases, 41.0% were suffered as shown in classification table.

<table>
<thead>
<tr>
<th>Omnibus Tests of Model Coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>Step 1 Step</td>
</tr>
<tr>
<td>Block</td>
</tr>
<tr>
<td>Model</td>
</tr>
</tbody>
</table>

The chi-square statistic and its significance level is given in table. Statistics for the Step, Model and Block are the same because we had not used stepwise logistic regression or blocking. The significant (P<0.01) chi-square value (182.82) showed that model is statistically significant.

<table>
<thead>
<tr>
<th>Model Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

\(^{a}\) Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

The strength of the relationship between the dependent variable and the independent variables is usually determined by coefficient of determination (R\(^2\)). The Cox and Snell R\(^2\) measure operates like R\(^2\), with higher values indicating greater model
Results and Discussion

fit. However, this measure is limited in that it cannot reach the maximum value of 1, so Nagelkerke proposed a modification that had the range from 0 to 1. Here we rely upon Nagelkerke's measure as indicating the strength of the relationship. If we applied our interpretive criteria to the Nagelkerke $R^2$ of 0.354, we would characterize the relationship as strong.

The classification matrices in logistic regression serve of evaluating the accuracy of the model. If the predicted and actual group memberships are the same, i.e. 1 and 1 or 0 and 0, then the prediction is accurate for that case. The overall percentage of accurate predictions is 77.8% which is the percentage of cases for which our model predicts accurately. In “Classification Table” it was cleared that 157 out of 246 (63.8%) respondents who have any health problem are classified correctly. 310 out of 354 (87.6%) respondents with no health problem are correctly classified.

<table>
<thead>
<tr>
<th>Observed of water</th>
<th>Predicted Percentage Correct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Step 1 of water</td>
<td>310</td>
</tr>
<tr>
<td>Yes</td>
<td>89</td>
</tr>
<tr>
<td>Overall Percentage</td>
<td></td>
</tr>
</tbody>
</table>

a. The cut value is .500
**Table 4.3.1: Ordinal Regression of drinking water quality influencing factors and health outcome**

<table>
<thead>
<tr>
<th>Step</th>
<th>Variables Entered</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>df</th>
<th>Sig.</th>
<th>Exp(B)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>2.363</td>
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<td>7.334</td>
<td>1</td>
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<td>.517</td>
<td>16.458</td>
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<td>.000</td>
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a. Variable(s) entered on step 1: a4_main, a85_Type_family, a29_Separate_water_storage, a95_Income_household, a90_Edu_M_head.

The final logistic regression model is

\[
\log(p/1-p) = 2.097 + 0.860 \times \text{main}(1) - 0.002 \times \text{main}(2) - 0.306 \times \text{main}(3) - 0.621 \times \text{main}(4) - 0.0804 \times \text{Type_family} - 0.561 \times \text{Income_household} - 0.177 \times \text{Education}
\]

These estimates (Column “B” of Table 4.3.1) described the relationship between the independent variables and the dependent variable, where dependent variable was on the logit scale. These estimates showed the amount of increase (or decrease, if the sign of the coefficient was negative) in the predicted log odds of suffered = 1 that would be predicted a 1 unit increase (or decrease) in the predictor, holding all other predictors constant. The independent variables that are non-significant (Columns labeled Wald and Sig. regarding testing whether the coefficients were statistically significant), the coefficients were not significantly different from 0, which should be taken into account when interpreting. Because these coefficients were in log-odds units, they were often difficult to interpret, so they were often converted into odds ratios.

Constant value (2.097±0.517) was the expected value of the log-odds of suffered when all the predicted variables were equal to zero.

Table C showed that overall “main” variable (drinking sources) (1=WASA, 2=Elec.pump, 3=H.pump, 4=T.well, 5=Other) were statistically significant (P<0.002).
Results and Discussion

main(1) and main (4) were found significant while main(2) and main (3) found non-significant (P>0.05).

Regarding “type of family” (Nuclear family), for every one-unit increase in Nuclear family, 0.804±0.225 decreased in log-odds of suffered, holding all other independent variables constant. The p-value was 0.000, so the null hypothesis that the coefficient equals 0 was rejected. Family type is a crucial determinant influencing household’s health status. The number of family members was positively correlated with poor drinking water quality because the large family in comparison to the small family (nuclear type) has poor socio-economic status (Khan et al, 2007).

For every one unit increase in “separate water storage”, 0.622±0.312 increased in the log-odds of “suffered” holding all other independent variables constant. The result shows, with the increase in number of households having separate storage water container, there is increase in number of households getting suffered. Considering the above fact, it can be said that the unhygienic way of handling the water is the reason behind the ill health of households, in spite of having separate container, also thrashed out in focus group discussion. It is also supported by a study that container with a faucet reduces the water related illness but hands introduced into a container may cause contamination (Swerdlow et al, 1992; Ries et al, 1992; Rice and Johnson, 1991). The p-value was found 0.047 which indicated that the null hypothesis that the coefficient equals to 9 was rejected. The odds ratio for separate water storage was 1.862, indicated that for family group, the odds of suffered 1.86 (or 18.6%), assuming that other variables kept constant.

For every one-unit increase in income had 0.561±0.157 decrease in log-odds of suffered keeping the effect of all other independent variables constant. The odds ratio for income was 0.571 or, if we invert it, 1.75, which showed that the odds for income were about 2 times greater in next income group, assuming that all other variables held constant. The result of logistic regression is shown in the table 4.3.1. It is obvious that household income is one of the important factors affecting the health status of the family as family income plays an important role for a healthy life. According to the above table, statistically significant p – value (p< 0.0001) depicts that families with higher income
Results and Discussion

were less likely to be suffered than those having low household income. The reason is that the people with high family income have more opportunities to have more number of domestic water sources, better drinking water source, and different measures to improve the drinking water quality, storage facility and improved sanitation facilities at home. So, income is the most important factor for improved health. The result of the present study was in line with the result presented by Pritchett & Summers (1996), who also supported the above results, that low income caused ill-health. More the family income, more the chances to improve drinking water quality, for instance, water treatment & hygiene practices etc which had great impact on health status. Furthermore, it is quite evident from the report by World Bank (1999) that poverty and ill-health were entwined. Poor people had worse health outcomes than better-off people.

Similarly with one-unit increase in education, the decrease in log-odds was found 0.177±0.093, while keeping the effect of all other variable constant. Women are mainly the responsible ones for the water consumption, management of water resources, hygienic practices, sanitation and health at household level. According to Esrey and Habichet (1998), the family health was dependent on mother’s education and they further illustrated that an educated mother protected their family from water related illness. Additionally, when piped water was introduced, mothers used it more effectively to practice better hygiene for their family. Similarly, mother years of education were found to be positively correlated with improved family health in different countries (Glewwe, 1999). The odds ratio was 0.838. Subtract 1 from the odds ratio and multiply by 100, percent change in odds of the dependent variable having value of 1. The odds ratio of education indicates that every unit increase in education is associated with a 16.2% decrease in the odds of suffered.
CONCLUSION

Multivariate analysis was carried out to see the comparative significance of each drinking water quality influencing factor in order to know the health outcome of households. Binary Logistic Regression (BLR) is a regression form, used when the dependent variable is a dichotomous and the independent variables are of any type. Health outcome i.e., suffered or not suffered was used as dependent variable with source of drinking water, type of family, separate drinking water container, household income and respondent’s education as independent variables. The results showed that with the increase in number of families with separate water storage container, there is an increase in families getting suffered. Considering this fact, it can be said that the unhygienic way of handling the water is the root cause behind the ill-health of families, in spite of having separate water container. The number of family members was positively correlated with poor drinking water quality, as the large family in comparison with small family has low socio-economic status. It is obvious from the multivariate analysis that families with higher income were less likely to be suffered than those having low household income. So far as socio-economic characteristics are concerned, the well educated mothers are more concerned to the health of their families, more aware about drinking water quality and use of measures to improve its quality.

