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DETERMINATION OF DRINKING WATER QUALITY OF DIFFERENT SCHOOLS (PRIVATE AND GOVERNMNET) IN CHAWINDA

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Keywords

Water
Water quality
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Drinking water analysis
Schools
Chawinda

ABSTRACT

Only 20% of Pakistan's population has access to clean drinking water, forcing the remaining 80% to make do with contaminated water. Every human being needs access to safe and clean water. Human consumption of water requires that it should be uncontaminated by physical, chemical, or biological agents. However, it does occasionally happen that human or natural activity can contaminate groundwater and surface water. The purpose of this study was to determine the quality of the drinking water. An analysis of the drinking water was done in the town of Chawinda in the Sialkot district. Total 60 samples from private and government schools were collected.
In the laboratory, physiochemical measures (pH, turbidity, TSS, TDS, fluorides, chlorides, total hardness, and fecal coliform) were compared to Pakistani national drinking water quality requirements and WHO guidelines. Most of the samples had pH values between 6.5 and 8.5, with the government school having the highest pH measurement of 8.55. The turbidity value fell between that of public and private schools. Additionally, the government schools' TSS and TDS values exceeded the recommended threshold. The maximum total hardness value found at the government school was 327 mg/L. Some samples had chlorides over the 250–288 mg/L range, which was not below it. Fluoride levels stayed between 1.5 and 2 mg/l; only a small percentage of private school samples were above the upper limit. The There was a finding of fecal coliform in government schools. Questionnaire survey was used for primary data collection. Respondent size of 200 with age group between 7-15 of grade 5,6 and 7 participated in questionnaire survey from private and government schools. And type of questionnaire is dichotomous questions. Fecal coliform in drinking water suggests that there may be an underground sewage pipe leak causing the unclean water to contaminate the drinking water. These elements are not safe for human consumption as they cause a variety of health impacts including nausea, lung irritation. Consumption of water with high level of TDS for a longer period of time can cause chronic health conditions like cancer and nervous system disorders. It was determined that drinking water needed to be treated because several of the metrics weren't within the acceptable range.

Introduction

Drinking water quality is a critical concern that directly impacts the health and well-being of individuals and communities. Access to safe and clean drinking water is essential for maintaining good health, preventing waterborne diseases, and promoting overall quality of life (Zhang et al.,2020). Drinking water quality in government schools is a crucial aspect of ensuring the health and well-being of students. Clean and safe drinking water is essential for hydration, proper cognitive function, and overall physical health. Access to safe drinking water is a fundamental right for every individual including schoolchildren. The quality of drinking water can significantly impact student health, particularly in school settings where large numbers of children gather daily. Contaminated or poor water quality can lead to various waterborne diseases. In recent years, there has been increasing recognition of the importance of ensuring drinking water quality worldwide (Ilyas et al.,2017).

In Pakistan, approximately 25% of the population has access to safe drinking water, which meets acceptable standards. Drinking water should be free from color, turbidity, odor, and microbes. In Pakistan water quality in most cities is deteriorating quickly. In Punjab, the rural population depends upon dug wells and rivers for water supply. It seems that Punjab has the best Water for drinking purposes mainly comes out from surface and underground aquifers near rivers or canals. The surface water quality is dropping rapidly due to the addition of raw municipal and industrial effluents and agricultural runoff into water resources. About 70% of the water used for drinking purposes comes from aquifers. The quality of drinking water is determined by the quality of the water source, the level, and treatment efficiency. In most of the rural areas of Pakistan, surface water is used for drinking after slow sand filtration and chlorination is not done at filtration stations (Sohail et al.,2014).

The most serious pollutants in terms of human health are pathogenic organisms. Altogether, at least 25% million deaths each year due to these water-related diseases including nearly two-thirds of deaths of children under five years of age. Diseases such as typhoid and cholera occur due to contaminated drinking water

Human health is adversely affected by various agents like pathogens, bacteria, and organic substances that are present in unsafe drinking water. A significant proportion of the population in developing countries is suffering from health-related issues due to unsafe drinking water and microbial contamination (Majeed et al.,2020).

Drinking water quality is one of the greatest factors affecting human health. However, drinking water

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water supply among all the provinces. The ratio is 24% in Sindh and people are utilizing water from unprotected sources. The rural communities of KPK and Baluchistan using water from the surface and dug wells are about 46% and 2% respectively (Kalair et al.,2019).

Water pollution is a physical process, that occurs in various water resources such as lakes, grounds, water, and rivers due to anthropogenic activities. The utilization of poor-quality water causes waterborne diseases and their spread. In Pakistan, 50% of diseases and 40% of deaths occur due to poor drinking water quality that comes from surface and ground sources (Khalid et al.,2018).

Palatability, viscosity, solubility odors, and chemical reactions are influenced by temperature. Thereby, the sedimentation and chlorination process and biological oxygen demand are temperature dependent. It also affects the bio-sorption process of dissolved heavy metals in water. Most people find water at a temperature of 10-15 most palatable. Color is measured by comparing the water sample with standard color solutions or colored glass disks. One color unit is equivalent to the color produced by a 1mg/l solution of platinum. Taste and odor in water can be caused by foreign matter such as organic materials, inorganic compounds, or dissolved gasses the numerical value of odor or taste is determined by measuring a volume of sample A and diluting it with the volume of sample B of an odor-free distilled water so that the odor of resulting mixture is just detectable at a total mixture of 200 ml.

quality in many countries, especially in developing countries is not desirable and poor drinking water quality has induced many waterborne diseases. Having access to safe drinking water is a basic human right for all people. Contaminants such as chemicals, microorganisms, and toxic substances in higher concentrations can become unsafe for drinking water. Contaminated drinking water can cause diseases such as kidney damage, gastrointestinal stress, cancer, and blue baby syndrome. The physical, biological, and chemical properties of drinking water have great importance because a minor fluctuation in these parameters affects human health. It is a crucial factor that greatly affects water quality and quantity of pollution in water bodies. However, PH of drinking water has no direct effect on humans. Indirectly it changes meat solubility and provides a suitable environment for pathogens. Its high range causes an acidic taste of drinking water (WHO ,2007).

Turbidity is the cloudiness of water. It is a measure of the ability of light to pass through water. It is caused by suspended materials such as clay, silt, organic material, plankton, and other particulate materials in water. Turbidity in drinking water is aesthetically unacceptable, which makes the water look unappetizing. The impact of turbidity is that it can increase the cost of water treatment for various uses. The particulates can provide hiding places for harmful microorganisms and nearby shield them from the disinfection process. Turbidity is measured by an instrument called a nephelometric turbid meter, which expresses turbidity in terms of NTU or TU. Turbidity of more than 5 NTU can be viable to the average person while turbidity in muddy water exceeds 100 NTU. Groundwater has

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Solids occur in water either in solution or in suspension these two types of solids can be identified by using a glass fiber filter that the water sample passes through. The suspended solids are retained on top of the filter and dissolved solids pass through the filter with water. If the filtered portion of a water sample is placed in a small dish and then evaporated, the solids as a residue. This material is usually called total dissolved solids or TDS. The residues of TSS and TDS after heating to dryness for a defined period at a specific temperature are fixed solids

The electrical conductivity of water is a measure of the ability of solution to carry or conduct electrical current since the electrical current is carried by ions in solution, the conductivity increases as the concentration of ions increases. Therefore, it is one of the main parameters used to determine the suitability of water for irrigation. Pure water is not a good conductor of electricity the electrical conductivity can be used to estimate the TDS. TDS can be used to estimate the ionic strength of water in the application of groundwater by treated wastewater (WHO).

Acidity is a measure of acids in solution the acidity of water is its quantitative capacity to neutralize a strong base to a selected PH level. Acidity in water is usually due to carbon dioxide, mineral acids, and hydrolyzed salts such as ferric and aluminum sulfates. The level of acidity is determined by titration with standard sodium hydroxide using phenolphthalein as an indicator. The alkalinity of water is mainly caused by the presence of hydroxide ions, bicarbonate ions, and carbonate ions or a mixture of two of these ions in water. Alkalinity is determined by titration with a very low turbidity because of the natural filtration that occurs as water penetrates through soil (Rehman et al., 2018).

PH is one of the most important parameters of water quality. It is a measure of how acidic/basic water is Acidic water contains extra hydrogen ions and basic water contains extra hydroxyl ions. It ranges from 0 to 14 with being neutral. less than 7 indicates acidity whereas greater than 7 indicates a base solution. Pure water is neutral with a pH close to 25. Its Safe ranges for drinking water from 6.5 to 8.5 water with a pH of 10 times more acidic than water with a pH of 7 and water with a pH of 5 is 100 times more acidic than the electrometric and colorimeter methods are available for determination. Excessively high and low pH can be detrimental to the use of water. A high pH makes the taste bitter and decreases the effectiveness of chlorine disinfection, thereby causing the need for additional chlorine. The amount of oxygen in water increases as PH rises. Low-PH water will dissolve metals and other substances. The effects of pH on animals and plants also most aquatic animals and plants have adapted to life in water with a specific pH and may suffer from even a slight change. Water with low pH or high pH is fatal a pH below 4 or above 10 will kill most fish and few animals can endure water with a pH below 3 or above 11. Acidic water can also decrease the number of hatched fish eggs, irritate fish and aquatic insect gills, and damage membranes.

Chloride occurs naturally in groundwater, streams, and lakes but the presence of relatively high chloride concentration in freshwater may indicate wastewater pollution. Chloride ions in drinking water do not cause any harmful effects on public standard acid solution using selective indicators. The high level of either acidity or alkalinity in the water may be an indication of chemical pollution for instance, if an acidic chemical has contaminated a lake that had natural alkalinity a neutralization reaction occurs between acid and alkaline substances the pH of the lake remains unchanged (Daud et al.,2013).

Hardness is a term used to express the properties of highly mineralized waters the dissolved minerals in water cause problems calcium and magnesium ions cause the greatest portion of hardness in naturally occurring water they enter water mainly from contact with soil and rock. Water with 300mg/l of hardness is generally considered to be hard, and more than 150mg/l of hardness is noticed by most people, and water with 5% mg/l is considered to be soft (Nabi et al.,2019).

Dissolved oxygen is considered to be the most important parameter of water quality in streams, rivers, and lakes. It is the key test of water pollution the higher the concentration of dissolved oxygen, the better the water quality. The actual amount of dissolved oxygen varies depending on the pressure, temperature, and salinity of the water.

health, but high concentrations can cause an unpleasant salty taste for most people. Chloride is not usually harmful to people. Standards for public drinking water require chloride levels that do not exceed 250 mg/l. There are many methods to measure chloride concentration in water but the normal one is the titration method by silver nitrate. A moderate amount of fluoride ions in drinking water contributes to good dental health. About 1.0mg/l is effective in preventing tooth decay, particularly in children. Excessive amounts of fluoride cause discolored teeth a condition known as dental fluorosis. The maximum allowable levels of fluoride in public water supplies depend upon local climate. The maximum allowable concentration of fluoride for potable water is 1.4 mg/l (Daud et al.,2010).

One of the most helpful indicators of water quality may be the presence or lack of living organisms' bacteria are considered to be single-celled plants because of their cell structure and the way they ingest food. Bacteria that require oxygen for their metabolism at low temperatures, bacteria grow and reproduce slowly as the temperature increases, the growth and reproduction is 10 the majority of species of bacteria have an optimal temperature of about 35°C. A lot of dangerous waterborne diseases are caused by bacteria, namely, typhoid, shigellosis, and cholera. Algae are also primarily nuisance organisms in water supply because of taste and odor problems they create certain species of algae and cause serious environmental and public health problems e.g. green algae can kill cattle and other domestic animals if animals drink contaminated those species. The water samples were analyzed for physical, chemical, and bacteriological contamination (khan K et al.,2013).

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Materials and Methods

2.1. Site Selection

Drinking water samples were collected from different private and government schools in Chawinda. It is a town located in Pasrur tehsil, Sialkot district Pakistan. The town sits at an altitude of 165 meters close to the border with Indian-administered Jammu and Kashmir.

