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Evaluation of Potential Biohazardous Agents and Water Borne Diseases in Drinking Water of Taluka Sakrand, District Shaheed Benazeerabad, Sindh, Pakistan

A. A. RAHU, A. B. GHANGHRO[++]*, A. R. ABASSI**, S. QURESHI***

Gambat Institute of Medical and Sciences (GIMS) Gambat Khairpur,

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Abstract: Water borne illness is responsible for mortality rate of over 25 millions of people worldwide as the quality of drinking water having the strong association with public health issues like viral, bacterial and protozoan diseases. Water quality at Pakistan is going worsen day by day due to indecorous management, poor sanitation and some human activities also subsidize the contamination which affects directly on water excellence and indirectly on public health. Water being an essential components of human health, as 60-65% diseases are accountable by drinking unhygienic water. In current research work, 34 ground water samples were collected as per standard procedure from study area were being used as a source of drinking water. Various Physico-chemical parameters(pH, Electric conductance (EC) , Salinity , TDS (Total Dissolved Salts) , Cl, Co, Ni, Zn, Mn, Fe, Cd and As) as per PSQCA (Pakistan Standard Quality Control Authority)/ WHO standards were analyzed. Present study shows the significant results regarding water quality the potentially biohazards agent contaminated the drinking water sources of taluka Sakrand District Shaheed Benazeerabad. The found toxic metals contaminate the drinking water sources and creating human health issues g like astrointestinal, liver, kidney, cardiovascular, and neurological diseases, cancer and some common water borne disease were also diagnosed and recorded. Deaths ratio at study area reported to the casualty were due to Typhoid, Shigellosis (Basillary Dysentary) and Viral Hepatitis.

Keywords: Water Borne Diseases, Biohazardous Agents, Drinking Water.

1. INTRODUCTION

In Sindh province the Nawabshah is the managerial head quarter of district and taluka which was founded in 1907 and recognized as city in 1912. The population figure of Nawabshah city is 22950 whereas the whole district comprises with total of 1071533 of populace. The climatic temperature raised very high in summer season that reduces up to -4^{0}C during the months of January and February, the area along with saline land bears agricultural soil which is productive for many crop yields. Majorly the people of district use water from Rohri canal for drinking, domestic and irrigation purpose, although the water supply schemes and groundwater has been using in the most Nawabshah city areas (Zardari, 2001; Efe *et al.*, 2005). With the increase in population of the city the basic need to sustain life is also increasing including clean drinking water. Surface and ground drinking water quality are badly effected due to the industrial waste, because the industries sapped off effluent into city canal. Urbanization and industrialization are one of the factors of contamination of surface and groundwater. Contamination of groundwater occasioned from all the processes and reactions from the point of condensation in the atmosphere to the tidying away in depth (Shahid *et al*., 2008). Due to unavailability of filtered water the majority of the population of the rural areas be contingent upon the groundwater for drinking purpose, whereas the quality of groundwater at Pakistan is worsening with each increasing day and the directly or indirectly this contaminated water become the main root of water borne diseases which consecutively causes 40% of demises at country (Efe *et al*., 2005; Bakhsh *et al*., 2005).

Availability of heavy metals in drinking water especially Pb and Cd creating health associated problem around the globe, because the heavy metals are the elements with molecular weight greater than 53, density greater than 6 gm/cm3 and atomic number greater than 20 and produce toxicity (Shyamala *et al*., 2008). The weathering of minerals and soils are the natural sources. Few heavy metals like, Fe, Mn, Mo, Cu and Zn should be lower in concentration as these are harmful for all living organisms, moreover As, Hg, Cd and Pb having no any biological importance and even are known as highly toxic to the health (Rahman *et al*., 2000; Oyetibo *et al*.,2007). A number of attempts have been made to examine the quality of surface and ground water for determination of heavy metals content from different parts of the country including Sindh province (Nouri *et al*., 2007; Avofolu, 2006; Leghari *et al.*, 2002;

[++]Corresponding Author Prof. Dr. Allah Bux Ghanghro Email: allah.bux@usindh.edu.pk
*Institute of Biochemistry, University of Sindh,
**Department of Fresh Water Biology & Fisheries, University of Sindh, Jamshoro.
***IARSCS, University of Sindh, Jamshoro.

