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A Study of Storage System for Drinking Water and its Health Impacts at Household Level in Punjab, Pakistan

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Abstract: Enough water is a guarantee to healthy life. Increasing the water availability at household level and storage facility are the most important determinants to reduce water related illness. This Study was designed to look at the water storage system at home and its health implications. Multistage sampling technique was used to select the study area while households were selected by using systematic sampling technique. A representative sample of 600 females of age 20-60 years was interviewed through a well structured interviewing schedule. It was concluded from Univariate analysis that 36.0% households had overhead concrete storage water system while 22.0% did not have storage water system at home. Furthermore, study findings revealed that 70.0% households had separate drinking water container and more than half (62.5%) of the households belonged to medium income group. One step forward, Bi variate analysis showed a highly significant and positive relationship between dependent variable (health outcome) and independent variables (main water storage system, separate water storage container and household income). Over and above, FGDs showed that in urban areas, majority of the households used cans as separate container for drinking water but these cans were without faucet and they used utensils to utilize water from the container. While in rural areas majority of the households were using pitchers as a separate container for drinking water. Based on the results of present study, it was suggested that proper education should be provided regarding the nature, type and the cleanliness of the storage containers at household level.

Key words: Drinking water, storage water container, health outcome

INTRODUCTION

Supplies of uncontaminated water are critical to health, but water quantity is even more important than quality for maintaining children's health (WHO/UNICEF, 2000). Enough water is guarantee to healthy life (Ensink *et al*., 2002). Different studies reviewed that the impact of water quality and quantity on the transmission of water-related illness and on improved health in general (Lewin *et al*., 1997). The association between water quality and diarrhea varied by the level of water availability so water quantity has a more important impact on improved health than water quality (Van der Hoek *et al*., 2001). Quality may vary between point of source and point of use. Increasing the availability of water in the house by having a household connection and a storage facility is the most important intervention to reduce diarrhea in Pakistan. Those families, using larger quantities of water and having main storage system at home, received greater benefits because of increased water availability (Lewin *et al*., 1997; Van der Hoek *et al*., 2001; Jensen *et al*., 2004; Esrey *et al*., 1991; Ensink *et al*., 2002). Keeping in view the water quality study, progressive contamination of water was observed during distribution and storage, accompanied with maximum coli form counts inside the storage containers at household level. Researchers in Peru stated that patients most probably belonged to households, where stored drinking water was dipped out by using hands or any utensil, than healthy control subjects. In another study, the drinking water into which hands were introduced was strongly linked with illness. Hands introduced into water storage containers during washing or scooping of water may have been the means by which stored water (Rice and Johnson, 1991; Swerdlow *et al*., 1992; Ries *et al*., 1992). In the light of the above discussion the present study was designed to explore the (1) the economic characteristics of the respondents; (2) the fact that water storage system affects the health of the respondents at household level and in the end of the present study it was suggested that proper education should be provided regarding the nature, type and the cleanliness of the storage containers at household level.

MATERIALS AND METHODS

Tri-angulations (cross sectional survey method and focus group discussion) technique was applied to collect data. Quantitative (survey methods) and

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Table 1: Distribution of the respondents according to the main storage system at home and health outcome

Parameter	Indicators	Frequency	Percentage
Main storage system at home	No	132	22.0
	Overhead Concrete	216	36.0
	Overhead fiber glass	54	9.0
	Overhead drums	198	33.0
	Total	600	100.0
Separate water storage container for drinking	Yes	420	70.0
	No	180	30.0
	Total	600	100.0
Cover their storage container or not	Yes	403	96.0
	No	17	4.0
	Total	420*	100.0
	*Missing N.A = 180		
Health outcome	Suffered	246	41.0
	Not suffered	354	59.0
	Total	600	100.0