Finally, it is concluded that the most important and contributing factors in explaining the health outcome were the Household Income, Respondent’s Education, Type of Family, Source of Drinking Water and Separate Water Storage Container.
CHAPTER V

QUALITATIVE ANALYSIS

Focus Group Discussion is a way to capture in-depth information from the participants in their own word. It helps to get different aspects of the topic as well as unveils the information about the area under discussion that may not have been covered by the investigator from individual interviews.

Findings from the Focus Group Discussions

Majority of the discussants had two water sources at home. According to them, once source was not enough to meet their domestic needs for instance dish washing, cloth washing, house cleaning and personal hygiene etc., so another source was essential. Few of the participants in urban areas had more than two sources at home because of the bad quality of main source, so they used separate source for drinking purpose. On the average, most of the participants had usually these three domestic sources i.e., WASA/MS, EP and the HP. The participants from rural background had HP and EP as their major domestic source instead of WASA/MS water whereas the participants belonged to urban areas mostly had WASA/MS and EP for their domestic consumption and other different sources also in addition to these. The reason to use different sources other than these three major sources was the poor water quality of major sources. Nearly all the participants told about the unpleasant smell and brackish taste of water from their major source.

Participants told that major sources for drinking purpose were water filter plants, WASA/MS, ground water (GW) etc. An important point come out of discussion was that boring depth plays a vital role in the ground water quality because the views of different participants were different in terms of GW quality. According to few of the participants, their GW was of sweet taste because they had deep boring from 130-160ft while others found it brackish in taste as they had 65-75ft deep boring.
Qualitative Analysis

A participant shared

“Humarey ilaajey ka zameeni pani khara hai, jo na to peeney k qabil ha, budboo b ati hai aur sabun ki jhag b nhe bunti. Is liyey peeney k liyey hum pani khaale se le kerey hain”

Water in our area is brackish and so is not fit for drinking purpose. Additionally, it is smelly and no lather is formed while washing hands. Therefore, we bring water from a water passage for drinking purpose.

Most participants, using water filter plants and tube well water, were satisfied with their drinking water source while WASA/MS source users were facing problems like foul smell in water because of sewerage mixing in drinking water.

Few were using measures to improve drinking water quality and majority of them were using ‘boiling’ as a measure. Whereas, in case of urban areas, filter was also in use at home.

One of the participants reported that

“Main eik se ziada tareeqey istmal kerti hun, jesey pani ubalney k sath filter b gher mein maujood hai. Kyon k aaj kal pani itna gunada ata hai k meri tassali nhe hoti. Wesey bhi sehut se zida koi cheez ehum nhe. Paisa sahi waqt per istmal kerna ziada behter hai bjae iss k k beemari k waqt doctor ki fees aur dawaiyon per istmal keya jae”

Water is so poor in quality nowadays that I have to use more than one measure to improve drinking water quality, such as use of filter along with boiling of water, for my personal satisfaction. Nothing is important than health so it is much better to be safe than to be sorry.

In rural areas, participants were using conventional methods like a member shared,

“Main to paani mutkey main daal deti hun kyoon k jis pani se hua aur roshini guzerti rhey, wo saaf rehta hai. Aur ye filter ka kaam b deta hai”

I used to put water in a pitcher because the light and air passed through it makes it clean and the pitcher itself works as a filter.
Similarly another method was contributed by a different participant

“Main peeney waley pani mein phitkeri daal deti hun jis ki waj se gundgi neechey beth jati hai aur pani saaf ho jata hai”

I add Alum in drinking water because of which unwanted dust settles down and water gets clean.

Most of the participants were having main storage system at home. Talking about urban and rural areas, nearly all of the participants had main storage system in former areas and in later ones some of the participants didn’t have main storage system at home, because in the presence of HP and more than one source, they didn’t feel any need of water storage system. Majority participant had plastic drums as main storage system but some of them were also having overhead concrete system at home. Plastic system was in much use because of its easy handling, no maintenance problem and it is economical too.

Almost each participant did not clean their storage system on regular basis because majority was not really concerned about the hygienic condition of storage system. Even a large number of participants was informed about the fact that unhygienic condition of storage system can contaminate water which ultimately affects health but they didn’t bother. In the same context, one participant quoted;

“How jantey bhi hain k storage system ki safai kitni zaruei hai beemari se bachne k livey mager humari susti k hum safai nhe kertey”.

Although we know the utmost importance of storage system cleanliness to avoid the diseases, but it is our laziness that we don’t perform this.

Among the reasons for having separate storage system, one was that participants had separate source of water for drinking purpose, additional to the domestic uses. Some participants also used measures to enhance drinking water quality and for this reason they used separate container for drinking water. In urban areas, major part of the participants kept cans as separate container for drinking water but without spout. While in Rural areas, pitchers were used as separate container. Majority of participants had container without faucet and utensils were being in use to dip in the container. One participant reported;
“Main pani waley bertun k sath glass baandh deti hun ta k bachey istmal k dauraan eidher oodher na ker dein”

I used to attach a glass with container, using a rope, so that children don’t misplace it while using.

Some participants who were a bit conscious about water usage pooled the reasons behind its excessive use which included different domestic activities like hand washing, bathing, dishwashing, cloth washing, cleaning fruits and vegetables, house and bathroom cleaning etc.

One participant added

“Safai kum pani sey mumkin nahin hai. Wuzu aur gusl k likey pani ziada hota hai jo k jism ko paak kerney k likey zaruri hai.”

Proper hygiene cannot be maintained by limited use of water. Ablution and bathing require too much water as it is necessary to make the body clean (paak).

One participant interrupted

“Humara mazhab islam b humain pani na zayak kerney ki taqeed kerta hai. Kyon k pani zayak kerney se gunah milt ha”

Our religion, Islam, also teaches us not to waste water as it is a sin.

Similarly some of the participants presented their views in the same way by saying that:

“Humarey Rasool (SAWW) ne bhi humko munasib miqdar mein pani k istamal ki taqeed ki hai , chahey wo wuzu k likey hi kyun na ho ”

“Our Prophet (PBUH) also taught to be economical with water even for the purpose of ablution”

Also few discussed that high bills turned them out to be more conscious about the use of water (in case of electric pump).

Majority partakers conveyed that they had single toilet and almost all of them had pacca toilet. Although participants replied that they cleaned their toilets regularly but on further probing considerable number of the participants came up with toilet problems and
improper cleanliness was the major one because of much usage. A large number of respondents told that their toilets were not properly constructed and maintained so were in a bad state.

**A participant who had single toilet at home thrashed out a statement**

“Jub sab gher walon k istmal k livey eik he toilet ho, to uski sfai rakhna bohut mushkil hota hi. Din main kitni dafa safai ki jae, kyon k toilet tu sara din istmal hona hota hi”

*When there is a single toilet for the whole family, then it’s hard to keep it clean as toilet is used all the day.*

Almost all the participants agreed with the above statement and other reasons behind the poor condition of their toilets, added by them, were the outflow of pipelines and blockage of gutters in their toilet.