3.2. Sampling

The drinking water samples were collected from the study area in the months of September and October 2023. Samples were collected in 1.5 -liter plastic bottles. All samples were collected from schools. 60 samples were collected in total, 30 from private schools and 30 from governmnet schools through new plastic bottles of 1.5 liters. The drinking water samples collected were analyzed in the laboratory. Physiochemical analysis was done. Physical parameters such as pH (9040C USEPA), turbidity (APHA 2130) and chemical parameters such as TDS (APAH 2540-F), TSS (APHA 4500-CL D), fluoride (APHA 4500 -

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Figure 3.1: Map of study area

3.3. Data Collection

Analysis of drinking water quality parameters of Chawinda was carried out between September 2023- November 2023. The primary data was gathered through a questionnaire. Various questions from the respondents were asked about their age, education, waterborne diseases, general body problems. The survey was conducted in the whole study area, and questions were asked to each water source consumers. The questionnaires were filled in and data was compiled.

3.4. Statistical analysis

Collected data was analyzed through the statistical package for social sciences (SPSS). Basic statistical parameters such as minimum, maximum, mean, median and standard deviation were used to analyze the data.

Total Suspended Solids

Pre-weighed filter paper was taken and placed in funnel. 50 ml of water sample was taken and allowed to filter through the filter paper. when the filtration process was done filter paper was removed containing the suspended solids. The filter paper was placed inside an oven at 105^{o}C to let it dry. After drying, filter paper was cooled at F), Hardness (0130.2 USEPA) biological parameters such as E. coli and fecal coliform were tested and monitored. The results were analyzed and compared with the standards of WHO.

3.5. Procedure

pH

First, the pH meter was calibrated. Drinking water samples were taken in a clean beaker. The pH meter probe was rinsed properly before use to prevent any carryover. Then the probe was immersed in the sample. The probe was stirred to establish equilibrium until the reading of the pH meter was recorded. [9040C USEPA]

Turbidity

The sample was taken in the turbidity cuvette. The lid of the cuvette was carefully closed to prevent any interference of light. The cuvette was placed in the turbidity meter and waited for a steady reading and the displayed reading was recorded. [APHA2130]

Total Hardness

10ml water sample was taken in a beaker. 1ml buffer solution was pipetted out in the water sample. A pinch of Eriochrome black T was added to the water solution which turns the color of the solution into purple. It was titrated against the standard solution of 0. 002M EDTA until the color of the solution changed to blue. Then the total hardness was calculated. [0130.2 USEPA]

$$ca^{2+}\ (mg/L) = \frac{(\text{mL of Titrant sample})\ (\text{M of Titrant})\ (40000)}{\text{ml of sample}}$$

Chloride

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room temperature in a desiccator and then weight the dried filter paper containing the suspended solids. The filter paper was weighed again. Calculations were done to find out weight of TSS. [APHA 4500-CL D]

TSS was calculated by using the following formula:

TSS (mg/L) = (A-B) x 1000/C

Here A = weight of the dried filter + residue in mg

B = weight of the filter paper in mg (before dying)

C = volume of sample filtered in L

Total Dissolved Solids:

Pre-weighed China dish was taken. Then a 50ml filtered sample was transferred into China dish. The dish was placed on a hot plate and water was evaporated completely. After complete evaporation, the residue was cool down at room temperature in a desiccator. After cooling the dish was weighed again. Calculations were done to find out the weight of dissolved solids. [APAH 2540-F]

TDS was calculated by the following formula:

TDS (mg/L) = (A-B) x1000/C

Here, A= weight of dried China dish + residue in mg

B = weight of the China dish in mg (before drying)

C = volume of sample filtered in L

Fecal Coliform

First agar was prepared by mixing 50g in 250ml water, heating the mixture till the boiling point is reached and it was then placed in Autoclave for 2 hours. The agar was then poured into petri dishes. Water sample of 1ml were added to agar with the help of droppers. The petri dishes were covered and 10ml water sample was pipetted out to a beaker in which 1-2 drops of potassium chromate were added which acts as an indicator. We titrated it against the standard solution of silver nitrate 0.1M, which was freshly prepared. A dropwise solution of $AgNO_3$ was added to the beaker. Titration continued until the color changed to brick red. Three readings were noted after performing the procedure three times. Then calculated the chloride concentration. [APHA 4500- CL D]

M1v1 = M2v2

M2 = M1x v1/v2

Strength of chlorides (mg/L) = Molarity x atomic

Molecular weight of chlorides

Fluoride

A 100ppm to 200ppm standard solution was made by dissolving salt solutions such as fluoride in water to calibrate the instrument. Buffer was added to the water sample and stirred gently. The ion-selective electrode probe was lowered into the beaker gently and stirred continuously. The displayed value was noted. The procedure was repeated for all samples. [APHA-4500 F] placed in an incubator for 24 hours. The samples were examined after 24 hours for signs of colonies. [APHA 9222]

3.6. Questionnaire survey

The questionnaire survey was used for the primary data collection. Respondent size of 200 with age group between 7-15 of grade 5, 6 and 7 participated in questionnaire survey from the private and governmnet schools that were affected from the poor drinking water quality. And the type of the questionnaire is dichotomous questions

RESULTS

All results were entered in excel and calculations of results was done through plotting graphs and tables. Analysis of results was done through according to the schools divided e.g. private and governmnet. The values of the parameter were

Table 4.1: Drinking water quality analysis of samples from private Schools

Sr.	pH	Turbidity NTU	TSS mg/I	TDS ppm
Standard value	**6.5-8.5**	**5NTU**	**25mg/I**	**1000ppm**
Private Schools				
1	7.81	1.09	4.6	584.3
2	7.46	1.75	183	105.13
3	6	0.13	174	331.1
4	7.94	2.73	11.06	559.2
5	6.7	1.89	18.01	458.3
6	7.81	1.02	12.5	556.3
7	7.72	15	25.21	649
8	8.02	0.33	28.3	771.4

9	7.1	2.05	17.2	357
10	7.09	1.73	14.4	868.2
11	8.15	1.38	28.5	993
12	8.06	0.33	20.2	995
13	7.73	0.99	16.12	112.3
14	6.94	0.25	11.5	547
15	7.65	1.63	10.42	947
16	8.36	1.74	17.6	743
17	7.72	1.43	18.43	875.4
18	7.1	1.97	9.98	545.2
19	7.97	3.33	10.53	448.3
20	7.56	1.85	8.76	395.1
21	7.2	3.33	27.3	401
22	7.2	1.97	10.42	819.4
23	7.2	1.47	19.77	211
24	7.4	1.66	26.2	839
25	7.59	1.69	19.2	413.39
26	7.12	0.29	20.22	427
27	7.98	0.38	11.5	401.3
28	8	0.29	8.12	804.1
29	7.3	1.03	6.5	528.4
30	7.41	0.76	7.5	204.7
Government Schools				
31	7.94	2.84	15.5	204.7
32	7.84	3.6	2.68	378.4
33	7.94	1.34	3.74	457.7
34	8.1	1.27	1.88	178
35	7.99	1	2.5	182
36	7.77	1.1	1.88	98.5
37	8.19	0.73	9.31	485
38	8.41	0.66	6.4	241
39	8.24	0.38	20.1	350

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40	7.8	0.9	4.3	179
41	8.01	0.5	3.85	244
42	7.77	0.66	12.7	209
43	8.5	2.53	12.5	188
44	8.41	1.07	10.9	195
45	7.98	1.34	14.4	186
46	8.39	1.27	10.33	171
47	8	1.34	17.2	188
48	7.98	1.18	15.4	494
49	8.15	2.43	11.5	181
50	8.46	0.71	16.12	164
51	8.31	1.27	19.2	280
52	7.41	1.52	8.12	194
53	8.55	0.8	6.5	165
54	7.4	0.9	17.3	255
55	8	1.2	6.4	288
56	8.02	1.1	3.74	296
57	8.3	0.6	1.88	264
58	8.2	1	4.78	1.89
59	8.7	1.22	7.3	212
60	8	1.03	4.16	234

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Table 4.2: Drinking water quality analysis of samples from government schools

Sr.	Chlorides (mg/I)	Fluorides	Hardness	Fecal coliform
Standard value	**250mg/I**	**1-1.5mg/I**	**500mg/I**	
Private Schools				
1	88.75	1.105	221.3	No
2	643.7	17.6	76.5	No
3	88.75	18.48	99.31	No
4	106.5	19.07	211.1	No
5	142	16.27	111.54	No
6	71	20.54	101.22	No
7	88.75	9.031	78.43	No
8	106.5	7.34	287	No
9	71	9.135	111.54	No
10	71	16.701	91.303	yes
11	357	0.265	78.43	No
12	993	0.642	89.33	yes
13	912.6	1.139	213.44	No
14	1244	0.642	127.21	No
15	553.1	106.5	96.254	No
16	106.5	0.408	165	No
17	0.408	232.53	126.2	No
18	232.53	1.434	99.75	yes
19	1.434	0.837	234.5	yes
20	0.837	1.375	89.65	yes
21	1.3575	360	97.45	No
22	360	1.53	221	No
23	1.53	312	164	No
24	312	1.208	187	No
25	1.208	0.162	177	yes
26	0.162	1.687	221	No
27	1.687	1.557	163	No
28	1.557	0.305	121	Yes

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29	0.305	0.456	99	No
30	0.456	0.3505	180	No

Table 4.3: Demographic Information

Demographic Information	Frequency
Gender	
Male	59
female	141
Total	200
Age	
7-12	5
11-15	37
15-18	141
18-22	17
Total	200
Education	
Matriculation	109
Intermediate	24
Graduation	13
Masters	50
PHD	4
Total	200

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Table 4.4: Condition of Water

Questions	Yes	No
Have you noticed any changes in appearance of water e.g. soil or suspended particles in water?	66%	34%
Do you drink water from school water taps?	55.5%	44.5%
Are you satisfied with drinking water quality of your school?	49.5%	50.5%
Do you feel any changes in taste of water?	50.5%	49.5%
Do you feel smell in drinking water?	58.5%	41.5%

Do you suffer from any water borne disease due to poor drinking water quality?	48.5%	7.5%
Do you have any complaints related to drinking water quality of your school?	67.5%	32.5%