qualitative (i.e. focus group discussions) data collection are, both widely used in social science research. The complementary nature of these methods combined with the use of the triangulation approach in the present study is intended to increase data reliability and validity (Smith, 1981; Suyono *et al*., 1981; Stycos, 1981; Manzoor, 1991). Multistage sampling technique (Asghar *et al*., 2010a; Kausar *et al*., 2011) was used to select the study area. At the first stage, three districts, Toba Tek Singh, Rawalpindi and Multan were selected through purposive sampling technique keeping in view the current water condition in these districts (PCRWR, 2011). At the second stage, one tehsil was selected from each district by simple random selection. At the third stage, two urban and two rural union councils were selected randomly. At the fourth stage, rural and urban localities were selected randomly for the selection of household. Households were selected by using systematic sampling technique. A representative sample of 600 females of age 20-60 years was interviewed as discussed by Fitz-Gibbon and Morris (1987). A well designed interviewing schedule was constructed keeping in view the research objectives and the conceptual framework of the study to collect data and draw inferences. For Focus Group Discussions (FGD) (Asghar *et al*., 2010b, PAP) unstructured interview schedule was designed to collect detailed information.

RESULTS AND DISCUSSION

In this section an attempt has been made to discuss, analyze and interpret relevant data for driving conclusions and formulating appropriate suggestions in the light of the study results.

Table 1 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 now a days trend is changing with time which can also be depicted from the results. It is emerged from the data presented in Table 1 that a vast majority of the respondents (70.0%) used a separate water container for drinking purposes. While a sizable percentage of the respondents i.e., 30% were not using separate drinking water container.

Table 2: Distribution of the respondents according to the household income

Household income (Rs. in thousands)	Frequency	Percentage
Low income group		
<5000	82	13.7
6-10	100	16.7
Medium income group		
11-15	166	27.7
16-20	209	34.8
High income group		
21-25	40	6.7
>26000	3	0.5
Total	600	100.0

It is also clear from the information given in Table 1 that a large proportion of the respondents i.e. 96.0% were habitual to cover their drinking water containers while only 4.0% did not cover their containers.

Household income also plays very important role for a healthy life. Above Table 2 indicates that 30.4% households belonged to low income group while 62.5% households came from the medium income group. And only 7.2% households fell into high income group.

Table 3 shows a relationship between dependent i.e. health outcome and the independent variable i.e. main storage system. Statistical results showed a highly significant and positive relationship (Chi-Square significant value $\leq$0.0001; Phi significant value $\leq$0.0001) between two variables i.e. main water storage system and health outcome. It can be shown from the information that more than fifty percent (59.8%) of those households having no storage system 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 i.e. 52.0% than those with overhead concrete (27.3%) and overhead fiber glass tanks (9.3%). Different studies also supported the

Table 3: Relationship between the main water storage system at home and health outcome

Health outcome	No	Overhead concrete	Overhead fiber glass	Overhead plastic drums	Total
Suffered	79.00	59.00	5.00	103.00	246.00
	59.80%	27.30%	9.30%	52.00%	41.00%
Not suffered	53.00	157.00	49.00	95.00	354.00
	40.00%	72.70%	90.70%	48.00%	59.00%
Total	132.00	216.00	54.00	198.00	600.00
	100.00%	100.00%	100.00%	100.00%	100.00%

Statistics Chi-Sq = 68.540, p≤0.0001; Phi = 0.338, p≤0.0001

Table 4: Relationship between the separate drinking water container and health outcome

Health outcome	Yes	No	Total
Suffered	112.0	134.0	246.0
	26.7%	74.4%	41.0%
Not suffered	308.0	46.0	354.0
	73.3%	25.6%	59.0%
Total	420.0	180.0	600.0
	100.0%	100.0%	100.0%

Statistics Chi-Sq = 118.901, p≤0.0001; Phi = -0.445, p≤0.0001

Table 5: Relationship between the household income (Rs. in thousands) and health outcome