A good number of participants communicated that they had improper drainage system in their locality. Gutter blockage and outflow of gutters were the major reasons, told by them, few of them imparted that it doesn’t happen in routine as these are maintained routinely. Some of them groused regarding their drainage system;

“Humarey ilaqey ki hlut tu bohut abter hai, sahi nakas ka nizam na honey ki waja se gutter ubal rahey hotey hain. Khs taur per germiyon aur barishon k mausam mein tu pni kitneey kitney din tak khera rehta hai jis ki waj se macher paida hotey hain aur kitni beemariyaan phailatey hain”

*Our area is in very pathetic condition as there is outflow of gutters due to improper sanitation especially in summer and rainy season. There is stagnant water during this season, a reason for mosquitos’ production along with many diseases.*

**Another participant added**

“Yehi khera pani zameen mein jazab ho ker zameeni pani ko kherb ker deta hai”

*Hard water absorbs in earth and in result destroys the quality of underground water.*

Urban areas participants raised objection on mixing of sewage water into drinking water because of rust and seepage of old underground supply pipes. And the same old and rusty
distribution system was attributed to cross contamination of drinking water with sewerage water.

Almost all participants had the same opinion that people should make their mind against this issue to combat this alarming situation otherwise they will be responsible for ill health. Contrary to this, only few of them took steps regardingly.

One participant grumbled in the same context

“We did a complaint, in WASA office, against mixing of poor quality water in drinking water resulted in poor health of our children caused by diarrheal diseases, but all in vain. We are tired of visiting doctor’s clinic along with paying medical charges which everyone cannot afford.

One of the participants contributed over the same issue by saying that

“We use boiled water or sometimes use water from a different source, in case drinking water is mixed with poor quality water.

Government is not taking any steps to enhance the quality of drinking water, according to most of the participants.

“Every government promises a lot but no application and water quality issue is becoming serious day by day.”
Whereas one participant had a different viewpoint

“Merey khiyal mein hakumat ziada na sahi mager kuch na kuch tu zarur ker rahi hai, jese humarey ilaqey mein tu hakoomat ne water filter plants lagaey hain jo k acha pani hai aur bohut log peeney k liyey yahan se pani ley ker atey hain”

In my view, Government is fulfilling its responsibility to some extent, as water filter plants are implanted in our area, providing good quality water used by a lot of people here.

Nearly everyone washed hands with soap after using toilet. Because everyone was informed that hand washing is necessary to prevent diarrheal diseases (Pait ki beemariyaan), so, a huge number of the participants were those who used to wash hands every time after using toilet. While some of the participants from rural areas followed this practice now and then.

One member of the group shared that

“Humarey toilet mein sabun nhe rakha hota, jis ki waja se hum kbhi kbhi sabun ka istamal kerna bhool jatey hain, kyion k sabun sehun mein lagey nalkey k ps rakha hota hai”

We are not habitual of the washing hands after using toilet because soap is placed near hand pump outside the toilet.

Almost every member of the group was of the same mind that Pakistan is now facing serious water related issues. Media have played a thought provoking role in this regard because majority members were having approach to media i.e. TV or radio, at their home.

One member quoted

“Main ne Geo news per kisi shehr ki report dekhi thi k wahan logon ko peeney k liyey saaf pani nhe mil raha tha. Eik khatoon ne degchi meinm pni dikhaya jis mein bohut keerey they”

I saw a TV report in relation to a city about absence of clean drinking water to the people there and in same perspective a lady showed a pan filled with water containing insects.
Another most told reason by number of participants was frequent load shedding which showed that Pakistan is facing limited water resources now days.

A member shared her experience

“Bijli bund honey ki waja se subho se sham tak andherey main bethey rehtey hain, bache parh nhe patey hin ur karobaar bhi ruk gaey hain. Ye sab museebtain, bijli na honey ki waja se hain. Jub pani he nhe ha, to bijli kahan se aey gi”

Due to heavy load shedding, there is no business as well as study. The root of all these problems is absence of electricity which is not possible without water.

Mostly participants agreed that growing population and careless behavior are the important reason for water shortage because our resources are limited to meet the need of all the population. So increase in resources is much more important than controlling the population.

One participant quoted

“Tamam maseil ki waja he bherti hue abadi hai”

Increasing population is the reason behind all problems.

Another member added to her

“Family planning k centre to jaga jaga nazer atey hain mager abadi kum hoti nzer nhe ati”

Although there are so many centers for family planning but there is no improvement in control of population.

Majority agreed that unavailability of clean water is resulting in the increase in diseases especially stomach diseases (pait ki beemariyaan). So to resolve this issue, government should take steps. Participants came up with two types of opinions. Major number of the participants agreed that water shortage can be solved like construction of dams.

One member expressed

“Hakoomut ko chahiye k kum se kum chotey dams to bunaey jub tak barey dams per koi mushterqa raey qaem nhe ho jati. kyon k pani ki qilaat ka nateeja ye ho ga k aney waley
Qualitative Analysis

"waqt mein jangein teil ki bjaey pani per leri jaein gi. Jesa k india ne kitne chotey chotey dams buna liyey hain aur pakistan ne eik bhi dam nhe bunaiya"

Government should construct at least few smaller dams, rather waiting for consensus about big dams. Keeping in view the current condition of water availability, the upcoming wars will be fought against water rather oil. Contrary to this situation in our country, India has made many smaller dams.

A very few members differ from others that this shortage can not be solved. Because according to them, man can't do anything in this regard, only God can do it.

One of the participants had her own viewpoint

“Ye sab humarey amaal ka nateeja hai aur ye ALLAH ka qeher hai”.

Current circumstances are the result of our deeds plus punishment by GOD.

Majority participants were those who went through water deficiency at home because usually these respondents

Most told reasons were electricity problem, limited WASA/MS supply i.e., three times a day but mostly water is supplied just for two times per day. Those people facing falling of water table problem mostly had EP and HP at home so often they had to face the boring or falling of water table problems.
CONCLUSION

Focus Group Discussion is in-depth information from the participants in their own words. Concluded from the above discussion, it was clear that the two sources i.e. WASA/Municipal & GW, were being used by most of the participants for domestic purposes and besides this, other sources including water filter plants, tube wells etc. were also in use for drinking purpose as were considered safe. Most of the participants were dissatisfied with the drinking water taste as they have groused of brackish taste of ground water. To improve the drinking water quality, only few participants were using measures. On the whole, participants had main storage system at their homes keeping in view the necessity of main storage system at times of water shortages. Almost every participant had separate storage covered container for drinking and cooking purposes but without faucet which resulted in unhygienic handling. This unhygienic way of handling plays a role to increase the diarrheal illness. Nearly every member had single and pacca toilet at home but participants had to face improper cleanliness of the toilet as the whole family had to use same single toilet. Use of single toilet by majority of the family members at home can also be the factor contributing in diarrheal illness because cleanliness is difficult to maintain in such case. On the other hand, a noticeable figure of participants showed anger for the Government because of absence of proper drainage system at their locality and also objected the mixing of sewerage water into drinking water, a source of diarrheal illness among their children. Most of the interviewers were used to wash their hands at critical times (every time after using toilet) but some participants in rural areas did not take into account hand washing practice regularly as they did not place the soap inside their toilet which can also be one of the reasons of diarrheal illness.
WATER SAMPLE TEST RESULTS

In addition to the quantitative (Survey methods) and qualitative (Focus Group Discussions) methods, Water sample tests from the research area were conducted to increase the reliability and validity of information. Water samples were collected from three districts i.e., Rawalpindi, Multan, and Tobe tek singh. These were collected from the selected locations both from urban and rural areas. This study covered the following sources of drinking water.

