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Research Article

**AN INCIDENCE OF HYPERTENSION AMONG PEOPLE AND  
ITS ASSOCIATION TO CONSUMPTION OF HARD WATER: A  
CROSS-SECTIONAL RESEARCH**<sup>1</sup>Dr. Hassan Jamil, <sup>1</sup>Dr. Muhammad Bilal, <sup>2</sup>Dr. Muhammad Rizwan Khan, <sup>3</sup>Dr. Ali Arshad<sup>1</sup>Services Hospital, Lahore<sup>2</sup>MO, BHU Thamywali, Mianwali<sup>3</sup>Medical Officer, RHC Basirpur, Okara**Abstract:**

**Objective:** Research was aimed to compare hypertension incidence in the communities consuming hard water in terms of its hardness at Hingorno, Sindh, Pakistan.

**Methods:** A cross-sectional research study was held in June, 2016. Area had two sources of water including water supply and rain which included fresh and hard water. Our research sample was 340 and comprised of above eighteen years age group with more than five years stay in the area. All the participants with diabetes, kidney disease, taking oral supplements and anti-hypertensive drugs were not included in the research. BMI, demographic features and BP (blood pressure) were also documented. Hardness in the sample of water was measured and above 180 ppm was considered as very hard water. Comparison of hypertension was made in the people using fresh or hard water with a significant p-value ( $< 0.05$ ).

**Result:** In the total research population 80 participants were found (23.5%) hypertensive; 38 hard water consumers (20%) and 42 fresh water consumers (28%). This variation was significant statistically, very high hardness was observed in the water sample testing and it was suggested that this water is not suitable for human health.

**Conclusion:** It is concluded that people are commonly observed hypertension which is not present in the fresh water cases and higher incidence of hardness was observed in the underground water resources of Hingorno.

**Keywords:** Fresh Water, Pre-hypertension, Hypertension and Underground Water.

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**INTRODUCTION:**

Life depends upon the consumption and availability of water. Human health depends on the pure and safe water resources. Estimates tell that 17% population of world used non-protected and remote water resource, lack of safe water was observed in 884 million [1]. Hard water was the only available source to many of them. A large amount of magnesium salts and calcium is present in the water which is categorized as hard water, hardness can also be attributed to the concentration of other metals such as divalent/multivalent cations forms like aluminum, strontium, barium, iron, manganese and zinc. Other underground impurities may also cause disease etiological factors like gastrointestinal issues, neural diseases, reproductive failure and renal dysfunction [2]. However, few of the minerals including magnesium salts and calcium with high levels also possess protective effect for ischemic heart disease and hypertension [3]. It is also considered that magnesium salts and calcium in the high levels cause lowering of vascular tone and they are protective against hypertension. Many research studies have shown that hardness of the water also has protective aspects on CVD and hypertension. Whereas, few studies failed to establish such relation [4, 5]. The differences can be attributed to the varying concentration of minerals and metals. Blood pressure relation with hard water has not been studied in Pakistan. Local area research studies are valuable as environment plays vital role in this regard. Research was aimed to compare hypertension incidence in the communities consuming hard water in terms of its hardness at Hingorno, Sindh, Pakistan.

**SUBJECTS AND METHOD:**

We held a cross-sectional descriptive research study at Hingorno, the population of the area was estimated as 2500 people including 1500 adults. The economic condition of the low and they belonged to labor class with poor literacy rate and reduced level of awareness about the healthcare facilities accessibility. The people of this area were using both fresh and hard water. We selected 340 participants (22% of the total population) based on National Health Survey guidelines [6] through non-probability purposive method. Sample comprised of above eighteen years age group with more than five years stay in the area. All the participants with diabetes, kidney disease, taking oral supplements and anti-hypertensive drugs were not included in the research. Research was carried out after informed consent by the participants with confidentiality was maintained. Information about gender, demography, hypertension risk factors, hypertension history and smoking were collected. Type of water being used was asked whether fresh or