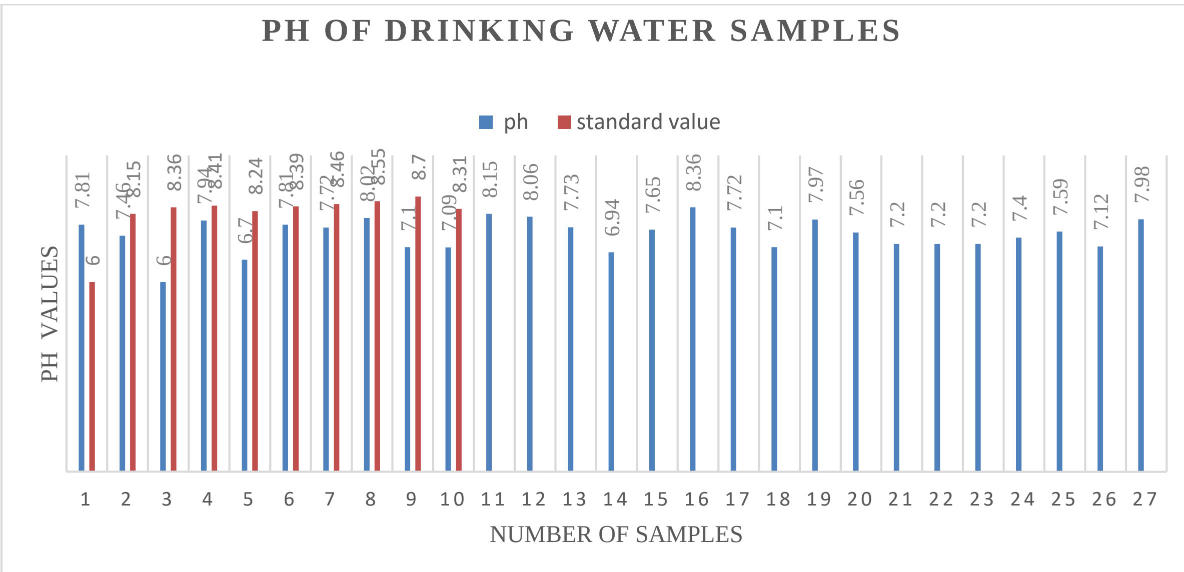

Figure 4.1: pH of drinking water samples from private Schools

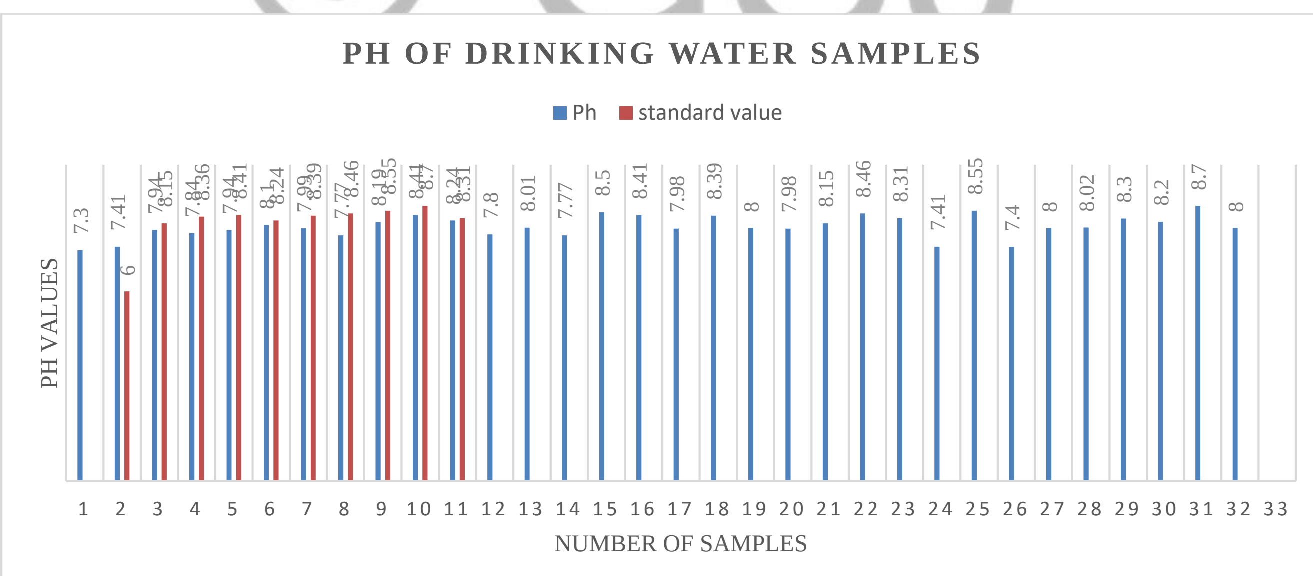

Fig 4.2: pH of drinking water samples from governmnet schools

In the private schools, the pH was within the limits with only a few samples lower than the standard pH and a few samples with pH higher than the standard limit. The pH of the drinking water samples from the private schools were all within the 6.5-8.5 range. Only a few samples from governmnet schools were above the 8.5 limit.

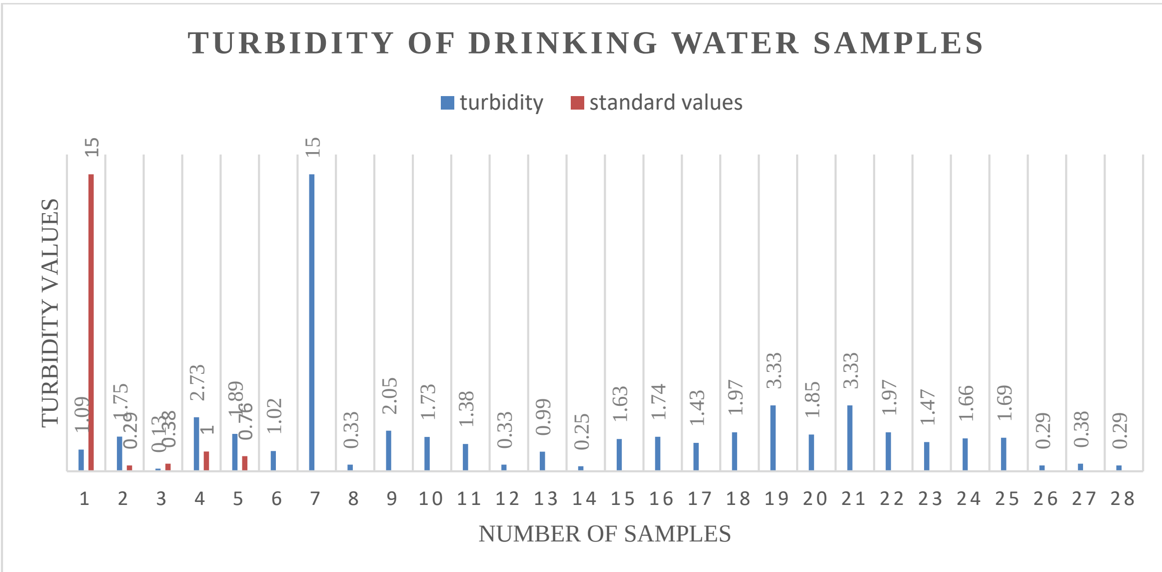

Fig 4.3: Turbidity of drinking water samples from private schools

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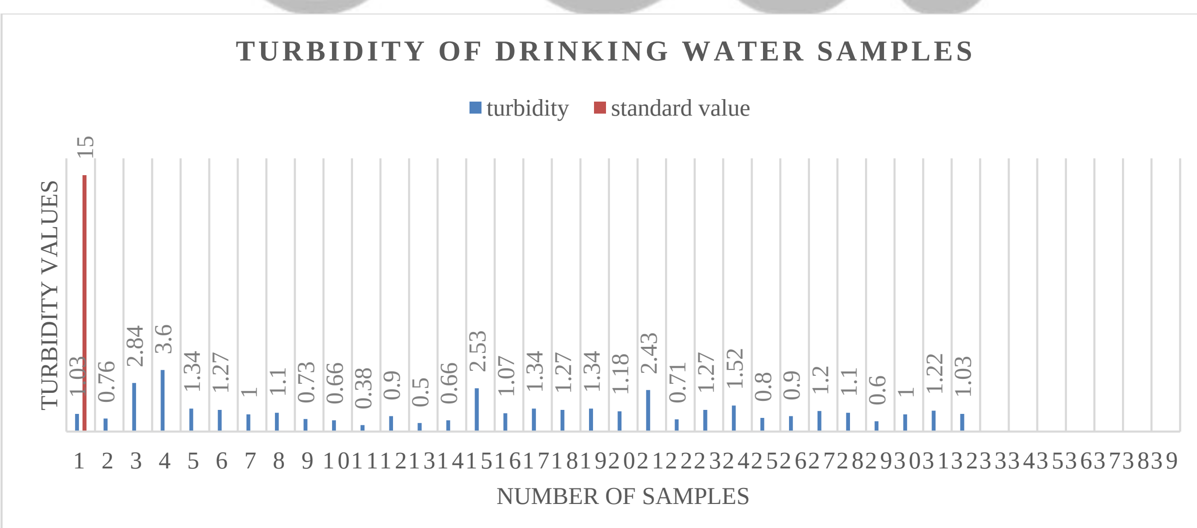

Fig 4.4: Turbidity of drinking water samples from government schools

The standard limit for turbidity is 5NTU. Samples from both private and governmnet schools were within the standard limit for turbidity.

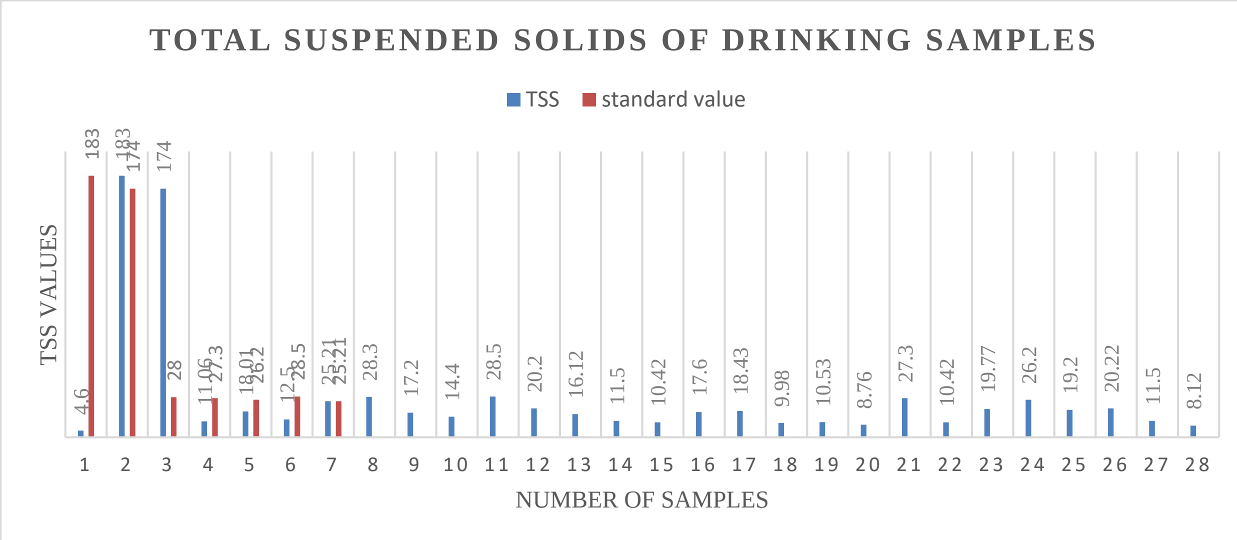

Fig 4.5: TSS values of drinking water samples from private schools

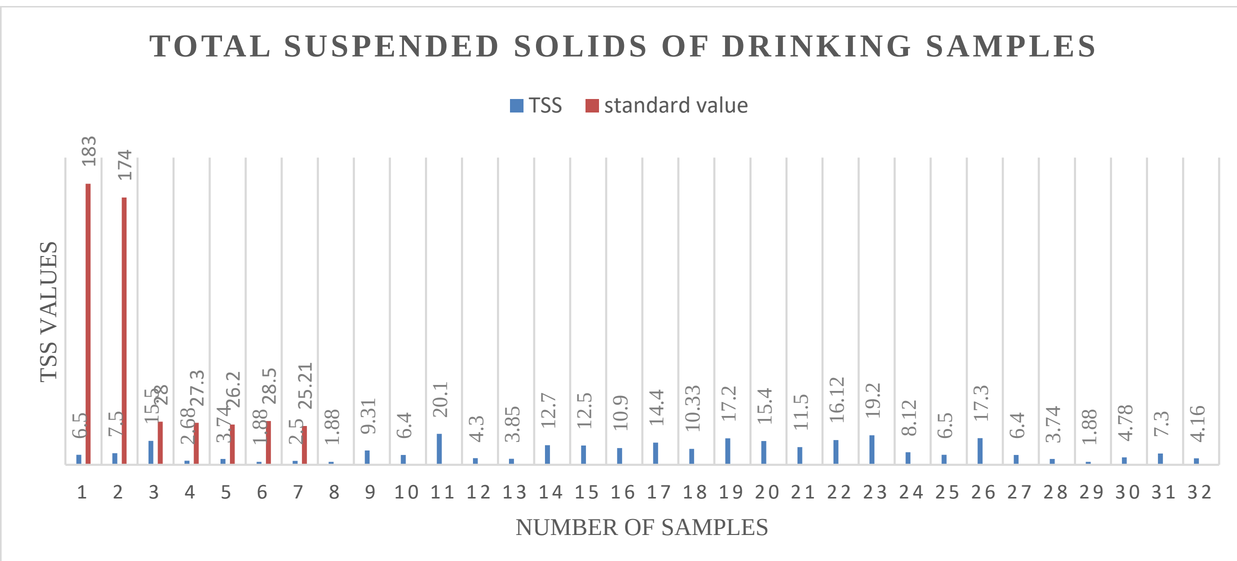

Fig 4.6: TSS values of drinking water samples from governmnet schools

TSS values in drinking water should be below 25mg/I in water. Drinking water samples from private schools showed fluctuations in the values and exceeded the limit. The highest value recorded to be 183mg/I of the drinking water sample from private schools. TSS values of drinking water samples from governmnet schools were within limits.