Alvi *et al.,* 2006; Khuhawar and Majidano., 2011; Arain *et al*., 2007; WHO, 1995; Pak-EPA, 2005; Ghanghro *et al*.,2015; Memon *et al*., 2016; Mohsin *et al.,* 2016; Uqaili *et al*., 2012; Kahlown *et al*., 2003). The arsenic concentration in groundwater of Khairpur and Matiari districts of Sindh province were also testified, also the quality of ground water with respect to heavy metals and physico-chemical parameters of some parts of the district Nawabshah was also reported (Solomons and Ruz.,1998; Waqar *et al*.,2003). Therefore, this critical situation surrounds the scientific community attention towards the polluted sites where the water befits the contaminated with these harmful toxic metals. Present research work aimed to determine the contaminants in drinking water sources of the study area and the water borne disease Burdon.

2. MATERIALS AND METHODS

Study Area: the water samples we are collected randomly from 26 hand Pump, 06 Motor Pump and 02 Tube Wells of different villages. The sample water was kept in 1.5L plastic bottle washed twice with distilled water at study area before taking sample in it, afterwards the water was conserved with addition of 5ml HNO_3 and closed bottle tightly with aluminum foil wrapping, all samples was brought to laboratory for analysis with analytical grade reagents. For metals detection the standard solution was prepared separately for each metal with dilution of 1000 mg/L stock solution.

Odor and color were determined by sensing and visual organ. Turbidity was measured with digital turbidity meter (PCCHECKIT, Germany), Electrical Conductivity (EC) Salinity, Total Dissolved Salts (TDS) and pH were measured with conductivity meter (Model no: sanso-direct con 200).Co, Ni, Zn, Mn, Fe, Cd metal concentrations were determinedusing Perkin-Elmer atomic absorption spectrometer (AAS-PEA-700) (available at Institute of Advanced Research Studies in Chemical Sciences, university of Sindh, Jamshoro).The Arsenic was determined by Arsenic kit method MERCK with detection range of 0.005mg/L to 0.5mg/L (Wu *et al.*, 2009).