hard and measured the amount of consumption as an intake of glass/ day and salt diet. BMI and BP were also documented. At an interval of five minutes reading were taken twice and final value was considered as mean value. Normal BP was ( $< 120/80$  mmhg), systolic and diastolic respectively  $120 - 139$  and  $80 - 89$  mmhg (pre-hypertension) and ( $> 140/90$  mmHg as in the range of hypertension). Stage-I was considered as Systolic BP ( $140 - 159$  mmHg) and diastolic BP ( $90 - 99$  mmHg), Stage-II was considered as ( $> 160/100$  mmHg hypertension) [10]. Both soft and hard water samples were checked for their characteristics. Heavy water was considered having a reading of above 180 ppm and it was not safe for the human routine consumption. Data entry and analysis was made through SPSS-17. Mean value was used for the presentation of quantitative variables such as age, daily intake of water and BMI. Qualitative variables such as gender, family history of hypertension and smoking were protective for ischemic heart disease and hypertension. Quantitative data was compared through student T-test and for qualitative data we used Chi-Square Test having significant p-value as ( $< 0.05$ ).

**RESULTS:**

Research included male and females respectively 216 males (64%) and 124 females (36%) with a mean age ( $42.63 \pm 12.2$ ). It was observed that 190 participants (56%) used hard whereas 150 participants (44%) used fresh water. Smokers were 60 (31.5%) using hard water and fresh water consumers has 62 smokers (41.3%) with significant p-value (0.16). Hard water group mean BMI was observed as (29.9) and fresh water group has (27.52) with a significant p-value of (0.23). Fresh water was consumed on an average as (1400 ml/day) and hard water consumption was (900 ml/day) with significant p-value (0.01). No difference was observed in the salt used during meals as p-value (0.457) reflected in Table-I. In terms of an average BP reading; 80 hypertension cases (23.5%) were documented. Hard water consumers 38 hypertension cases (20%), among them 12% were pre-hypertension, 6% with stage-I and 2% with stage-II hypertension. Fresh water consumers were 42 hypertensives (28%), including 17% as pre-hypertension, 7% of stage-I and 4% of stage-II hypertension. Soft water consumers were slightly more hypertensive (p-value = 0.23) as reflected in Table-II. Every three among four reservoirs were found in the range of hard water categorized unsuitable for human use. Unsafe water was being used by half of the research population including 168 people (49%).  $120 - 180$  ppm level was safe and above this level was categorized as hard

water including one hand-pump being used by the 172 people (51%) as reflected in Table-III.

### DISCUSSION:

Life needs healthy and safe drinking water. Worldwide the safe water is available to 51% population [11]. A large amount of magnesium salts and calcium is present in the water which is categorized as hard water, hardness can also be attributed to the concentration of other metals such as divalent/multivalent cations forms like aluminum, strontium, barium, iron, manganese and zinc. Harness enters in to water when water percolate by the underground minerals. Common sources of hardness include limestone, calcium, dolomite and magnesium [12]. However, few of the minerals including magnesium salts and calcium with high levels also possess protective effect for ischemic heart disease and hypertension. It is also considered that

magnesium salts and calcium in the high levels cause lowering of vascular tone and they are protective against hypertension. Many research studies have shown that hardness of the water also has protective aspects on CVD and hypertension [3 – 6]. Whereas, few studies failed to establish such relation [13]. Variable results are because of varying concentration of minerals according to the geographical variations. We observed in our research that fresh water was consumed by 28% population and hard water was being consumed by the 20% population without any significant statistical difference. National and international research literature about this topic less available and sometimes scarce. According to Kawano research as he conducted research on 67 people and his outcomes state significant and small protective effects of hard water [14]. CVD favorable affects have been observed by numerous other research studies held in Iran and Sweden.