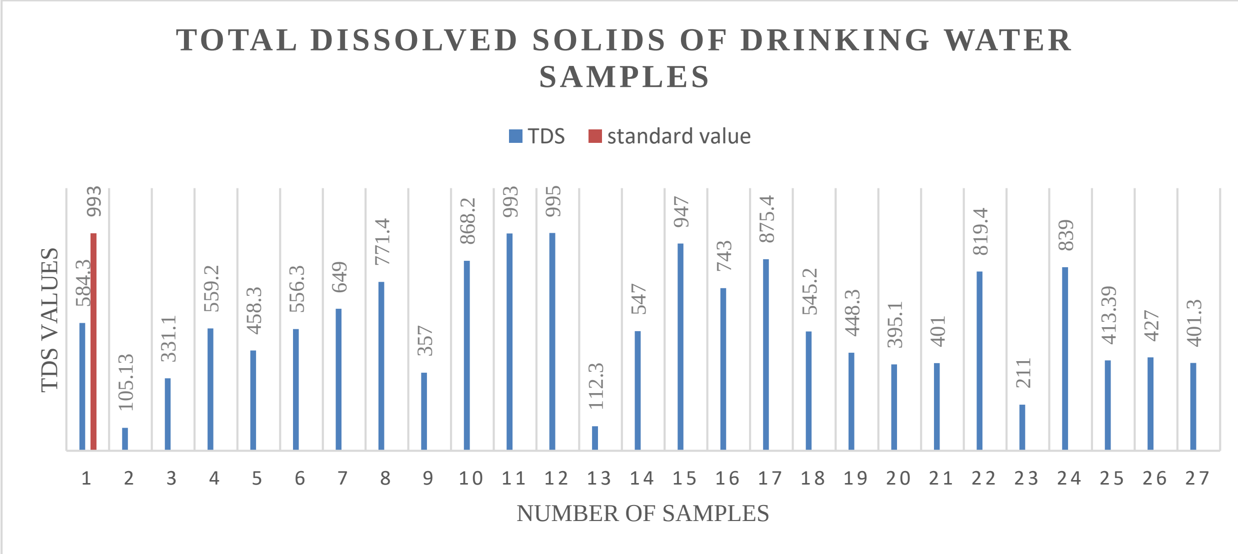

Fig 4.7: TDS values of drinking water samples from private schools

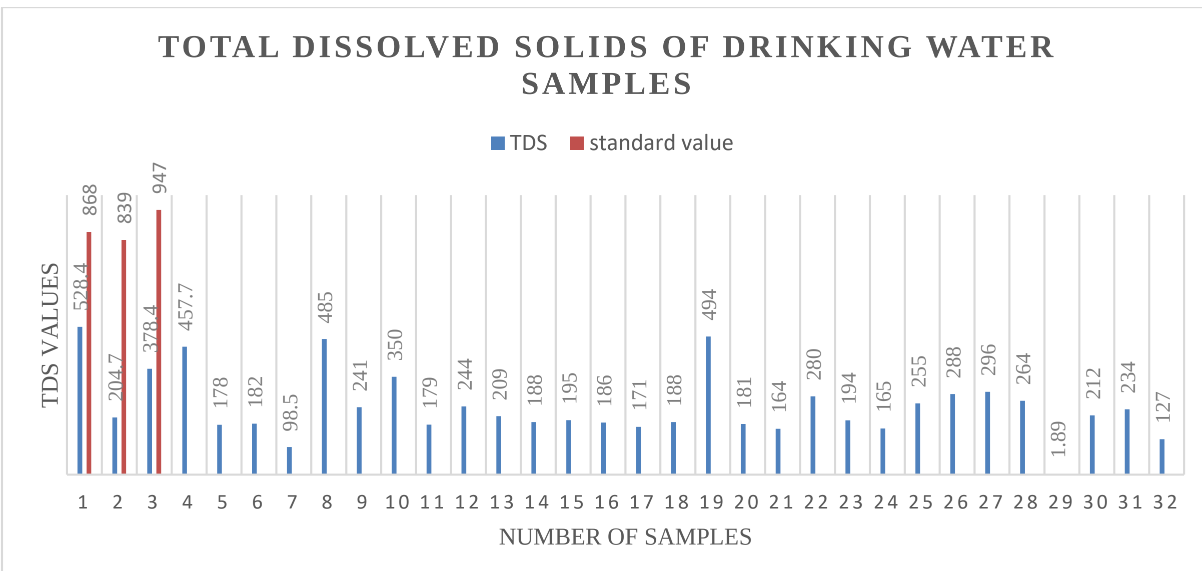

Fig 4.8: TDS values of Drinking water samples from Government schools

The standard limit for TDS in drinking water is 1000ppm. The TDS values from both private and governmnet schools were within the limit and standard values.

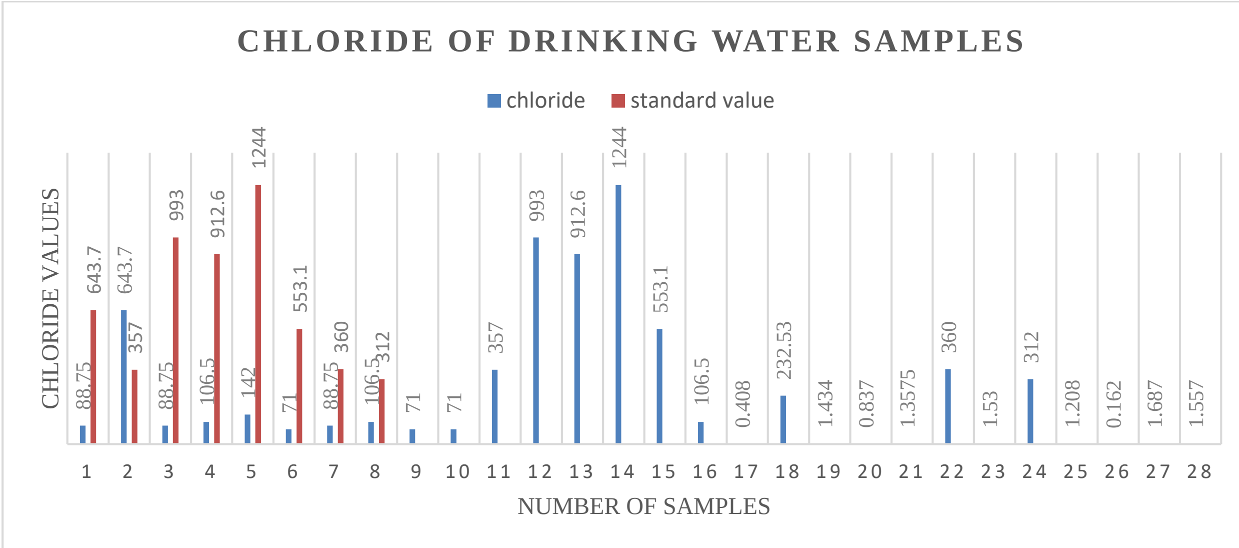

Fig 4.9: chlorides in drinking water samples from private schools

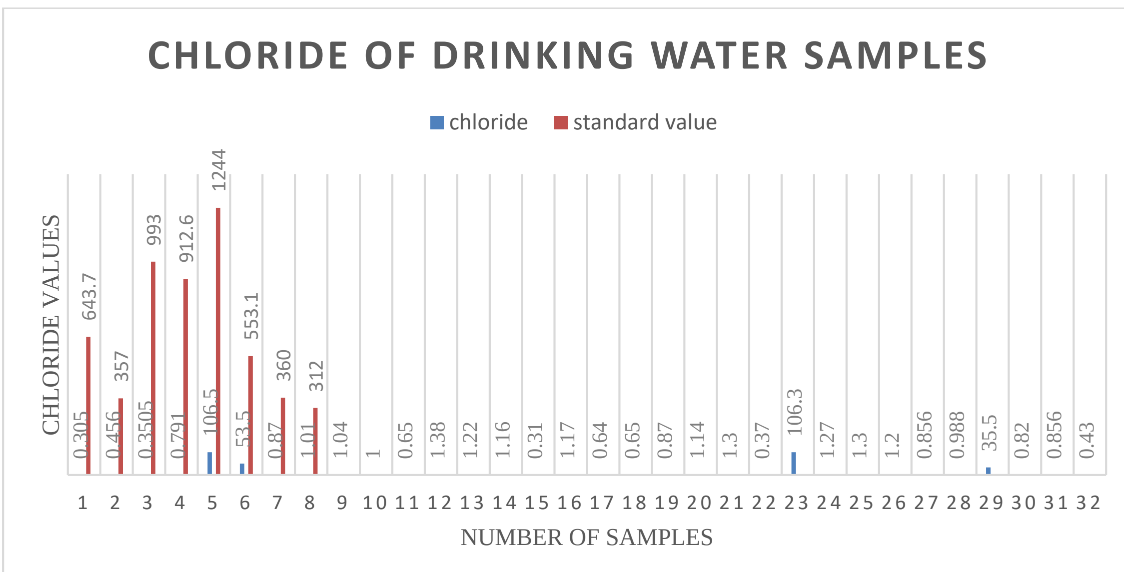

Fig 4.10: chlorides in drinking water samples from Governmnet schools

250mg/I am the standard limit for chlorides in drinking water. Chloride values recorded from the drinking water samples of governmnet schools were within the limit. Some of the samples from governmnet schools were exceeded the standards. The highest chloride value recorded was 1244mg/I.

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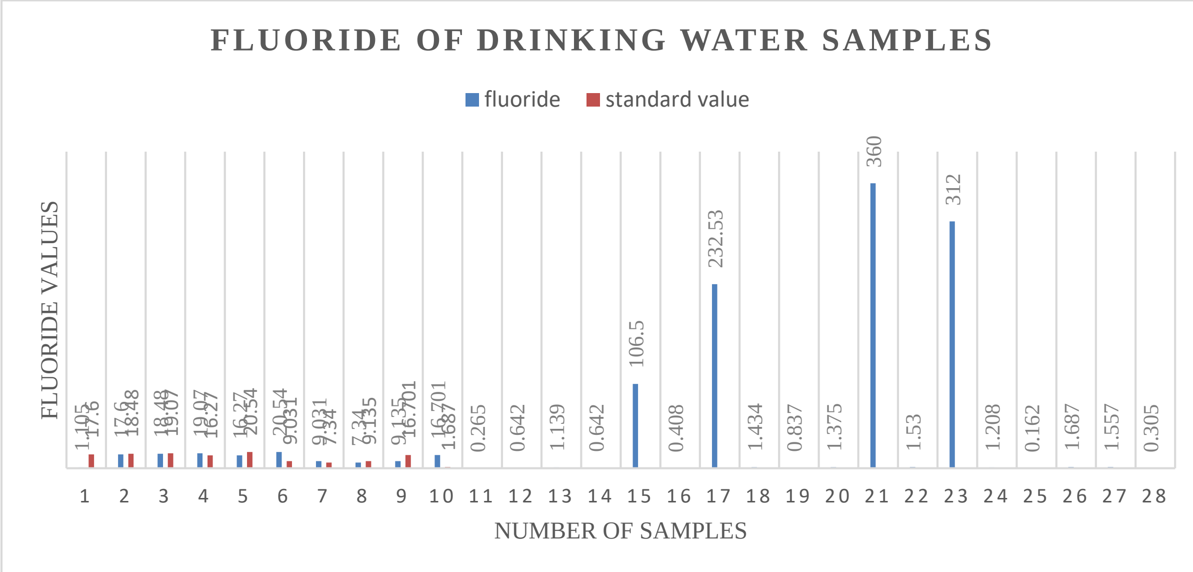