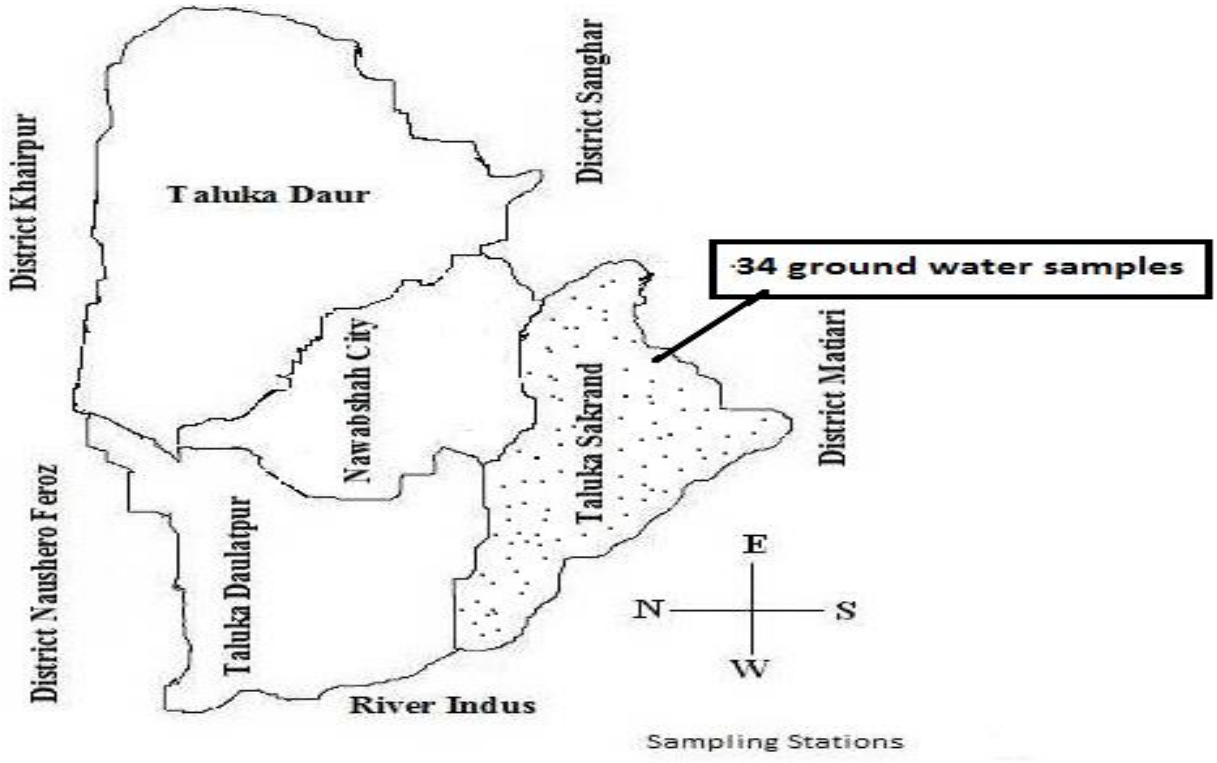

Fig. 1 Map of District Shaheed Benazeerabad (Nawabshah)

Data Analysis

All the experiments had three replicates. Data was analyzed for one-way analysis of variance followed by Student-Newman-Keuls multiple test at 0.05 level using compare means procedure of SPSS 18.

3. RESULTS AND DISCUSSION

Table No: 1 Physico-chemical analysis of ground water samples of Taluka Sakrand

Sample Code	Source	Color	Odor	Turb (NTU)	EC µS	Sal. %	TDS mg/l	pH	Cl mg/l	Co Ppm	Ni ppm	Zn ppm	Mn ppb	Fe ppm	Cd ppb	Asm g/L
					Mean = 1503 ±SD (n=3)	Mean = 0.77 ±SD (n=3)	Mean = 999.17 ±SD (n=3)	Mean = 7.76 ±SD (n=3)	Mean = 219.79 ±SD (n=3)	Mean= 49.55 ±SD(n=3)	Mean= 169.41 ±SD (n=3)	Mean= 37.11 ±SD (n=3)	Mean= 103.83 ±SD (n=3)	Mean = 0.44 ±SD (n=3)	Mean= 148.56 ±SD (n=3)	Mean = 0.01 ±SD (n=3)
S-01	HP	CL	OL	B5	1733	0.9	1130	8.2	289	90.46	62.7	23.5	25.64	0.782	179.8	0.025
S-02	HP	CL	OL	B5	931	0.5	610	7.9	68	60.43	55.1	29.2	66.08	0.145	170	0.01
S-03	HP	CL	OL	B5	1668	0.8	1080	7.6	416	68.38	11.25	30.8	107	0.595	182	0.005
S-04	HP	CL	OL	B5	889	0.4	580	7.5	59	31.42	136.3	36.45	25	0.512	119.6	0.005
S-05	HP	CL	OL	B5	2280	1.2	1480	7.4	365	101	58.8	15.13	150	0.722	462	0.025
S-06	HP	CL	OL	B5	966	0.5	630	7.9	85	61.61	106.8	22.19	110.8	0.272	156	0.01
S-07	TW	CL	OL	B5	1317	0.7	860	7.82	153	42.01	77.8	16.89	43.36	BD	139.8	0.005
S-08	HP	CL	OL	B5	1992	1.0	1300	8.14	314	50.14	98.36	14.8	30.03	0.472	201	0.005
S-09	HP	CL	OL	B5	1802	0.9	1120	7.66	212	47.98	45.67	14.4	50.72	0.502	216	0.025
S-10	HP	CL	OL	B5	1759	0.9	1140	7.4	289	61.48	81.13	27.7	126.1	2.037	212.2	0.01
S-11	MP	CL	OL	B5	1650	0.8	1070	7.8	348	56.35	46.6	33.94	54.18	0.736	175.8	0.005
S-12	MP	CL	OL	B5	984	0.5	687	7.9	76.5	54.38	82.6	31.98	BD	0.522	106	0.005
S-13	MP	CL	OL	B5	319	0.2	223	7.6	51	9.65	233	26.7	34.58	0.324	72.8	0.025
S-14	HP	CL	OL	B5	2370	1.3	1652	7.9	272	79.57	348.4	24.97	57.37	0.713	194	0.01
S-15	HP	CL	OL	B5	1916	1.0	1339	7.8	204	60.52	346.4	34.6	83.06	0.018	143.6	0.005
S-16	HP	CL	OL	B5	1320	0.7	922	7.7	136	11.94	252.6	33.5	66.13	BD	177	0.005
S-17	HP	CL	OL	B5	1662	0.9	1163	7.8	399	43.91	304.2	41.54	86.82	BD	206.7	0.025
S-18	HP	CL	OL	B5	1733	0.9	1130	8.2	289	55.26	221.5	35.69	130	0.004	137	0.01
S-19	HP	CL	OL	B5	931	0.5	610	7.9	68	78.77	312.3	46.14	97.24	1.17	129.8	0.005
S-20	HP	CL	OL	B5	1668	0.8	1080	7.6	416	72.68	308.4	48.09	83.4	0.928	145.4	0.005
S-21	HP	CL	OL	B5	889	0.4	580	7.5	59	20.06	206.3	42.59	98.23	0.382	86.6	0.025
S-22	HP	CL	OL	B5	2280	1.2	1480	7.4	365	55.3	241.8	48.61	105.7	0.879	143.3	0.01
S-23	HP	CL	OL	B5	966	0.5	630	7.9	85	17.92	182.7	29.2	94.5	0.58	69.1	0.005
S-24	TW	CL	OL	B5	1317	0.7	860	7.82	153	28.96	243.2	43	95.7	0.53	103.7	0.005
S-25	HP	CL	OL	B5	1992	1.0	1300	8.14	314	16.71	178.5	47.48	251.9	0.52	112.8	0.025
S-26	HP	CL	OL	B5	1802	0.9	1120	7.66	212	14.62	131.9	46.14	132.4	0.562	95.4	0.01
S-27	HP	CL	OL	B5	1759	0.9	1140	7.4	289	70.95	214.8	60.41	202	0	136.6	0.005
S-28	MP	CL	OL	B5	1650	0.8	1070	7.8	348	86.01	230.3	60.19	201	0.121	170.8	0.005
S-29	MP	CL	OL	B5	984	0.5	687	7.9	76.5	26.69	208.8	51.43	158.3	0	112	0.025
S-30	MP	CL	OL	B5	319	0.2	223	7.6	51	64.21	194.5	56.24	173	0.734	129.8	0.01
S-31	HP	CL	OL	B5	2370	1.3	1652	7.9	272	33.69	160.7	48.98	150.3	0.397	113.1	0.005
S-32	HP	CL	OL	B5	1916	1.0	1339	7.8	204	43.7	120.9	45.64	153.1	BD	64.5	0.005
S-33	HP	CL	OL	B5	1320	0.7	922	7.7	136	32.8	131.8	49.62	152.8	BD	83.2	0.025
S-34	HP	CL	OL	B5	1662	0.9	1163	7.8	399	35.4	124	44.3	134	BD	103.7	0.01