Ground water (GW) [Hand pump, Boring]
WASA/Municipal,
Water filter plants, and
Tube wells.

The area wise distribution of water sources is as under:

**Rawalpindi**: Water filter plants, Tube well, hand pump, WASA/Municipical supply (total=8)

**Multan**: Water filter plants, hand pump, WASA/Municipal supply (total= 6)

**Tob tek singh**: Bore, hand pump, tube well, WASA/Municipal supply (total= 5)

The water quality parameter for which the samples were analyzed is mainly divided into the following four categories:

**Water Quality test (Chemical Analysis)**

Physical and aesthetic:
pH,
Electric conductivity (EC),
Turbidity,
Color, taste, odor.

Major Chemical Parameters:
alkalinity (Alk),
Bicarbonate (HCO₃),
Carbonate (CO₃),
Calcium (Ca),
Magnesium (Mg),
Hardness,
Sodium (Na),
Potassium (K),
Chloride (Cl),
Sulphate (SO₄),
Nitrate (NO₃),
Total Dissolved Solids
Trace and Ultra trace elements:
Fluoride (F),

**Water Quality Test (Microbiological Analysis)**
Total Coliforms
Fecal Coliforms
E. Coli

Water Samples Collection from tap water
For the collection of water samples, un-rusted taps were selected and the water was let to be flown out of these taps for a few minutes.

Water sample collection from tube well
The samples from tube wells representing ground water were collected after making their flow run for at least 10 minutes continuously.

Water sample collection from distribution network water
All the containers of water samples were filled at a slow pace to avoid the turbulence and any formation of air bubbles, after flushing and cleaning the system for a considerable time.

Microbiological samples
The water samples containing microbiological contamination were collected in clean, sterilized plastic bottles. While during the transportation of these samples, they were kept cool and in the dark.

**RESULTS**

**Rawalpindi**
As it is clear from the results, (See Appendix) out of 8 sources, none of the water sources was found safe for drinking purposes, either due to chemical or microbiological
contamination. Seeing that the water quality analysis revealed that all the samples were found chemically contaminated with calcium and one of them with nitrate. While only WASA is the source that was not chemically contaminated but it was found highly contaminated with microbiological contamination i.e., Total Coliforms, Fecal Coliforms, and EColi. The analysis revealed that all the samples were microbiologically contaminated but contrary to this only tube well was the source that was not found microbiologically contaminated. Similarly, keeping in view the PCRWR facts and figures regarding drinking water demonstrated that out of 15 only four sources were supplying safe drinking water including 3 sources having a slight problem of calcium. The results of the analysis depicted that 53% of the water samples were contaminated with Coliforms and 33% of the samples were found to be polluted with E. coli (Kahlown et al., 2008).

During the early 1990’s, an explosive disease borne by water known as hepatitis E virus (HEV) spread out in Islamabad and its suburban city Rawalpindi. In a study of the population of about 36,705 individuals, acute icteric hepatitis was recorded among 3,827 cases. The basic and main cause of this epidemic was the water supply for the plant deriving from a stream that was highly contaminated (Abdur Rab et al, 1997).

**Multan**

From Multan city 6 water samples were collected, keeping in view the water quality data (See Appendix), it was revealed that almost all the samples were chemically contaminated except WASA and one of the Water filter plant but WASA was found contaminated with Total Coliforms and Fecal Coliforms. Hand pump was the source having turbidity problem with higher concentration of calcium (Ca) and with microbiological contamination (Total Coliforms, Fecal Coliforms, and E.Coli). While water filter plants were found fit for human use. In the same context, WWF (2007) reported that bacteria and virus were found contaminating the drinking water in public water supply. Due to leakage of damaged pipes by ex-filtration and infiltration, the city areas were found greatly affected by the chronic diarrhea illness, hepatitis and other water-borne diseases spreading through private sources. According to the statistics of Multan Nishter Hospital, more than 295 cases of deaths were reported due to the water related diseases along with the registered 46166 cases of chronic diseases, 5921 cases in civil hospital, and 7689 cases in municipal dispensaries regarding this connection.
Likewise, according to the PCRWR, 16 sources from various locations were collected. Out of these 16 sources, none of them was supplying safe drinking water. In each case one or more parameter(s) were found beyond the drinking water guidelines or the PSQCA standards (Kahlown et al., 2008).

**Toba Tek Singh**

From the results (See Appendix), it was concluded that out of these 5 samples, all were found unfit for human consumption, either due to chemical or microbiological contamination. The analysis was revealed that all of the samples were found to be contaminated with potassium, sodium, sulphate and Total Dissolved Solids (TDS). Turbidity was observed beyond the permissible limits. Taste was found also objectionable.
CHAPTER-VI

SUMMARY, CONCLUSION & RECOMMENDATIONS

The links among water quality and health risks have already been well established. It is a bitter fact that inadequate quality and quantity of water are the main hosts of illness whereas poor sanitation facilities and unhygienic practices, additionally, play role to cause diarrhea, intestinal worms and hepatitis.

Another problem is the unawareness or carelessness with those who do have access to clean water. Their unsanitary handling and storage means for drinking is often unfit use. Unsafe water, lack sanitation facilities and unhygienic practices are responsible for diarrheal illness.

Today contaminated water kills more people than cancer, AIDS, Wars or accidents. It is vitally important that the water which humans drink be free of disease-causing germs and toxic chemicals that cause a danger to public health.

Keeping in view the above situation, this study was designed to identify the factors influencing drinking water quality, ultimately on health in Punjab, Pakistan. Thus, this study was designed to look into drinking water quality influencing factors and their health outcome. A sample of 600 married females (20-60 yrs) was interviewed seeing that in most cultures, women are responsible for the use and management of water resources, sanitation, hygiene, and health at the household level.

The objectives of the present study were:

- To know the socio-economic characteristics of the respondents.
- To look into the awareness level of the respondents regarding the current water situation and its quality.
- To investigate the relationship between drinking water quality influencing factors and their health outcome.
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- To suggest policy recommendations for policy makers to formulate the policies for the efficient handling of limited freshwater resources and its quality.

The respondents were selected by using multistage sampling technique from the urban rural areas of three districts; toba-tek Singh, Multan and Rawalpindi of Punjab province. Data was collected through well structured interviewing schedule. Over and above Personal interviews were also taken. To ensure the validity of the instrument pre-testing was done on 45 respondents. The information gathered were then processed and analyzed through the application of statistical techniques. The Uni-variate (frequency and percentage distribution), bi-Variate (Chi- Square test, Phi statistics), and multi-Variate analysis (BLR) were performed.

A theoretical framework of the study was developed mainly on Germ Theory which highlighted the social factors that affect the drinking water quality and ultimately on human health. Over and above, attitude is the factor that how some people lead healthier lives than others. So keeping in view this fact the theory of planned behavior was also developed along with the Germ theory.