Fig 4.11: fluorides in drinking water samples from private schools

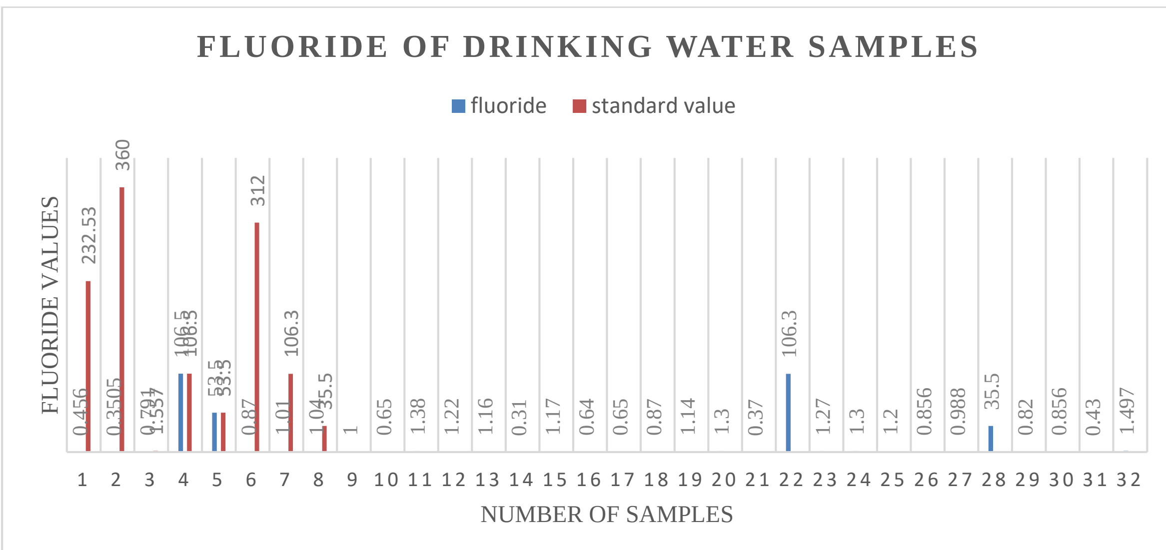

Fig 4.12: fluorides in drinking water samples from governmnet schools

The standard limit for fluorides in drinking water is 1.5mg/L. the values in drinking water samples were highly fluctuating but mostly remained within the limits. Some of the samples from private schools were exceeded. The values recorded from the samples of governmnet schools were within the standard limit. The highest value recorded was 360 mg/L.

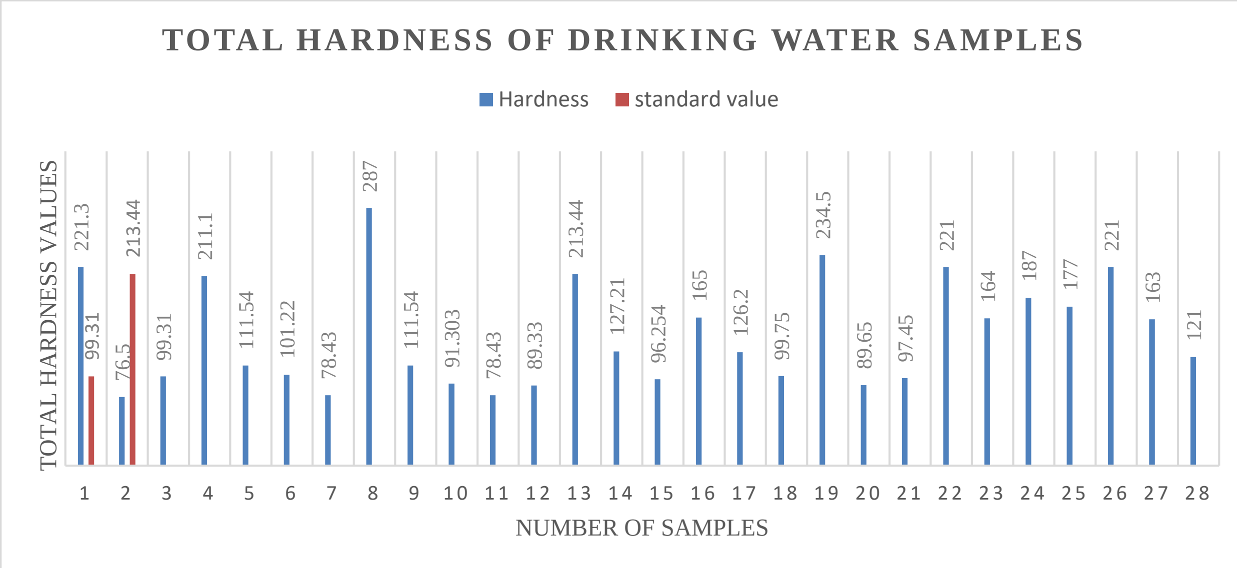

Fig 4.13: total hardness in drinking water from private schools

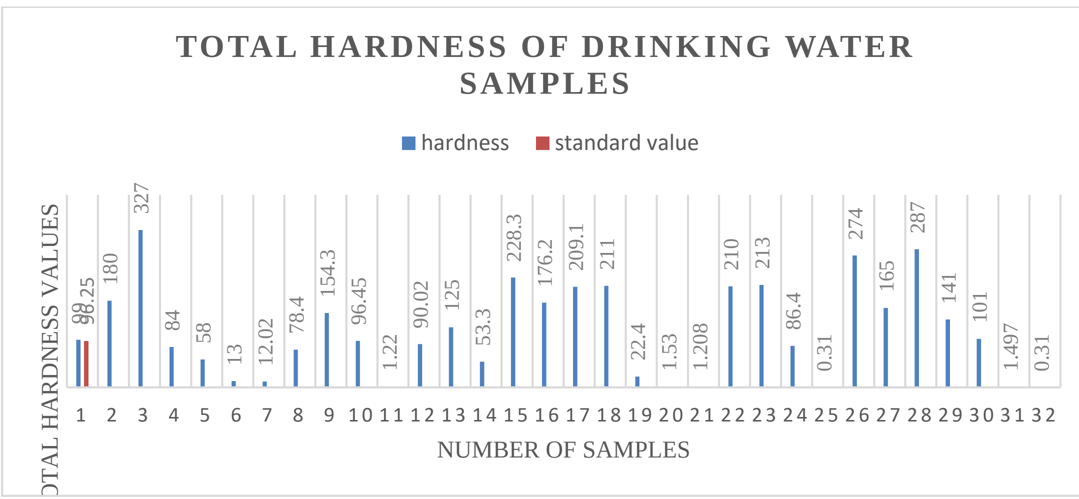

Fig 4.14: Total hardness in drinking water from governmnet schools

The standard limit for total hardness in drinking water is 500mg/I. The highest value recorded was 234.5 mg/I was below the standard set by WHO. Samples from both private and governmnet schools mostly were below the standard limit.

Fecal coliform

In drinking water, no fecal coliform should be found. Drinking water should be clean from any kind of biological organisms. The samples from governmnet and private schools showed no presence of any biological organism but some samples from governmnet showed presence of biological organisms.

DISCUSSION

Safe drinking water is a basic need for good health, and it is also basic right of humans. Fresh water is already a limiting resource in many parts of world. In the next century it will become even more limiting due to increased population. The study explored the drinking water quality of Chawinda, district Sialkot through the collection of 60 samples from the private and governmnet schools. Many studies have shown that in many areas of Pakistan water quality is deteriorating [23,24]. The color, odor and taste of drinking water samples in the study area were found within the acceptable limits except for water samples from governmnet high school Chawinda. pH is considered to be significant parameter in water quality analysis. PH indicates the alkaline or acidic nature of water. If the pH of water sample is below 7, the sample is considered acidic. If the pH of water is above 7, water sample is alkaline. The majority of water samples had pH values within the permissible limits set by WHO. Only some samples of governmnet schools were crossing the limit. The minimum value of pH 6 was found in tap water of city public school Chawinda. The Maximum value of pH 8.55 was found in tap water at governmnet girls' high school Chawinda. The water with low pH often has corrosive nature and have serious consequences on human health if consumed beyond permissible limits.

Many samples of fluorides were above the limits. High level of fluoride in water can cause dental

Turbidity water indicates the presence of TSS and TDS. The high turbidity value indicates that water is not as clean as it might appear. Water with high level of turbidity cause diseases. All the turbidity values were found within the permissible limits set by WHO. Moreover, the minimum value of turbidity was found 0.33 NTU in the tap water of Army public school Chawinda. Whereas, the maximum turbidity value was found in the spring water of Governmnet girls' Middle school, Chawinda.

Similarly, the TDS presence indicates presence of chlorides ions. The higher the TDS in water, the higher chemical and biological oxygen demand leading to decreasing level of dissolved oxygen in water. TDS values were also seen to be crossing the standard value of private schools the lowest value of 1.89mg/I was found at unique public high school Chawinda. The maximum value of 995mg/I was found in the hand pump water sample from Islamic high school Chawinda.

Drinking water with high TDS values is considered unfit for human consumption as it indicates the presence of ions like sodium, potassium, chloride and other toxic ions. Due to presence of such ions the water might taste salty and bitter.

TSS are the suspended solids which can be separated from water with the help of filter paper as their size is generally bigger than the TDS. As it can be seen from the graphs the samples from private schools revealed high TSS values.[31] TSS values of governmnet schools were found within the limit. Due to presence of suspended solids

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fluorosis in people. Samples from private and governmnet schools were seen to be crossing the limits.[38]

Fecal coliform was confirmed in the water samples from private and governmnet schools which confirm the suspicion that biological impurities are common in drinking water. Waterborne diseases can occur due to these pathogenic microorganisms some of diseases include typhoid, fever, Hepatitis A [32]. Coliform bacteria may not likely cause illness however their presence indicates other disease-causing organisms in water system.

water does not appear clean. Hardness which is the measure of minerals like calcium and magnesium was determined by using the titration method. All the samples were within the permissible limits set by WHO. Chloride in drinking water mainly occurs due to disinfection of water. samples from the private schools were crossing the limit.[25]

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Conclusion

The analysis and results led to the conclusion that the biological parameter total coliform and the physio-chemical parameters, such as ph, turbidity, chloride, TDS, TSS, fluorides, and total hardness, in this study region were found to exhibit a greater variety of WHO and PAK-EPA standard. Fecal coliform bacteria were also present in the sources of polluted drinking water. Furthermore, the data from the questionnaire survey show that primary school students had a greater prevalence of most waterborne infections, perhaps because they were the most susceptible age group for these illnesses

ACKNOWLEGMENTS

I start in the name of Allah the most Gracious and the most merciful. All praises are for Allah who is the source of knowledge and enlightenment and endowed to humanity and all respects for his Last prophet (P.B.U.H) First and foremost, I am grateful to Allah Almighty for giving me the strength and the knowledge to work on this research and complete it to the best of my efforts. Further, I would like to thank my institute, Kinnaird College and its principal **Dr. Rukhsana David** for giving me this opportunity.