*S: Sakrand, HP: hand pump, MP: Motor pump, TW: Tube well, OL: Odorless, CL: Colorless, BELOW NTU nephlometric Turbidity unit, uS : micro Siemen , mg/L : Milligram per liter , TDS : Total Dissolved salts

In the present study, all water samples were colorless and odorless due to the ground nature of water samples and depth of boring. The physical parameters observed in this present stud are in conformity with the data reported in previous research works in which (Wu *et al*., 2009). According to the WHO standards for drinking water the drinking water for human consumption should be colorless, odorless and tasteless. The turbidity of all samples is <5 NTU, pH value of all water samples was found within the WHO permissible limit i-e 6.5 to 8.5. The maximum and minimum values of Electric conductance (EC) (319µS/cm to 2370µS/cm) whereas the normal WHO value of electric conductance is 1562 µS/cm, Salinity (0.2 % to 1.3%), TDS (Total Dissolved Salts) (223 mg/L to 1652mg/L) and Chlorides (51 mg/L to 416mg/L) were determined from the collected water samples. The similar results were described by Khaiwal *et al*., 2007 that ground water samples from Bahawalpur City, Pakistan. Total dissolved solids Total Dissolved solids (TDS) refer to the amount of inorganic substances suspended or dissolved in water. The normal permissible value for TDS in drinking water is 500 mg/L to 1000 mg/L. These results were in accordance with the results formerly stated for ground water sources from district Matiari, Sindh (Uqaili *et al*., 2012).