Dr. John Snow, in the 1854, was convinced the disease was caused by germs found in the public drinking water. Just about everyone else blamed miasma. Snow gave the world dramatic evidence that contaminated drinking water caused the diarrheal illness. Before it was common to destroy germs in public drinking water using chlorine disinfectants, diarrheal illness routinely sickened and killed tens of thousands of people every year. The unsanitary conditions of cities, in which wastewater often mixed with drinking water, made these areas breeding grounds for diarrheal illness. John Snow high lighted the above mentioned social factors in his Germ theory which are the major cause of diarrheal illness. These social factors;

- Source of drinking water
- Un Sanitary conditions
- Mixing of waste water into drinking water
- Use of measures
- Un hygienic condition, gives birth to the germ which resulting diarrheal illness and these all five social factors are the major drinking water quality influencing factors.
People’s cognitions, their beliefs, opinions, motivations and so on, clearly have an impact on their behavior in general and their health behavior in particular. Theory of planned behavior makes an effort to explain how our beliefs and opinions can affect our health behavior. The theory of planned behavior (Ajzen, 1991) is an extension of an earlier model, the theory of reasoned action (Ajzen and Fishbein, 1980). This theory shows how the different factors interact. These factors are:

- Intention to behave determines actual behavior and is itself determined by
- attitude towards the behavior,
- subjective norm, and
- Perceived behavioral control.

These factors can influence each other as other people’s attitudes can influence the degree to which a person feels confident about behavior change. Similarly the degree of confidence a person feels about behavior change can affect his or her beliefs about the consequences of the behavior change. Furthermore, perceived behavioral control not only affects the intention to behave, But also can have a direct impact on whether the behavior is actually carried out.

The working Hypothesis of this study was;

1) Awareness regarding the water condition in Pakistan

Awareness level regarding the water quality is associated with health outcome.

2) No of domestic water sources

More number of water sources at home is associated with health outcome.

3) Nature of sources

Nature of drinking water source is associated with health outcome.

4) Physical parameters of drinking water

Taste and color of drinking water is associated with health outcome.

5) Drainage Facilities
Drainage facilities are associated with health outcome.

6) Sanitation Facilities
Sanitation facilities are associated with health outcome.

7) Hand washing
Hand washing after using toilet is associated with health outcome.

8) Use of measures
Health outcome and use of measures are associated.

9) Main storage system
Storage facility at home is associated health outcome.

10) Have separate drinking water container other than main storage system
Separate drinking water container other than main storage system is associated with health outcome.

11) Respondent’s Education
Education of the respondent is associated with health outcome.

12) Household Income
Household income is associated health outcome.

13) Family type
Family type is associated with health outcome.

In this study, all the factors have been pinpointed which affect the drinking water quality and ultimately these risk factors influence our health. It is hypothesized that people having better socio-economic conditions hold better opportunity to have more number of domestic water sources, adopt different measures to improve the drinking water quality, have improved storage and sanitation facilities, and are much conscious about their health. Education of the respondent and male head of the family, type of the family, type of house, age of the respondent and the household income are the socio-economic factors
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discussed in this study. Because socio-economic characteristics plays a key role in determining the drinking water quality.

The relationship of the explanatory and criterion variables was investigated through bi-variate and multi-variate analysis.

At the first stage of analysis, Uni-variate analysis was performed. Here the values of each explanatory variable were tabulated and classified into categories and their frequency and percentage distribution were calculated.

Amongst these variables, Source of domestic water is one of the factors (independent variable) to look into the effects on dependent variable i.e. health outcome. In the light of results, majority of respondents (63.5%) were using two sources for their domestic use and more than half of the respondents (57.5%) were using EP as a main source of their domestic water. While more than one-fourth of the respondents (35.0%) were using different sources of water for drinking and cooking purposes. These sources included water filter plants, water courses etc followed by 18.7% respondents using WASA/MS source for drinking and cooking purposes. While 18.2% respondents were using tube well.

Distribution of the respondents regarding the physical properties of drinking water & their health outcome depicted that 72.7% of the respondents were greatly satisfied with the color of their drinking water while according to 58.5% of the respondents, ground water is drinkable in their locality and 41.5% respondents told us that ground water was not of a good quality and was undrinkable

Distribution of the respondents according to the use of measures to improve the drinking water quality showed that more or less one-fourth of the respondents were using measures to improve the drinking water quality. Amongst those, 44.6% of the respondents were using boiling as a measure to improve the drinking water quality and 24.8% of the respondents were using both filtration and boiling measures to improve the drinking water quality.
It is clear from the results that one-third of the respondents had overhead plastic drums at their while 22.0% respondents had no main storage system at their homes. On asking about the periodical cleaning of water storage system, almost half of the households (51.3%) never cleaned their storage system. On the other hand, approximately a half (48.7%) of the households cleaned their storage system only once in a year. Majority of the respondents 277 of 468 i.e., 59.0% were facing fungus problems in their storage system at home while dust is second most problem faced by the respondents of 209 (468) i.e., 44.7%.

Regarding the hygienic conditions of their water storage system, majority of the respondents i.e. 56.3% were fully satisfied and sizable percentage (32.5%) of the respondents were somewhat satisfied. While only 11.2% of the respondents were not at all satisfied with the hygienic condition of their water storage system. Most of the respondents had iron pipe lines at their homes instead of plastic pipelines i.e., 77.7% and 22.3% respectively.

A vast majority (70.0%) of the respondents used a separate water container for drinking/cooking purposes. Afterwards, it was explored that a large proportion of the respondents i.e. 96.0% used to cover their drinking water container while only 4.0 % did not cover their containers.

Distribution of the respondents according to the fact whether they conscious or not regarding the use of water depicted that more than half of the respondents i.e., 52.3% were greatly conscious about the use of water. Besides, 35.0% of the respondents were somewhat conscious about the use of water and only 12.7% respondents were not at all conscious about the use of water. Majority of the respondents (53.7) fully taught their children about the proper use of water and not to waste it rather save it. However, 38.8% respondents didn’t teach their children fully but to some extent. There were several reasons behind the fact that why respondents taught their children about the practice of not wasting water rather saving it. Most told reasons were saving cost of high bills [367 (600) i.e. 61.2%] and second most told reason was the importance of saving water in Islam [348 (600) i.e. 58.0%].
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After knowing this, among the measures adopted, the most adopted measure was proper maintenance of distribution and storage system told by 81.2% households while 18.8% respondents adopted different measures to save water at their homes like half opening of tap and turn on the tap according to the need and then soon after turn off the tap etc.

Concerning the number of toilet at home, data showed that lesser number of respondents i.e. 15.2% had three or more than three toilets at home while most of the respondents had single toilet at home i.e. 53.8%. As far as structure of toilet at their homes was discussed, more than half of the respondents (63.2%) had pacca toilet at their homes and 36.8% respondents had semi pacca toilets at their homes.

Keeping in view the problems related to the toilets, it was discovered that 58.2% respondents had no issues with their toilets whereas amongst those, having problems related to the toilets, improper cleanliness was the major problem faced by the respondents (22.3%). According to 67.7% of the respondents, they had proper drainage system in their locality and one third of the respondents reported that they had improper drainage system in their locality.

Distribution of the respondents according to the mixing of sewerage water into the drinking water depicted that a large proportion (71.3%) of the respondents had reported that sewerage water was not mixing with drinking water and 28.7% groused that they faced the problem of mixing of sewerage water into their drinking water especially in rainy season. A vast majority of the respondents i.e., 75.7% reported that nothing was done by any NGO or Govt. to improve the quality of drinking water in their locality while 24.3% respondents told that Govt. had taken steps to improve the quality of drinking water in their locality like the installment of water filter plants.