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FATIMA NASEER

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Tables

Table 4.1: Drinking water quality analysis of samples from private Schools

Sr.	pH	Turbidity NTU	TSS mg/I	TDS ppm
Standard value	**6.5-8.5**	**5NTU**	**25mg/I**	**1000ppm**
Private Schools				
1	7.81	1.09	4.6	584.3
2	7.46	1.75	183	105.13
3	6	0.13	174	331.1
4	7.94	2.73	11.06	559.2
5	6.7	1.89	18.01	458.3
6	7.81	1.02	12.5	556.3
7	7.72	15	25.21	649
8	8.02	0.33	28.3	771.4
9	7.1	2.05	17.2	357
10	7.09	1.73	14.4	868.2

11	8.15	1.38	28.5	993
12	8.06	0.33	20.2	995
13	7.73	0.99	16.12	112.3
14	6.94	0.25	11.5	547
15	7.65	1.63	10.42	947
16	8.36	1.74	17.6	743
17	7.72	1.43	18.43	875.4
18	7.1	1.97	9.98	545.2
19	7.97	3.33	10.53	448.3
20	7.56	1.85	8.76	395.1
21	7.2	3.33	27.3	401
22	7.2	1.97	10.42	819.4
23	7.2	1.47	19.77	211
24	7.4	1.66	26.2	839
25	7.59	1.69	19.2	413.39
26	7.12	0.29	20.22	427
27	7.98	0.38	11.5	401.3
28	8	0.29	8.12	804.1
29	7.3	1.03	6.5	528.4
30	7.41	0.76	7.5	204.7
Government Schools				
31	7.94	2.84	15.5	204.7
32	7.84	3.6	2.68	378.4
33	7.94	1.34	3.74	457.7
34	8.1	1.27	1.88	178
35	7.99	1	2.5	182
36	7.77	1.1	1.88	98.5
37	8.19	0.73	9.31	485
38	8.41	0.66	6.4	241
39	8.24	0.38	20.1	350
40	7.8	0.9	4.3	179
41	8.01	0.5	3.85	244

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42	7.77	0.66	12.7	209
43	8.5	2.53	12.5	188
44	8.41	1.07	10.9	195
45	7.98	1.34	14.4	186
46	8.39	1.27	10.33	171
47	8	1.34	17.2	188
48	7.98	1.18	15.4	494
49	8.15	2.43	11.5	181
50	8.46	0.71	16.12	164
51	8.31	1.27	19.2	280
52	7.41	1.52	8.12	194
53	8.55	0.8	6.5	165
54	7.4	0.9	17.3	255
55	8	1.2	6.4	288
56	8.02	1.1	3.74	296
57	8.3	0.6	1.88	264
58	8.2	1	4.78	1.89
59	8.7	1.22	7.3	212
60	8	1.03	4.16	234

Table 4.2: drinking water quality analysis of samples from governmnet Schools

Sr.	**Chlorides (mg/I)**	**Fluorides**	**Hardness**	**Fecal coliform**
Standard value	**250mg/I**	**1-1.5mg/I**	**500mg/I**	
Private Schools				
1	88.75	1.105	221.3	No
2	643.7	17.6	76.5	No
3	88.75	18.48	99.31	No
4	106.5	19.07	211.1	No
5	142	16.27	111.54	No
6	71	20.54	101.22	No
7	88.75	9.031	78.43	No
8	106.5	7.34	287	No
9	71	9.135	111.54	No

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10	71	16.701	91.303	yes
11	357	0.265	78.43	No
12	993	0.642	89.33	yes
13	912.6	1.139	213.44	No
14	1244	0.642	127.21	No
15	553.1	106.5	96.254	No
16	106.5	0.408	165	No
17	0.408	232.53	126.2	No
18	232.53	1.434	99.75	yes
19	1.434	0.837	234.5	yes
20	0.837	1.375	89.65	yes
21	1.3575	360	97.45	No
22	360	1.53	221	No
23	1.53	312	164	No
24	312	1.208	187	No
25	1.208	0.162	177	yes
26	0.162	1.687	221	No
27	1.687	1.557	163	No
28	1.557	0.305	121	Yes
29	0.305	0.456	99	No
30	0.456	0.3505	180	No

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Table 4.3: Demographic Information

Demographic Information	**Frequency**
Gender	
Male	59
female	141
Total	200
Age	
7-12	5
11-15	37
15-18	141
18-22	17

Total	200
Education	
Matriculation	109
Intermediate	24
Graduation	13
Masters	50
PHD	4

Table 4.4: Condition of Water

Questions	Yes	No
Have you noticed any changes in appearance of water e.g. soil or suspended particles in water?	66%	34%
Do you drink water from school water taps?	55.5%	44.5%
Are you satisfied with drinking water quality of your school?	49.5%	50.5%
Do you feel any changes in taste of water?	50.5%	49.5%
Do you feel smell in drinking water?	58.5%	41.5%
Do you suffer from any water borne disease due to poor drinking water quality?	48.5%	7.5%
Do you have any complaints related to drinking water quality of your school?	67.5%	32.5%