Chloride (Cl^-) is major inorganic components, which may destroy the quality of water for drinking purpose. Chloride was observed under the normal range accordance with the WHO limit (250 mg/L). Furthermore arsenic is known as a potent carcinogen and poses a serious public health issues in many countries like Bangladesh, India, China, Vietnam, Nepal and Myanmar (Rasmussen *et al*., 2001). Cobalt, Nickel, Zinc, Manganese, Iron, Cadmium, and Arsenic is an essential element for humans and plays a beneficial role in normal growth and reproduction (Oller *et al*., 1997).

The concentration of Cobalt (9.65ppb to 101 ppb), Nickel (11.25 ppb to 348 ppb), Zinc (14.4 ppb to 60.0 ppb), Manganese (25 ppb to 251ppb), Iron (0.0 ppb to 2.03 ppb) and Cadmium (64.5 ppb to 464 ppb), Arsenic (0.005 mg/L to .0.25mg/L) were shown in table 01, in most of the samples the Zn concentration in drinking water was found within the normal range in Pakistan.

The physical parameters observed in this study were in conformity with the results of a previous study in which ground water samples were observed colorless, odorless but were slightly saline (Wu *et al*., 2009). The occurrence of turbidity of surface water may be permanent or seasonal. The normal WHO turbidity limit in drinking water is 5 NTU The high turbidity is usually associated with higher levels of disease-causing microbes and indirectly constitutes a health issue (Alvi *et al*., 2006).

Electric conductance (EC) of water is a measurement of the amount of salts dissolved in water and thus EC indicates concentration of total dissolved solids. The normal WHO value of electric conductance is 1562 µS/cm and the results indicate that drinking water samples were highly ionized due to excessive dissolve solids and other impurities. The similar results were previously reported for ground water samples from Bahawalpur City, Pakistan (Khaiwal *et al*., 2007). Total dissolved solids (TDS) refer to the amount of inorganic substances suspended or dissolved in water. The normal permissible value for TDS in drinking water is 500 mg/L to 1000 mg/L. These results were in accordance with the results previously reported for ground water sources from district Matiari, Sindh where the EC, TDS concentration was above the permissible value and elevated TDS concentration which make the water unsuitable for human drinking. In addition, increased TDS concentration also affects the individuals suffering from heart and kidney problems. High TDS values also affect skin and cause rashes, and disturb body hair as well. TDS did not play a direct role in health risks, but high salt contained water's extended utilization (above 500 ppm) can cause stiffness of the joints, kidney stones, gallstones, and hardening of arteries (Ozkan *et al.*, 2007). The elevated level of TDS decreases the tastiness and causes gastrointestinal irritations in human and laxative effect mainly upon transits as reported by Young *et al.*, 1987).