**Table-I.** General characteristics of individuals using fresh and hard Water

Detail	Hard Water Users		Fresh Water Users		P-Value
	Number	Percentage	Number	Percentage	
<b>Male</b>	114	60	102	68	0.126
<b>Female</b>	76	40	48	32	0.023
<b>Smokers</b>	60	31.5	62	41.3	0.167
<b>Family having hypertension</b>	27	14.2	35	23	0.347
<b>Body Mass Index (BMI)</b>	29.9	-	27.52	-	0.235

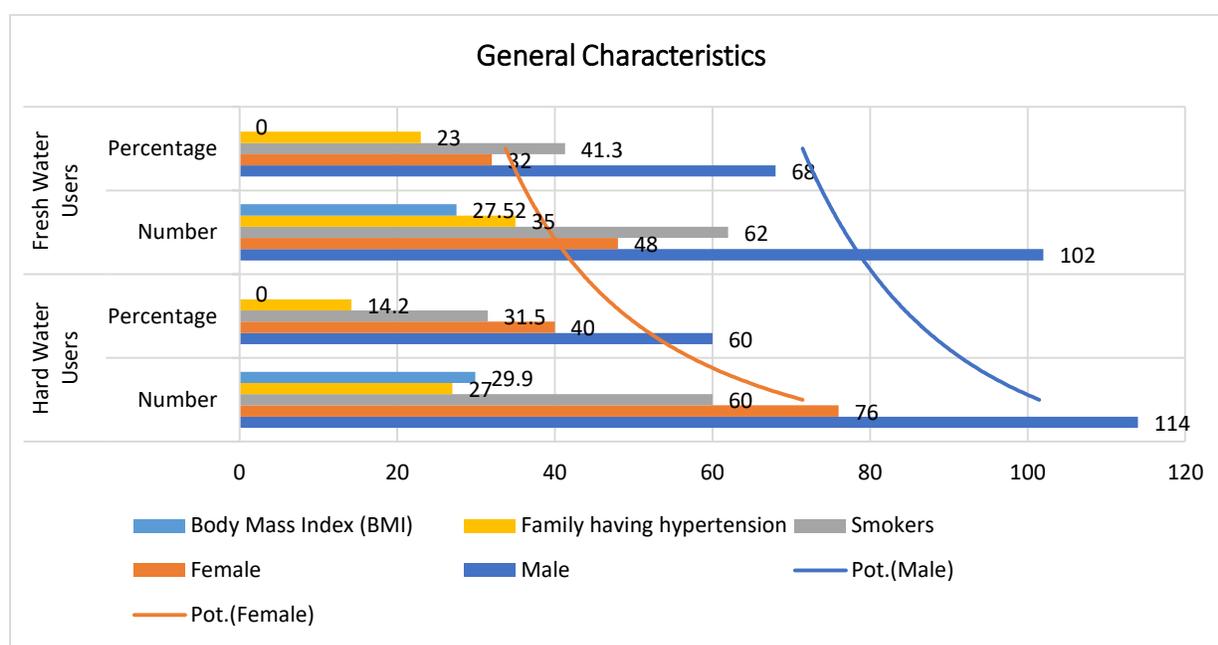
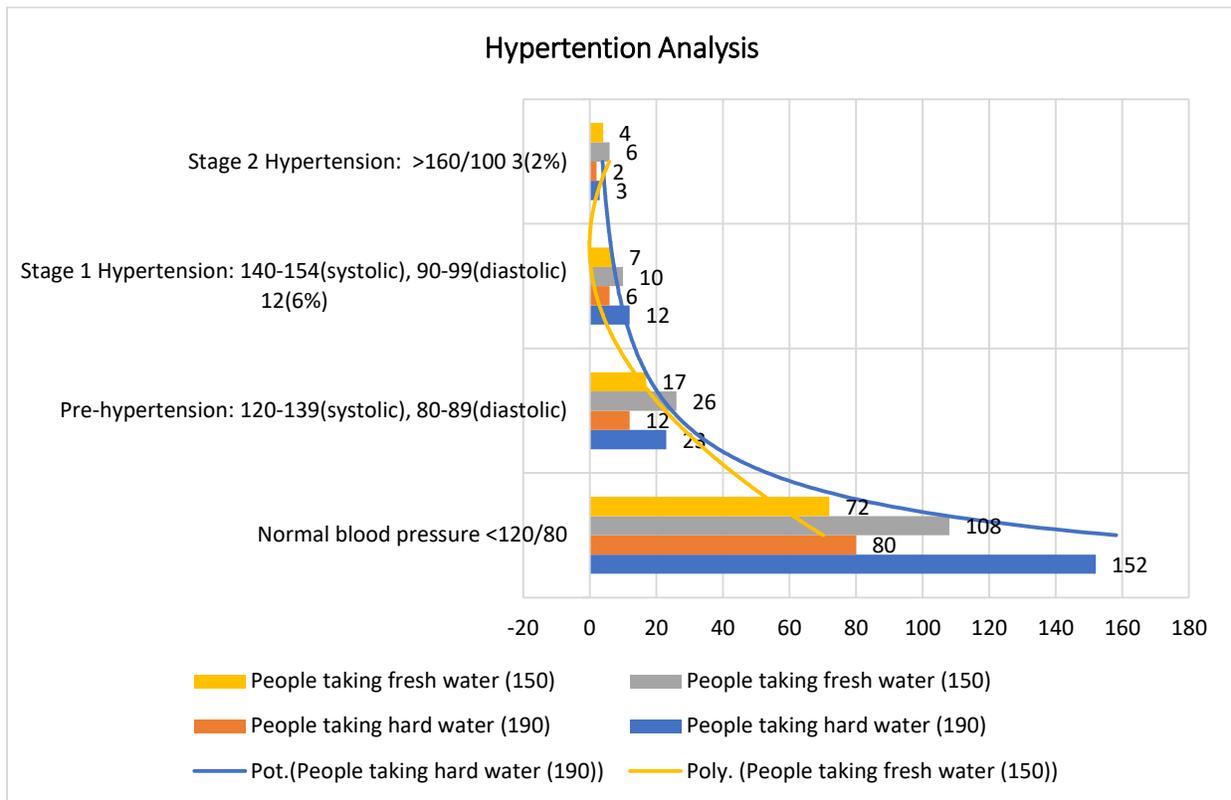