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Figures

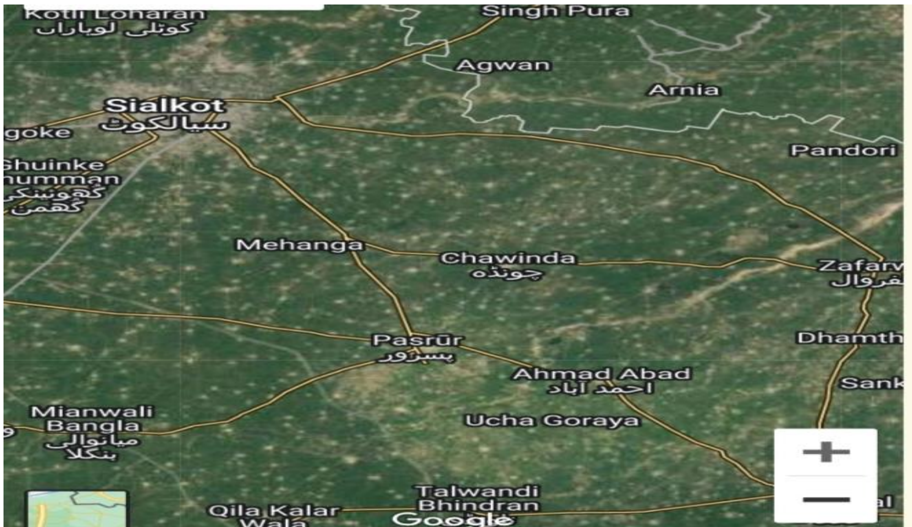

Figure 3.1: Map of study area

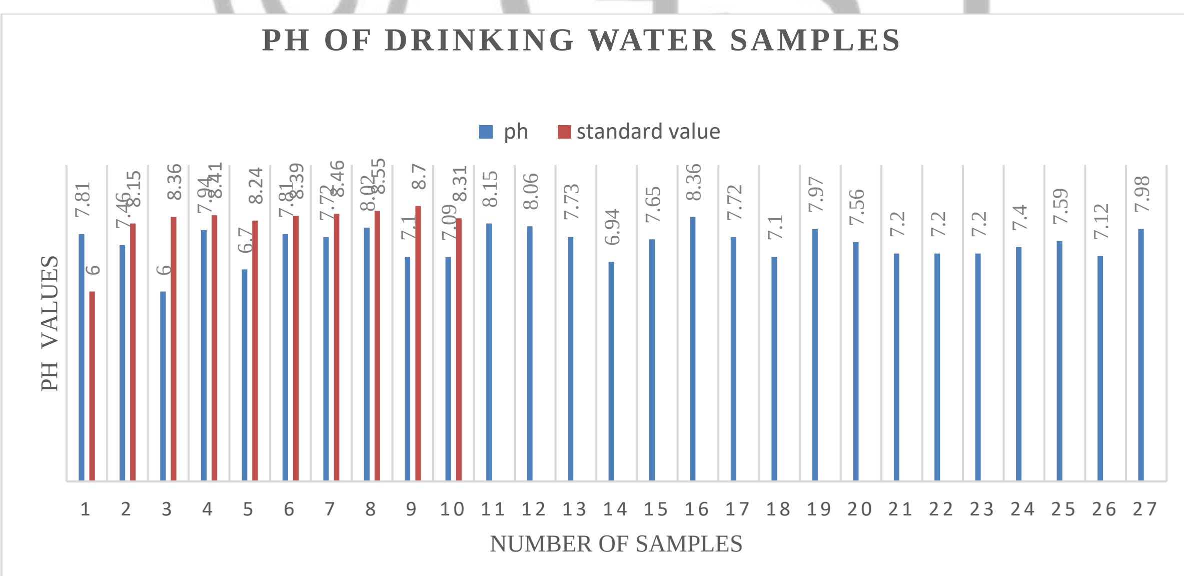

Figure 4.1: pH of drinking water samples from private Schools

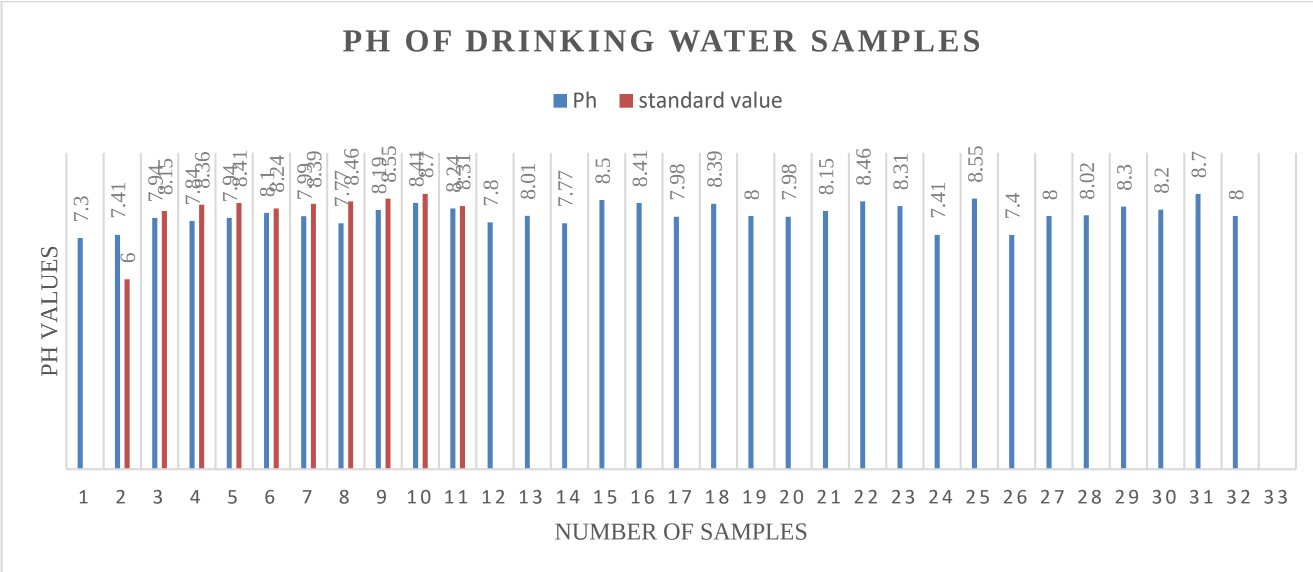

Fig 4.2: pH of drinking water samples from governmnet schools

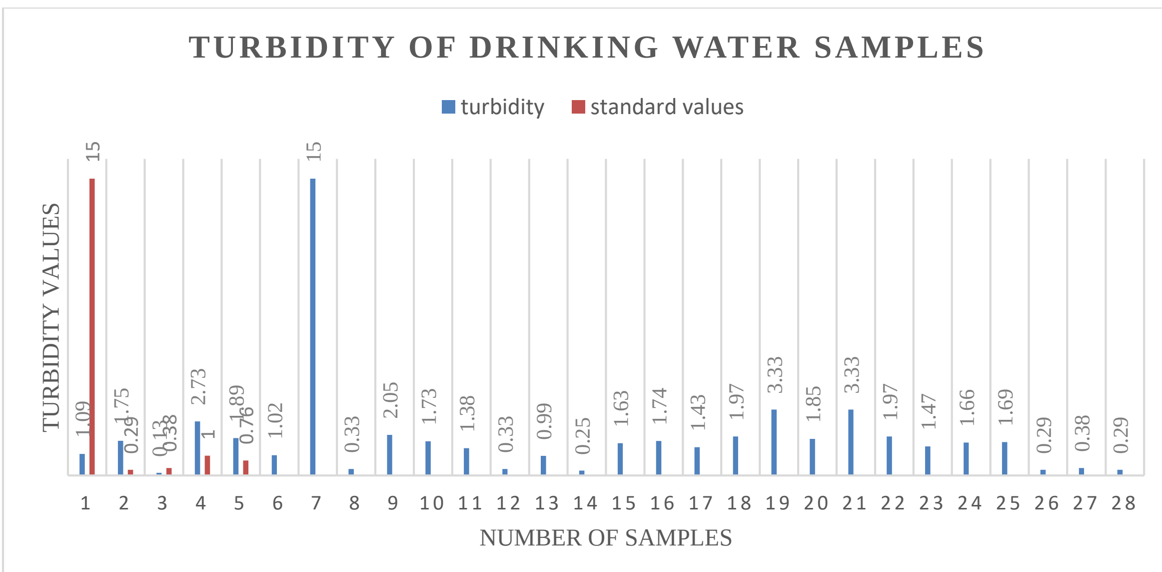

Fig 4.3: Turbidity of drinking water samples from private schools

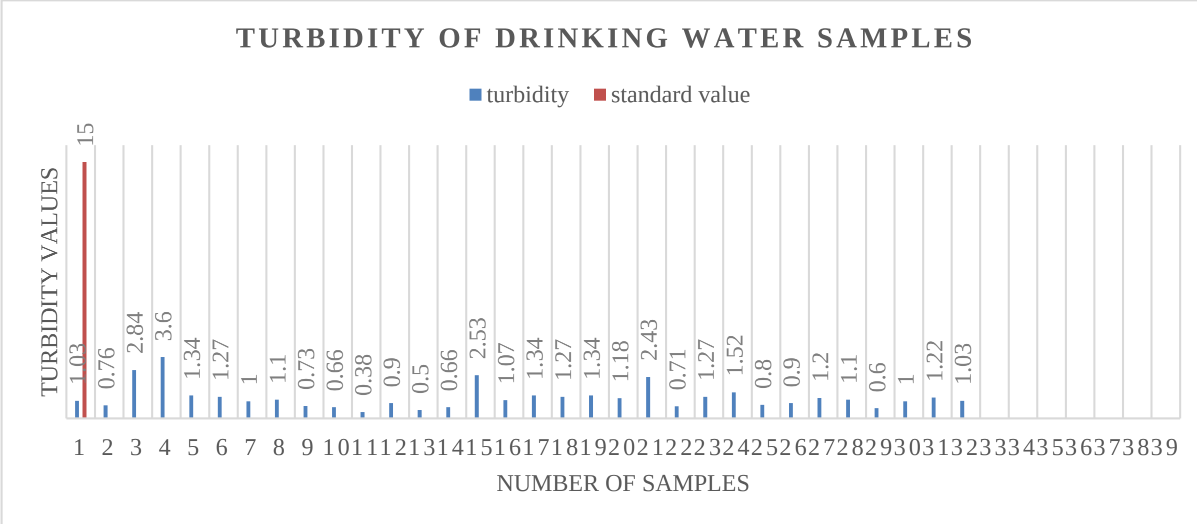

Fig 4.4: Turbidity of drinking water samples from government schools

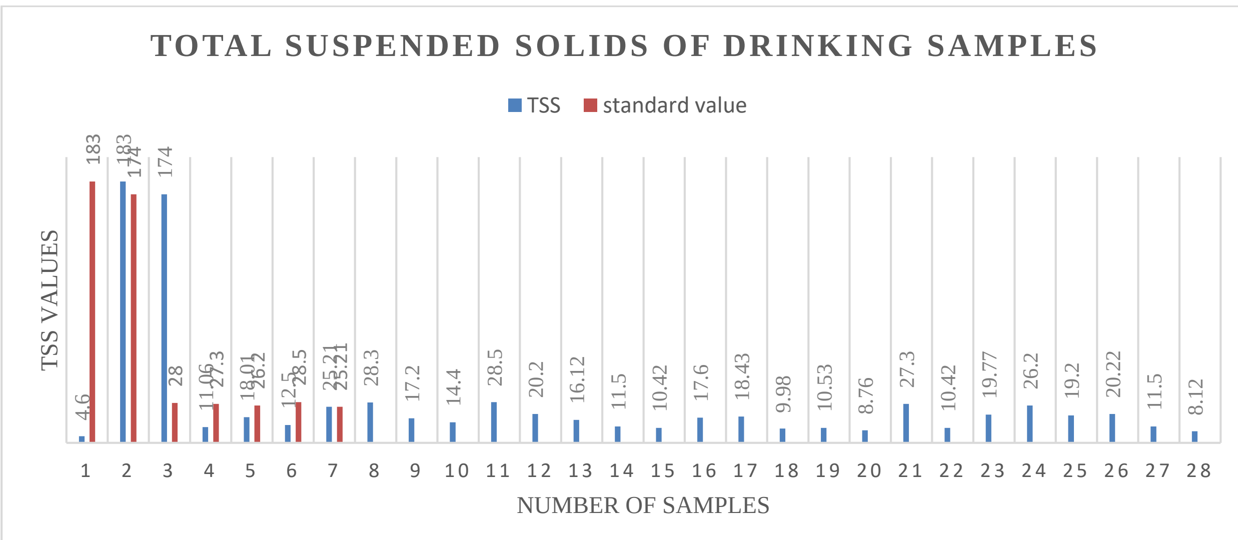

Fig 4.5: TSS values of drinking water samples from private schools

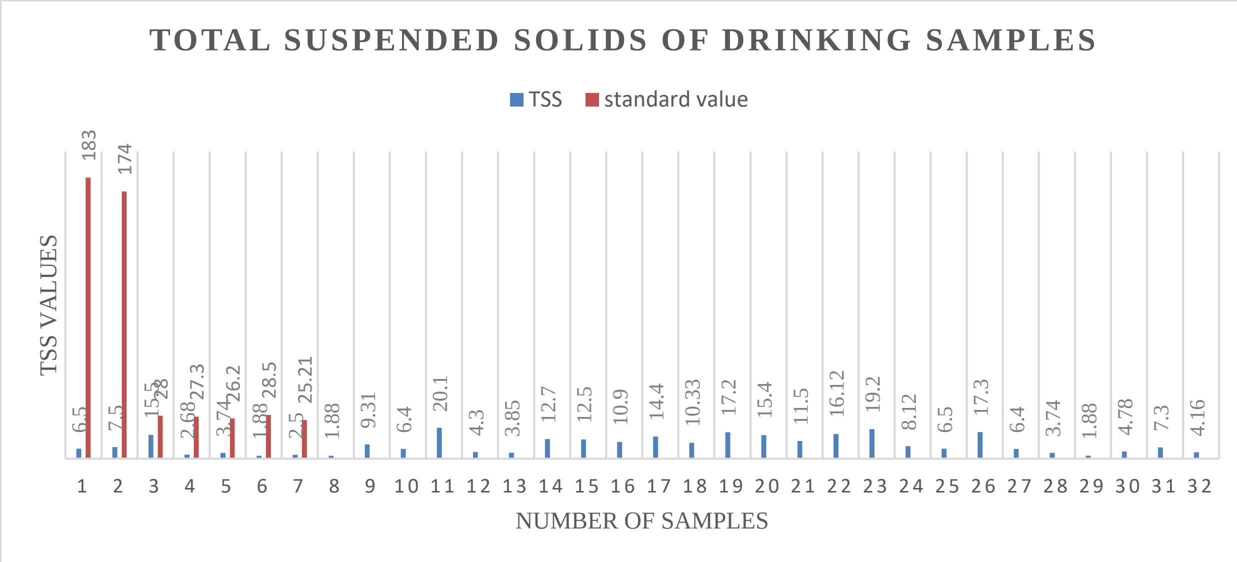

Fig 4.6: TSS values of drinking water samples from governmnet schools

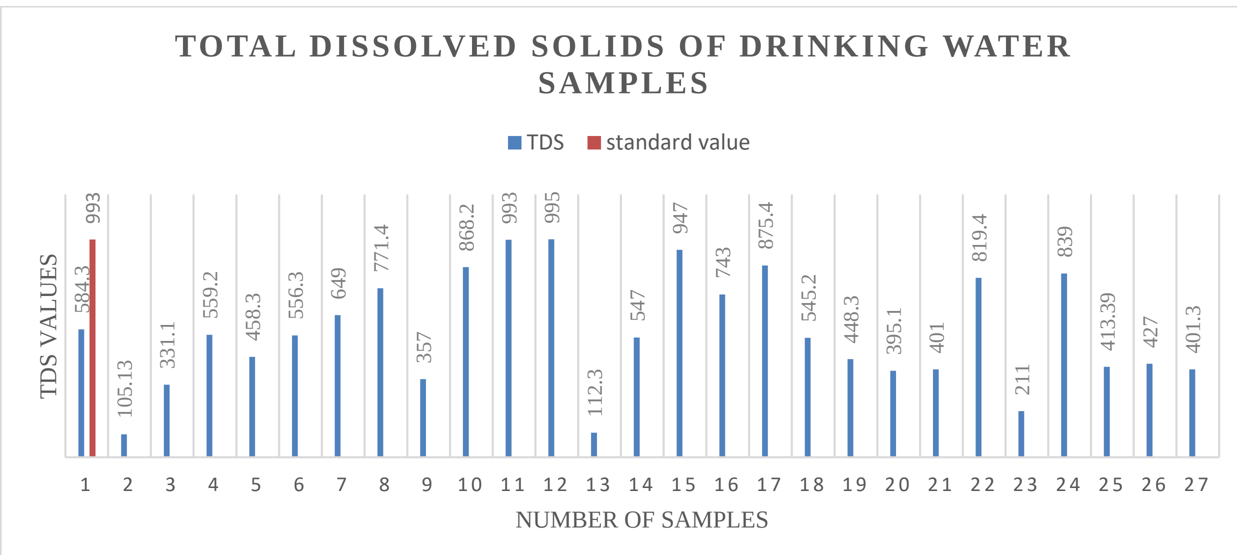