Chlorides are major inorganic components, and if present in level above the permissible limit (WHO normal limit is 250 mg/L) will directly effect on quality of drinking water. Elevated chloride level was found to cause corrosion of pipes which can lead to increased concentration of metals in the water supply. Arsenic is known as a potent carcinogen poses major public health issues in many countries like Bangladesh, India, China, Vietnam, Nepal and Myanmar (Ozkan *et al*., 2007). It occurs in water in the form of arsenite, arsenate, and organic arsenicals. The concentration of arsenic in drinking water of many regions of Pakistan exceeds the WHO standard of 10 ppb (µg/L). A study conducted previously reported that drinking water available to eleven cities of Punjab showed an excess of arsenic (Kahlown *et al.*, 2003). Overexposure to arsenic in drinking water causes several health concerns including nausea, vomiting, lower white and red blood cells production, damage blood vessels, disrupt the heart rhythm and cause uncomfortable tingling in hands and feet. Long-term exposure to arsenic can also cause several kinds of melanosis and cancer. Zinc (Zn) is an essential element for humans and plays a beneficial role in normal growth and reproduction (WHO,1995), with the permissible of 3 mg/L level. In most cases, Zn concentration in drinking water is found within the normal range in Pakistan. Waqar *et al.*, 2003 conducted study in Karachi showed a higher concentration of Zn (4.02 mg/L). However, Solomons *et al.*, 1998published data that Zn concentration in drinking water varied between 0.040 to 0.046 mg/L in pre-monsoon and post-monsoon seasons of district Thatta, Sindh. Cadmium Cadmium (Cd) has no positive role in health causing both acute and chronic problems in humans whereas the range for Cd concentration in drinking water set at 0.003 mg/L by WHO. Consumption of Cd may be a reason of severe gastrointestinal problems, such as nausea and diarrhea, while chronic exposure may causing kidney damage, reproductive problems, bone damage and cancer. Manganese (Mn) is a normal constituent of human diet and postures a small problem in some parts of Pakistan where it exceeds the WHO standard limits (0.5 mg/L). Previous research work showed that the concentration of Mn (2.56 mg/L) was high in groundwater samples of Khyber Pakhtoonkhwa (Rahman *et al.*, 200). The excess concentration of different salts like sodium (Na), calcium (Ca), magnesium (Mg), potassium (K) and chlorides (Cl) were found from sewerage water of Fullali Canal, Hyderabad (Qureshi *et al*., 2012). Over exposure of manganese Mn through drinking water causes permanent neurological disorders similar in symptoms to idiopathic Parkinson disease (Oller *et al*., 1997). Iron (Fe) is an essential element for the normal physiology of humans and its deficiency and overexposure both can cause severe health linked problems. In drinking water, the permissible limit of Iron set by WHO is 0.3 mg/L. In Pakistan it was reported that Fe concentration was overloaded in 28% of ground water samples and 40% of surface water samples (Muhammad *et al*., 2013).

Iron overexposure is a less common condition in comparison to its deficiency, but it can lead to several

serious health problems like cancer, diabetes liver and heart diseases as well as neurodegenerative disorders (Daniels *et al.*, 1990; Rasmussen *et al*., 2001). Cobalt is relatively low in drinking water, it stimulates the production of red blood cells thus, used to treat anemia in pregnant women, so the water samples of both phases were suitable for drinking purpose with respect to cobalt contents. Nickel (Ni) is known to be a compound causing cancer in humans. The maximum admissible concentration set by WHO for nickel in drinking water is 0.02 mg/L. The high concentration of nickel was reported in ground water samples (0.01–2.19 mg/L) and 75% of surface water samples from Karachi which is exceeded the US EPA limit for Nickel. Nickel is also recognized to causes variety of adverse health effects, including dermatitis, cardiovascular diseases, lung fibrosis, kidney problems and cancer of the respiratory tract (Rasmussen *et al*., 2001; Berg *et al*., 2001).

The load of diarrhoeal disease around the globe causes approximately 1.8 million demises annually, with 88% of drinking unhygienic water (Ozkan *et al*., 2007). In developing countries the deaths due to diarrhoea is probable about 8.0% compared with developed states of the globe that having 0.5% estimation of mortality rate however diarrhoeal diseases death rate displaying much variances among developed and developing countries of the sphere.

Quality and Quantity of water has an enormous influence on diarrheal illness. Accessibility of safe water supports to lessen the diarrheal illness. Relationship between the quality and quantity of water with waterborne diseases burden record were presented / included in this study.

Several chemicals and toxic metals contaminate the drinking water sources and associated with human health and that contamination leads to gastrointestinal, liver, kidney, cardiovascular, and neurological diseases and cancer (Young *et al*., 1987). In present study, Total subjects (male and female) of some common water borne disease were diagnosed and recorded at taluka hospital administration, district Shaheed benazeerabad during 2014, Water Borne Diseases i.e; Typhoid Fever, Shigellosis (Basillary Dysentary), Amoebiasis, Acute Poliomyelitis Viral Hepatitis (A & E), Ascariasis Burden distributed in different age group of male and female at study area. The skin rashes, ear pain and other infectious diseases are widespread complaints after the flood (Baltazar *et al.*, 1988). Long-term mortality can be directly attributed to the flooding; such as increases in diarrheal deaths in low-income nations (Daniels *et al.*, 1990).