On basis of the awareness level of the respondents about the need of hand wash with soap after using toilet, data depicted that most of the households (89.3%) were fully aware of the need to wash hands with soap after using toilet while few of them i.e., 10.7% respondents were somewhat aware of the fact that hands should be washed with soap after using toilet. Also It is discovered that a clear majority of the respondents i.e., 92.3%
washed their hands with soap after using toilet especially after defecation. Contrary to this, only 7.7% respondents did not wash their hands with soap after using toilet. It is revealed that 66.6% respondents reported that their family members used to wash their hands every time after using toilet and 20.8% respondents reported that their family members used to wash their hands sometimes after using toilet. While only 12.6% of households rarely used to wash their hands after using toilet.

Distribution of the respondent according to their opinion about the serious problem of water resources in Pakistan depicted that a clear majority of the respondents i.e., 86.1% were agree with the fact that Pakistan is now facing a serious issue of limited water resources especially drinking water resources. Conversely, only 13.8% were undecided whether Pakistan is facing or not a serious water shortage problem now-a-days. According to 34.8% respondents, growing population was the top most reason for this water shortage, while according to the 27.8% respondents, lack of proper planning is the top most reason for this water shortage which was followed by the careless behavior about the use of water, told by 19.7% respondents.

Distribution of the respondents according to the fact that water shortage is creating a problem illustrated that a vast majority of respondents i.e., 90% were agreeing with the fact that shortage of water is creating a serious problem for us. And only 10% respondents were unable to decide whether water shortage is creating problems or not. We also came to know that 60.8% and 52.5% respondents have reported that drought and electricity were the problems emerged due to the limited water resources, respectively. However, according to 41.3% respondents, maintenance of proper hygiene was one of the major problems as a result of water shortage. Most of the respondents i.e., 77.7% were fully agreed with the fact that this shortage of water problem can be solved and 16.5% were somewhat agreed that this problem can be solved. Whereas only 5.8% respondents were not agreeing that this shortage can be solved.

Distribution of the respondents according to their opinion about the steps taken by the govt, to resolve this shortage showed that a large proportion of the respondents, 91%, govt was not taking any steps for resolving the problem of water shortage which is
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increasing day by day and due to which Pakistan is now passing through her murky days. Contrary to this, only 5.8% and 3.2% respondents respectively, were somewhat or fully agreed with the fact that Govt. was taking some steps (e.g., installation of water filter plants and awareness generating campaigns about proper water usage through media).

More or less half of the respondents i.e. 49.7% respondents were agreed with the fact that it is the responsibility of both family and government. While 31.7% respondents were unable to decide whether an individual can contribute or not in this regard. On the other hand, 18.6% respondents had the view that only the government can resolve this serious problem because an individual can’t do anything in this regard.

Major number of the respondents, 60.3% faced water shortage at home and according to the 39.7% respondents, they didn’t face water shortage at home. Whereas, a sizable percent (37.6%) of the respondents, frequently experienced water shortage at home while some (36.2%) faced water shortage sometimes. However, 26.2% respondents told that usually they didn’t face water shortage but very rare.

As far as socio-economic characteristics of the respondents were concerned, more than a half of the respondents were living in a joint family system. A sizable majority (62.5%) of households belonged to medium income group i.e., from 11,000-20,000 Rs/month and a bit less than (42.2%) of the respondents were illiterate.

In cross tabulation, the relationship of dependent variable (health outcome) with each of the independent variables (drinking water influencing factors and socio-economic characteristics) was checked. The socio-economic characteristics included female education, family type, and household income. In addition to this, drinking water influencing factors included sources of domestic water, nature of drinking water (physical properties) taste and color of drinking water, use of measures to improve the drinking water quality, awareness regarding the use of bad quality water, main storage system at home, separate container for drinking, number and structure of toilet, mixing of sewerage water into drinking water, and problems facing due to water shortage at home. Chi-
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square and phi statistical tests showed that all independent variables and dependent variable i.e. health outcome (suffered and not suffered) were significantly correlated.

Bi-variate results drew an attention to; those households who were using one source of fresh water at their homes were more likely to suffer than those households who were using two or more than two sources at their homes. Statistical value also showed the significant relationship between the number of sources at home and health outcome. So it is obvious that the number of the water sources can play a key role in order to control the diarrheal illness because quantity can be an important factor that affects the health. While those households who were using different source other than their main domestic water source for drinking purposes, i.e., water filter plants, purchase water from vendors and commercial water (NESTLE) etc were less suffered.

Households went through ill-health, where respondents had low level of awareness regarding the effect of bad quality water on health. Chi square value (p= 0.000) reflected the significant association between the awareness level regarding the effect of bad quality water and health outcome. Phi value (p= 0.000) also confirmed this association. As far as the use of measures is concerned, it is observed that those households who were not using measures to improve the drinking water quality, suffering from diarrheal illness rather than those who were adopting measures to improve the drinking water quality. Main storage tank takes an important part in preventing diarrheal illness. Statistical results also showed a significant relationship between the main storage system and health outcome seeing that households having no main storage system at home were getting much suffered than those having main storage system at home. Out of those having storage system, plastic drum users were getting more diarrheal illness than those with overhead concrete and overhead fiber glass tanks. Whereas the respondents with separate storage container for drinking were getting less suffered as compared to those with no separate storage water container. Chi sq. (p=0.000) and Phi values (p=0.000) both showed significant relationship between separate storage container for drinking purposes and health outcome.

Household having three or more toilets were getting less suffered than those having two and single toilets at their homes. And almost a half of the respondents having single toilet at their home were getting suffered. Both Chi square [p=0.000 (24.453)] and Phi
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[p=0.000 (0.202)] showed that number of toilet at home and health are significantly correlated. And those having semi pacca toilet at their home, majority of them (62.4%) became suffered from diarrheal illness. This gives an idea that the sewerage and drainage can have a significant effect on diarrheal illness.

The hand washing practice after using toilet takes an important part in reducing diarrheal illness. It is noticed that those respondents who didn’t use to wash hands after using toilet were getting much suffered 56.5% (26 out of 46) than those who used to wash hands after toilet use, 39.7% (220 out of 554). Statistical values Chi-Sq= 4.962, P ≤ 0.020; Phi = -0.091, P ≤ 0.026 also showed that there is a remarkable effect of hand washing, after toilet use, on health outcome. Furthermore, households who were washing hands with soap every time after using toilet didn’t suffer than those who used to rarely wash their hands with soap after using toilet. It is observed that almost fifty percent households were suffering from diarrheal illness and similar trend was followed where mothers were educated up to primary level but it was reported that occurrence of diarrhea was lowest when the mother had followed secondary or higher level of education. However a primary education did not lead to a significant reduction in diarrheal illness. This depicted the impact of female education on family’s health and with the increase in education, health status become improved.

Statistical results [Chi sq (0.002) and Phi (0.003)] also showed significant relationship between family type and health outcome Because the Number of people is an important factor for an improved household’s health status seeing that more number of people can be a reason of poor hygiene. Families with high income have more chances to improve the drinking water quality for instance, water treatment & hygiene practices etc which had great impact on household’s health status. Through bi-variate analysis a strong and positive association between the socio-economic characteristics of the respondents i.e. respondents’ education, family type, and monthly income towards the health outcome (suffered or not suffered) was found Both Chi-Sq and Phi statistics showed the significant relationship between explanatory variable and criterion variables. To go over the main points of the findings at bi-variate level it was discovered that that the dependent variable (health outcome) and all independent variables (socio-economic characteristics and other drinking water influencing factors) were significantly correlated.
For multivariate analysis, logistic regression technique is applied to identify the factors influencing drinking water quality and their health outcomes. Health outcome was the dependent variable which was measured in terms of suffered or not suffered. The explanatory variables were: source of drinking water, type of family, separate water storage container, household income and respondent’s education.