Fig 4.7: TDS values of drinking water samples from private schools

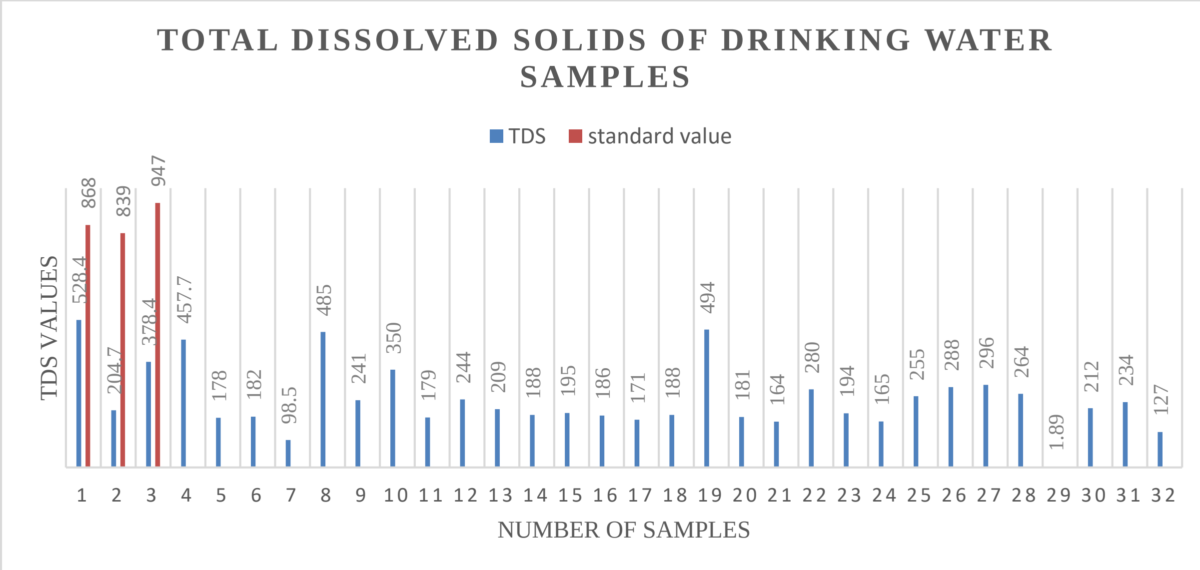

Fig 4.8: TDS values of Drinking water samples from Government schools

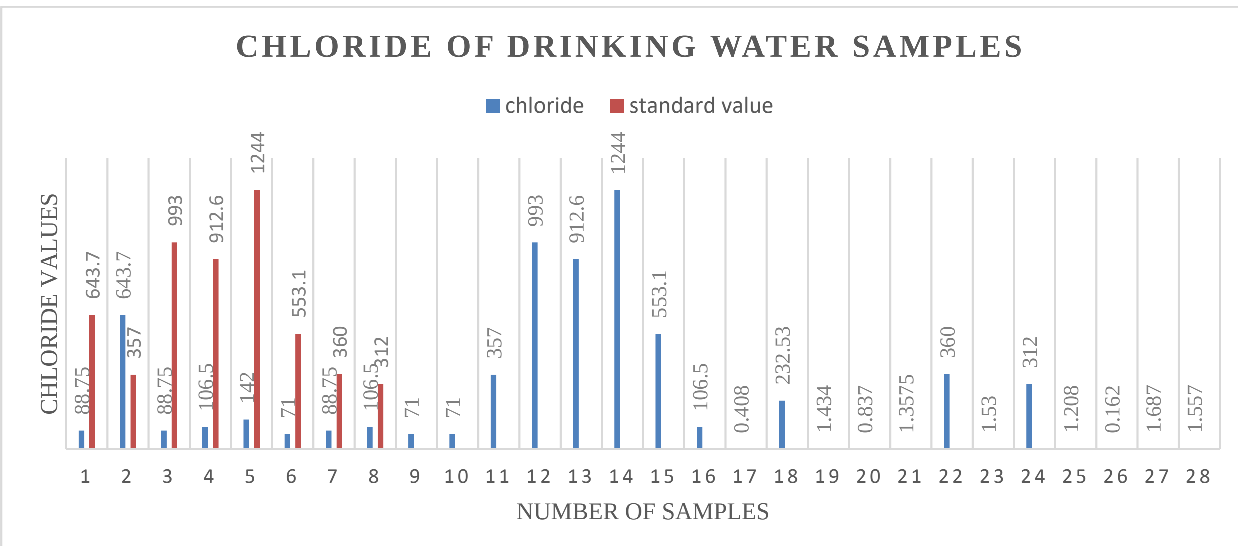

Fig 4.9: chlorides in drinking water samples from private schools

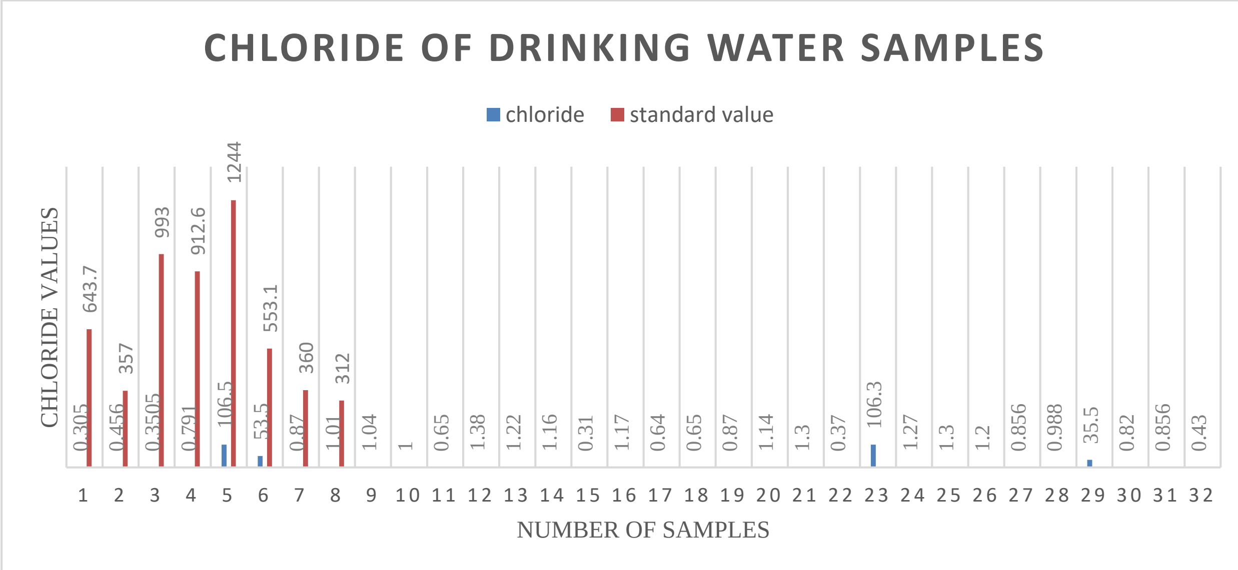

Fig 4.10: chlorides in drinking water samples from Governmnet schools

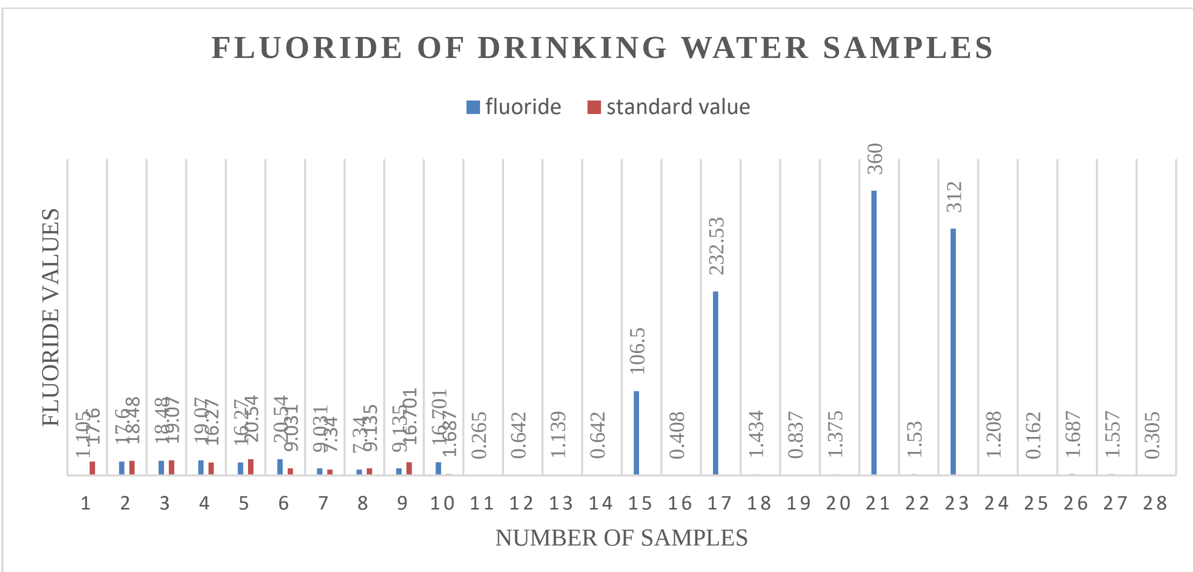

Fig 4.11: fluorides in drinking water samples from private schools

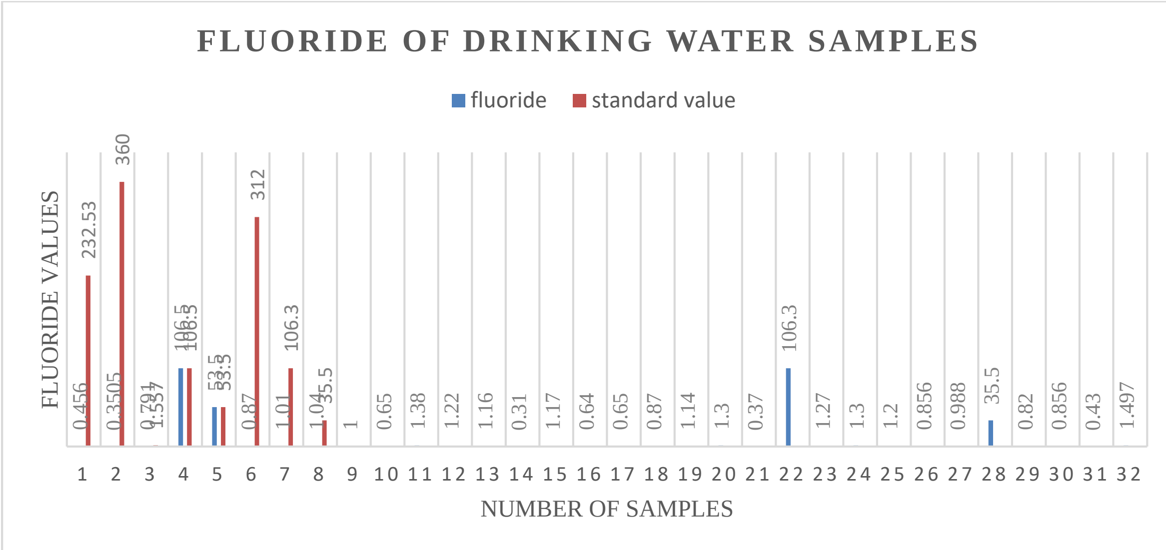

Fig 4.12: fluorides in drinking water samples from governmnet schools

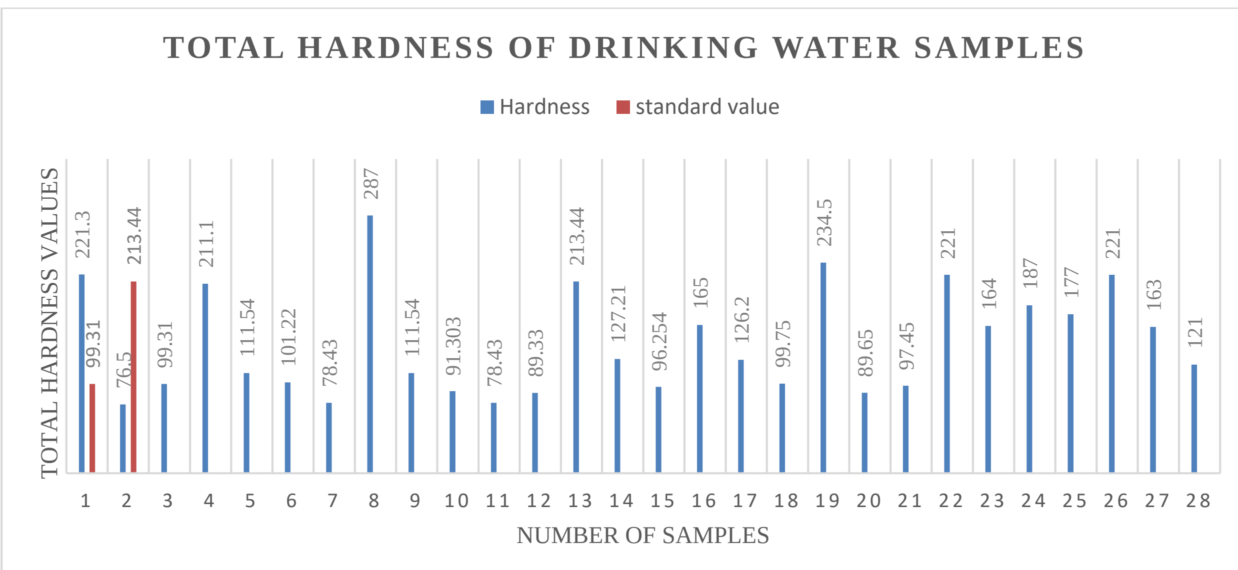

Fig 4.13: total hardness in drinking water from private schools

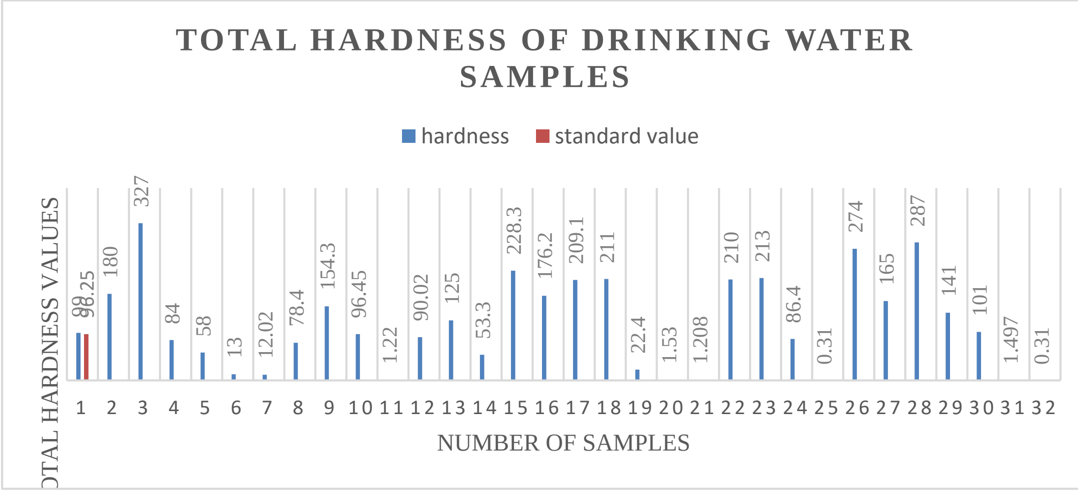

Fig 4.14: Total hardness in drinking water from governmnet schools

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