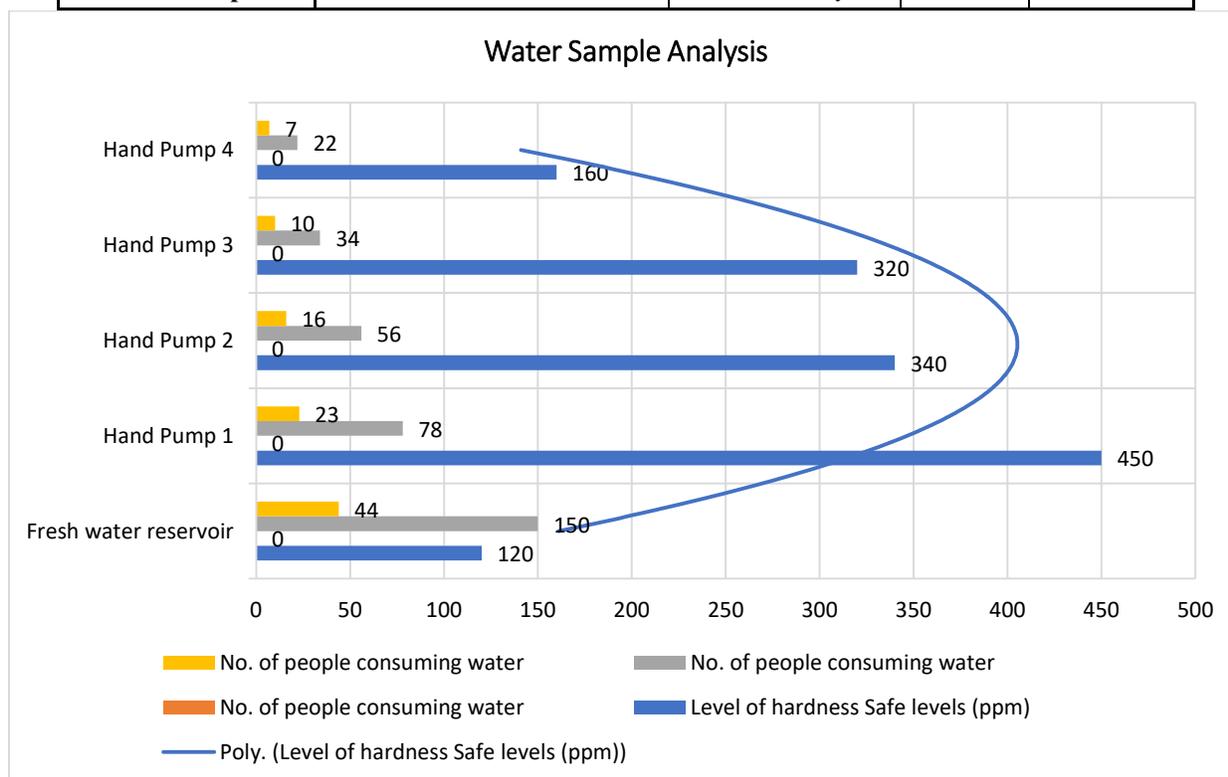
Table-II. Hypertension in people taking hard/fresh water