The results showed that with the increase in number of families with separate water storage container, there is an increase in families getting suffered. Considering this fact, it can be said that the unhygienic way of handling the water is the root cause behind the ill-health of families, in spite of having separate water container. The number of family members was positively correlated with poor drinking water quality, as the large family in comparison with small family has low socio-economic status. It is obvious from the multivariate analysis that families with higher income were less likely to be suffered than those having low household income. Furthermore, it is quite evident that family health was dependent on mother’s education in view of the fact that the educated mothers try to save their families from illness.

Through FGD’s it was taken out that most of the participants were using two sources (WASA/MS and GW) for domestic water at home. In addition to this, there were other sources used by the participants including water filter plants, tube wells, water courses etc. for drinking purpose. Most of the participants were not satisfied with the taste of the water as they have groused of brackish taste. Very few of the participants were using measures to improve the drinking water quality. On the whole, participants had main storage system at their homes as according to them it is necessary because time to time they had to face water shortages, so the main storage system was used to store water for their usage. Almost every participant had separate storage covered container for drinking and cooking purposes but without faucet. The unhygienic way of handling plays a role to increase the diarrheal illness. Nearly every member had single and pacca toilet at their homes seeing that participants had to face improper cleanliness of their toilet as the whole family was using the same toilet. On the other hand, some of the participants were very annoyed with Govt. as they had no proper drainage system at their locality and made objection of mixing of sewerage water into drinking water. More than half of the
participants were used to wash their hands every time after using toilet but in rural areas some of the participants did not take into account hand washing practice regularly as they did not put the soap in their toilet. As far as the awareness level of the participants was concerned a clear majority of the participants were informed that now days Pakistan is facing a dire condition of water keeping in view their first hand experienced in this regard. According to them, as Pakistan is running out of water so Govt. must took steps regardingly for instance building small dams, proper management of water resources, forestation etc.

7.2. Conclusion

Safe drinking water is a human birthright, whereas, in Pakistan, poor quality drinking water is a major cause of water related illness. Unfortunately, in Pakistan, Water and Sanitation is the ignored sector and consequently a great majority of the households do not have access to safe drinking water and also lack sanitation facilities. These poor people are not only deprived of financial resources but they also lack access to basic needs such as education, health, and safe water supply and sanitation facilities.

The key objective of this study is to highlight the drinking water quality influencing factors and its implications for human wellbeing. So, at the stage of uni variate analysis, simple descriptive statistics (frequencies and percentages) were calculated. It is evident from the bi-variate findings that all the drinking water quality influencing factors, both socio-economic characteristics (family type, respondents education, household income etc) and other drinking water quality influencing factors (number of water sources, source of drinking water, taste and color of drinking water, use of measure, separate water storage container, hand washing, number of toilets) had highly significant and strong relationship with the health outcome.

However, the limitation of bi-variate findings was that only one independent and dependent variable was introduced in the analysis which can make the results spurious. Therefore, Multi-Variate analysis was carried out to see the comparative significance of each drinking water quality influencing factors in order to know the health status of household.
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The multivariate analysis showed that with the increase in number of families with separate water storage container, there is an increase in families getting suffered. Considering this fact, it can be said that the unhygienic way of handling the water is the root cause behind the ill-health of families, in spite of having separate water container. The number of family members was positively correlated with poor drinking water quality, as the large family in comparison with small family has low socio-economic status. It is obvious from the multivariate analysis that families with higher income were less likely to be suffered than those having low household income. Furthermore, it is quite evident that family health was dependent on mother’s education in view of the fact that the educated mothers try to save their families from illness.

Briefly, Multi-variate analysis identified the most important and contributing factors in explaining the health outcome were:

- The source of drinking water
- Type of family
- Separate water storage container
- Household income and
- Respondent’s education.

FGD results are more or less same as the quantitative results. But FGD is in-depth information from the participants, through which, we got some additional information. Like, an important point came out of discussion was the “boring depth” of the ground water. Also, we came to know that participants were using different sources of drinking water, like water courses etc. Participants also shared that they used conventional measures to improve drinking water quality, such as phitkari in water and Pitchers were also being in use as a separate water storage container.

Above findings will play an important role to the policy makers to formulate the policies for the efficient management of limited drinking water resources and its quality, in order to improve health status.

Recommendations

In the light of the above findings, following suggestions are made;
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- Govt. should work on emergent basis in the battle of drinking water shortage.

- Educational programs should be conducted for housewives to make them well aware of hygiene and sanitation practices which ultimately affect human health.

- Awareness should be created by govt and NGO’s through seminars and media among people about the safe drinking water sources.

- Thought provoking messages should be conveyed for housewives regarding the use of cheap measures to improve drinking water like use of chlorine tablets and boiling etc.

- Different programs should be highlighted about the importance of proper storage systems, its maintenance and cleanliness.

- Govt. should start income generating activities for housewives at domestic level to improve their financial status keeping in view this fact that families with high income have more chances to improve drinking water quality, for instance, by using measures and hygiene practices etc.

Limitations of the study

Due to time and resource constraints, the results of this study were presented collectively rather separately in both rural and urban areas. Generally, the results were interesting but the analysis gives the overall picture from both urban and rural areas. It might be more specific, if the analysis is taken out separately.
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Appendix A

* UUC = Urban Union Council, RUC = Rural Union Council, C = Colony, V = Village
Appendices

Appendix B

DRINKING WATER QUALITY AND ITS IMPLICATIONS FOR HUMAN HEALTH

INTERVIEWING SCHEDULE

SECTION- 1 (Source of Domestic Water)

V1 How many sources of fresh water do you have in your home?

1) One
2) Two
3) More than two (specify number) ________________

V2 What is your main source of domestic water?

1) WASA/Municipal supply
2) Canal bank pump
3) Electric pump
4) Hand pump
5) Tube well
6) Well
7) Commercial water
8) Others (specify)

V3 What is the main source of drinking / cooking water?

1) Wasa/Municipal supply
2) Canal bank pump
3) Electric pump
4) Hand pump
5) Tube well
6) Well
7) Commercial water
8) Others (specify) ________________

V4 Are you satisfied with the taste of drinking water supplied from your source?

1) Greatly Satisfied
2) Somewhat Satisfied
3) Not much Satisfied
4) Not at all

V5 Are you satisfied with the color of drinking water supplied from your source?

1) Greatly satisfied
2) Somewhat satisfied
3) Not much satisfied
4) Not at all

V6a Is ground water able to drink in your locality?

1) Yes
2) No

V6b If no, what are the reasons?

1) Domestic sewage
2) Industrial waste
3) Agricultural pollutants
4) Others

V7 Are you aware of the fact that water table is decreasing day by day?

1) Fully aware
2) Somewhat aware
3) Not much aware
4) Not at all

SECTION- 2 (Use of Measures)

V8a Do you adopt any measures to improve the quality of drinking water?

1) Yes
2) No

V8b If yes, what are these measures?

1) Filtration
2) Boiling
3) Chlorination
4) Others ___________________

SECTION- 3 (Health Outcome)

V9 Are you aware of the fact that bad quality water can damage your health?

1) Fully aware
2) Somewhat aware
3) Not much aware
4) Not at all aware
V10a  Is any of your family members has suffered because of water?

1)  Suffered  
2)  Not suffered

V10b  If Suffered, then do you or your family member face any of the following problems due to water intake?