	Low income group		Medium income group		High income group		
Health outcome	<5000	6000-10,000	11000-15000	16000-20000	21000-25000	>26000	Total
Suffered	60.0	82.0	52.0	45.0	7.0	0.0	246.0
	73.2%	82.0%	31.3%	21.5%	17.5%	0.0%	41.0%
Not suffered	22.0	18.0	114.0	164.0	33.0	3.0	354.0
	26.8%	18.0%	68.7%	78.5%	82.5%	100.0%	59.0%
Total	82.0	100.0	166.0	209.0	40.0	3.0	600.0
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Statistics Chi-Sq = 154.963, p≤0.0001; Phi = 0.508, p≤0.0001

results of the present study. According to Ensink *et al.* (2002); Van der Hoek *et al.* (2001); Jensen *et al.* (2004) main storage tank was the guarantee to healthy life and absence of water storage facility was one of the factor for diarrheal illness.

Table 4 reflects that Chi sq. (p = 0.000) and Phi values (p = 0.000) both showed a highly significant association between two variables i.e. predicting variable separate storage container for drinking water and criterion variable health outcome. It can be observed from the information presented in Table 4 that those respondents who were using separate drinking water container were getting less suffered i.e., 26.7% than those who weren't i.e. 74.4%. Results of the present study were also inline with the results presented by Swerdlow *et al.* (1992); Ries *et al.* (1992); Rice and Johnson (1991). According to them those households who stored water in a separate container with a faucet can reduce the number of diseases. Furthermore, they presented that hands introduced into water storage container during scooping water may have been a mean of contamination during dipping utensil.

Table 5 shows both Chi-Sq and Phi statistics showed the significant relationship between two variables i.e. explanatory variable household income and criterion variable health outcome. It can be observed from the information presented in Table 5 that 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%)]. It is depicted from the data that as the level of income increased, the cases of suffered households were decreased and vice versa. Pritchett and Summers (1996) also supported the results presented in this study. According to them low income caused ill-health. As Families with high income have more chances to improve the drinking water quality for instance, water treatment and hygiene practices etc which had great impact on household's health status.

FWR (2000) also mentioned a factor of Poor health which was lack of toilet and the reason given for not having a toilet was that the household did not have the money to build one. Furthermore, World Bank (1999) also illustrated that poverty and ill-health were intertwined. Poor people had worse health outcomes than better-off people.

Findings from the focus group discussions: Most of the participants were having main storage system at home. In urban areas almost all participants had main storage system. While in rural areas only few of them reported that they were having main storage system at home

because they were having hand pumps and more than one sources of water, they didn't feel need of water storage system at home. Amongst those who had storage system at home majority of them had plastic drums as main storage system. The main reason to use plastic drums was of its easy handling, no maintenance problem and economical too.

Almost every participant did not clean their storage system regularly because majority was not really concerned about the hygienic condition of storage system. Even half of the participants were informed 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;

"As we know the fact that clealiness of storage system is essential to prevent water related illness but due to our careless behaviour we didn't practice it".

One reason for having separate storage system was that they had separate drinking water source other than domestic use. Some participants reported that adopted the separate storage as a measure to have a good drinking water quality. In urban areas, majority of the participants used cans as separate container for drinking water but these cans were without faucet and used to dip utensil in the container. One participant stated; I used to attach a glass with container, using a rope, so that children don't misplace it while using.

While in rural areas majority of the participants were using pitchers as separate container to store water for good quality drinking water.

Conclusion: Based on the present findings, it can be concluded that main water storage system at home and separate water storage container are the key determinants in reducing water related illness as the results depicted that all the independent variables (main water storage system at home, separate drinking water storage container and household income) are correlated to dependent variable (health outcome). Over and above, it is further probed during Focus Group Discussions that households had separate drinking water storage container but without faucet rather than using water by dipping utensil into the container. Furthermore, it is mentioned that majority households had their drinking water container covered. Hence, it is suggested that proper education should be provided regarding the nature, type and the cleanliness of the storage containers at household level. Moreover, it is recommended that awareness about the proper usage of drinking water container should be provided.

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