Blood Pressure and Hypertension	People taking hard water (190)		People taking fresh water (150)		p-values
	Number	Percentage	Number	Percentage	
Normal blood pressure <120/80	152	80	108	72	-
Pre-hypertension: 120-139(systolic), 80-89(diastolic)	23	12	26	17	0.213
Stage 1 Hypertension: 140-154(systolic), 90-99(diastolic) 12(6%)	12	6	10	7	0.475
Stage 2 Hypertension: >160/100 3(2%)	3	2	6	4	0.547



**Table-III:** Analysis of water samples from all Sources

Reservoirs	Level of hardness Safe levels (ppm)	No. of people consuming water		
		Condition	Number	Percentage
Fresh water reservoir	120	Satisfactory	150	44
Hand Pump 1	450	Unsatisfactory	78	23
Hand Pump 2	340	Unsatisfactory	56	16
Hand Pump 3	320	Unsatisfactory	34	10
Hand Pump 4	160	Satisfactory	22	7



Beneficial effects have been observed in terms of magnesium salts and calcium contents in the water for CVD mortality and hypertension by Sauvart *et al.*, Lake *et al.*, Monarca *et al.* and Tubek *et al.* in their quantitative reviews [9 – 22]. Whereas, Morris found no associated benefit in his research of hard water [23]. We noticed that hard water was consumed less by the people as per the recommended water intake due to changed taste and accessibility which has associated risks of low blood pressure, dehydration and renal stones. Safe water was being provided by only one hand-pump in the total of four. Except bad taste no side effects are associated to hard drinking water including gastrointestinal symptoms such as diarrhea. According to the report of WHO

(2008), an individual's awareness about electrolytes causing water hardness is necessary; especially in the case of harmful contents such as cadmium, lead levels and arsenic in the underground water. We were not able to measure the electrolytes level in the individuals because of limited resources but we succeeded in the attention diversion toward the issue of hard water consumption in Pakistan. There is a raised need for the specific research studies exploring the quantity of toxic minerals present in the consumable water such as lead, arsenic etc. Moreover, bottled water and its affects also need to be investigated in the larger interest of the public health.

**CONCLUSION:**

In the total research population 80 participants were found (23.5%) hypertensive; 38 hard water consumers (20%) and 42 fresh water consumers (28%). This variation was significant statistically, very high hardness was observed in the water sample testing and it was suggested that this water is not suitable for human health. It is concluded that people are commonly observed hypertension which is not present in the fresh water cases and higher incidence of hardness was observed in the underground water resources of Hingorno.

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