1)  Pain/Cramps in stomach/abdomen 
2)  Loose motions/watery motions  
3)  Vomiting 
4)  Gas trouble 
5)  Blood in stool 
6)  Constipation 
7)  Others

V10c  From where do you get treatment?

1)  Govt. hospital 
2)  Private clinic 
3)  Health worker 
4)  Hakeem 
5)  At home

V11a  Do these health problems affect your social relations?

1)  Yes 
2)  No

V11b  If yes, then state reasons:

1)  Falling of hairs/white hairs 
2)  People not interested to get marry there  
3)  Stomach problems 
4)  Skin problems 
5)  Others _____________

SECTION-4 (Storage and Consumption)

V12a  What is the system of water storage at your home?

1)  Overhead concrete water tank 
2)  Overhead fiber glass water tank 
3)  Overhead drums
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4) Others (specify) _______________________

V12b At what time do you perform periodical cleaning of your water storage system?

1) Two to three times a month
2) Once a month
3) Once in three months
4) Once in a six months
5) Once a year
6) Never

V12c Do you think that storage system at your home has any of the following?

1) Fungus
2) Rust
3) Dust
4) Leakage
5) Others (specify), __________________________

V12d Are you satisfied with the hygienic conditions of your water storage system?

1) Greatly satisfied
2) Somewhat satisfied
3) Not much satisfied
4) Not at all

V13 What type of pipelines you have, from where you get water in storage systems?

1) Iron pipes
2) Plastic pipes
3) Others (specify), __________________________

V14a Do you have separate water storage container for drinking/cooking purposes?

1) Yes
2) No

V14b If yes, is this water storage container covered?

1) Yes
2) No

V15 Are you or other family members are personally conscious about the use of water at home?
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1) Conscious greatly
2) Somewhat conscious
3) Not much conscious
4) Not at all

V16 Do you teach your children / other family members about saving water?

1) Fully taught
2) To some extent
3) Not so much
4) Not at all

V17 What is your main motive behind saving water?

1) Saving cost of high bills
2) Saving water resources for others or for future
3) From islam point of view
4) DK

V18 What measures do you / other members adopt to save water?

1) Half opening of tap
2) Proper maintenance of the system (leakage repair etc.)
3) Others _________________________
4) DK

SECTION - 5 (Sanitation and Drainage)

V19 How many toilets do you have?

1) One
2) Two
3) Three and more

V20 What is the structure of toilet at your home?

1) Kacha
2) Pacca
3) Semi pacca

V21 Do you have any of the following problem with your toilet?

1) Improper cleanliness
2) Leakage of pipelines
3) Others
4) Nothing
Appendices

V22 Is there proper drainage system in your locality?

1) Yes
2) No
3) DK

V23 Do you think that sewerage water is mixing with drinking water in your locality?

1) Yes
2) No
3) DK

V24 Is any NGO/Government working to improve the quality of drinking water in your locality?

1) Yes
2) No
3) DK

SECTION- 6 (Personal Hygiene)

V25 Are you aware of the fact that washing hands with soap after using toilet (defecation) is necessary for health?

1) Fully aware
2) Somewhat aware
3) Not much aware
4) Not at all

V26a Do you and your family members wash hands with soap after using toilet(defecation)?

1) Yes
2) No

V26b If yes, then how many times wash your hands with soap?

1) Every time after using toilet(defecation)
2) Sometimes
3) rarely

SECTION- 7 (Awareness regarding Water Situation)

V27 Do you agree with the fact that Pakistan is particularly having serious problems of drinking water resources?
1) Strongly agree
2) Agree
3) Undecided
4) Disagree
5) Strongly disagree

V28 In your opinion, what is the top most reason of this water shortage?

<table>
<thead>
<tr>
<th>Reasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase in population</td>
</tr>
<tr>
<td>Carelessness of the users</td>
</tr>
<tr>
<td>Lack of planning</td>
</tr>
<tr>
<td>Mismanagement of various agencies</td>
</tr>
<tr>
<td>Others</td>
</tr>
</tbody>
</table>

V29 Do you agree with the fact that this water shortage is creating a serious problem for us now?

1) Strongly Agree
2) Agree
3) Undecided
4) Disagree
5) Strongly Disagree

V30 If yes, then what are those problems?

1) Drought
2) Electricity problems
3) Hygiene/health problems
4) Wars over water
5) Others ______________

V31 Do you agree that this water shortage problem can be solved?

1) Strongly Agree
2) Agree
3) Undecided
4) Disagree
5) Strongly Disagree

V32 Do you think that government is taking any step to resolve this problem of water shortage?

1) Strongly Agree
2) Agree
3) Undecided
4) Disagree
5) Strongly Disagree

V33 Do you agree with the fact that an individual or a family can contribute greatly in meeting with the problem of water shortage?

1) Strongly agree
2) Agree
3) Undecided
4) Disagree
5) Strongly disagree

V34a Have you ever experienced any serious shortage of water at your home?

1) Yes
2) No

V34b If yes, how often you experienced this shortage?

1) Frequently
2) Sometimes
3) Rarely

V34c What are the reasons of this water shortage?

1) Electricity failure
2) Problems in water supply systems/mismanagement
3) Lesser rains
4) Falling of water table
5) Others ________________________

SECTION- 8 (Socio-Economic Characteristics)

V35 Age of the respondent (in yrs) _____________________

V36 Marital status

1) Married
2) Separated
3) Divorced
4) Single

V37 Relationship with the male head of the household

1) Self
2) Wife
3) Daughter
4) Daughter-in-law
5) Grand daughter
6) Son
7) Others _______________

V38 Type of family

1) Nuclear
2) Joint
3) Extended

V39 Total males ______

V40 Total females ______

V41 Children ___________

V42 Structure of house

1) Kacha
2) Pacca
3) Semi-pacca

V43 Is the house owned by a member of the family or rented?

1) Owned
2) Rented
3) Others ______________

V44 How many years of schooling do you have?

1) Illiterate
2) Primary
3) Middle
4) Matric
5) Intermediate
6) Graduate
7) Masters and above

V45 How many years of schooling male head has?

1) Illiterate
2) Primary
3) Middle
4) Matric
Appendices

5) Intermediate
6) Graduate
7) Masters and above

V46 Occupation of the respondent?

1) Housewife
2) Govt employer
3) Self employed
4) Others (specify)

V47 Occupation of male head?

1) Businessman
2) Govt employer
3) Unemployed
4) Others (specify)

V48 How many members of the house are earning? Enter no.

__________________________

V49 How much is the total monthly income of the household

1) Less than Rs.5000
2) Rs.6000 to 10,000
3) Rs.11000 to 15,000
4) Rs.16000 to 20,000
5) Rs.21000 to 25,000
6) Rs.26,000 and above
Appendices

Appendix C

Qualitative Un Structured Interviewing Schedule

Domestic Water sources

- Number of sources including all domestic water sources
- Nature of sources used for drinking purposes
- Physical properties of drinking water (taste, color, and odor)

Storage Facilities

- Main storage system at home
- Periodically cleanliness of the storage system
- Separate storage container for drinking/cooking purposes
- Whether the storage container covered or not
- Way of handling of drinking water

Sanitation Facilities

- Number of toilets at home
- Structure of toilet
- Cleanliness of toilet
- Problems related to the toilet

Drainage Facilities

- Mixing of sewerage water into drinking water
- Whether the Govt. is taking any steps or not to improve the drinking water quality

Hygiene Practice

- Hand washing practice
- Washing hands with soap or not
- Timings of hand washing with soap
- Use of measures to improve the drinking water quality