Table - 2 Water Borne Diseases Burden at taluka Hospital Sakrand during 2014

S. No:	Name of Disease	No: of Cases			Age Group (years)				No: of Deaths
		M	F	Total	Under 1 M/F	1-14 M/F	15-44 M/F	45+ M/F	
01	Cholera	------	------	------	------	------	------	------	------
02	Typhoid Fever	468	356	824	39/34	271/216	96/54	62/52	08
03	Shigellosis (Basillary Dysentary)	312	298	610	45/47	151/154	69/66	47/31	18
04	Amoebiasis	117	90	207	------	25/13	45/40	47/37	------
05	Acute Poliomyelitis	05	06	11	------	5/6	------	------	------
06	Viral Hepatitis (A & E)	420	354	774	5/0	75/52	182/159	158/143	60
07	Ascariasis	36	33	69	------	------	20/15	16/18	------
F-Statistics at df = 20		**198889.47**	**255772.75**	**1.82**	**1.00**	**1.00**	**330591.20**	**122.11**	**3546.01**

one-way analysis of variance followed by Student-Newman-Keuls multiple test at 0.05 level SPSS 18.

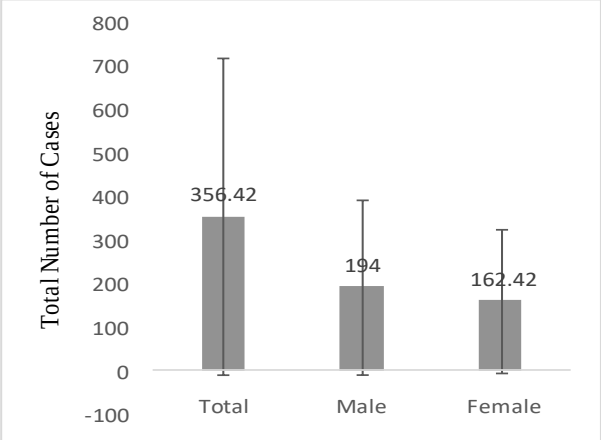

Fig-2. Water borne disease burden at taluka Hospital Sakrand during 2014

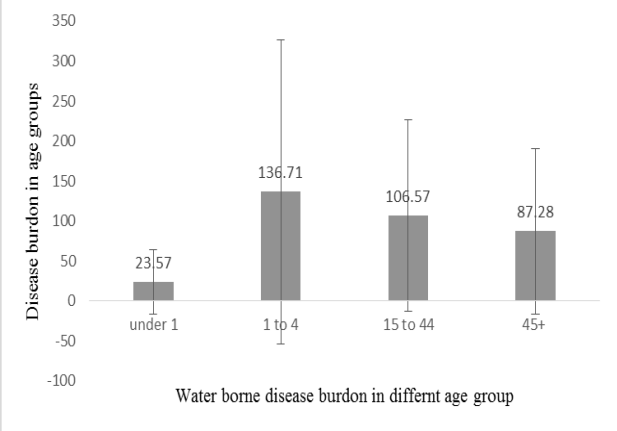

Fig-3. Water borne disease burden in different age group at taluka Hospital Sakrand during 2014

Total number of subjects (male and female) of some common water borne disease were diagnosed and recorded at taluka hospital administration, district Shaheed benazeerabad during 2014, Water Borne Diseases i.e; Typhoid Fever, Shigellosis (Basillary Dysentary), Amoebiasis, Acute Poliomyelitis Viral Hepatitis (A & E), Ascariasis. Burden of diseases was found to distributed in different age group of male and female at taluka Hospital Sakrand during 2014 (table 02). Deaths ratio was also recorded during the study year at study area due to Typhoid, Shigellosis (Basillary Dysentary), Viral Hepatitis (A & E) , 08, 18 and 60 respectively, was reported at casualties and were not diagnosed properly due to non-availability of such laboratory at remote areas.

4. CONCLUSION

The Present research work revealed that the significant results regarding water quality the potentially biohazards agent contaminated the drinking water sources of taluka Sakrand District Shaheed Benazeerabad. Several chemicals and toxic metals contaminated the drinking water sources and associated with various human health and this contamination leads to gastrointestinal, liver, kidney, cardiovascular, and neurological diseases and cancer, some other common water borne disease. Deaths occur during the study year at study area and health department recorded the casualty due to Typhoid, Shigellosis (Basillary Dysentary), Viral Hepatitis (A & E). This research is part of the efforts taken to evolve and develop a community based awareness and establishing especial and temporal prevalence of biohazards in drinking water sources of the study area.

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