Fluoride Levels in Drinking Water and Its Impact on Children's Oral Health: A Comparative Study between two Schools (Zawia city)

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Abstract

Fluoride is a crucial component in water, influencing dental health by potentially improving or diminishing issues like tooth decay and discoloration. To understand this better ,we have studied water samples were collected from two schools in Zawia city to evaluate fluoride levels and students' oral health. One school located in Judaim district and the other one in Harsha were chosen for analysis. Water samples were tested at specialized labs in Zawia oil refinery company using a DR 6000 UV-VIS Spectrophotometer. Results showed that Al Taher El Zawy School had a fluoride level of 0.36, whereas EMhamed Ajili School had no detectable fluoride. Comparatively, Al Taher El Zawy School exhibited better water quality in terms of fluoride content. WHO recommends fluoride levels in drinking water between 0.1 to 1.5.

Furthermore, a questionnaire was distributed to 50 students from each school aged 11 to 18 to gather data on water sources, usage, dental issues, and oral hygiene practices. Data were analyzed using descriptive statistics and the Mann-Whitney test, revealing that most students consumed water for drinking. Factors like lack of knowledge and poor oral hygiene may be contributing. This research aids in understanding the importance of optimal fluoride levels in drinking water for overall well-being, particularly in Zawia and Harsha. These findings stress the need for oral health education and regular dental check-ups.

Keywords: Fluoride, Discoloration, Teeth Decay, Oral Health, World Health Organization.

Introduction

Fluoride is an essential mineral that has been widely recognized for its role in preventing dental caries and promoting oral health. However, excessive or insufficient levels of fluoride in drinking water can have adverse effects on dental health. Therefore, it is crucial to assess the fluoride content in water sources and examine its impact on teeth. Fluoride is a common trace element found in various water sources, with higher concentrations typically associated with underground sources. Seawater, for instance, has been noted to possess a total fluoride concentration of 1.3 mg/liter. In regions rich in fluoride-containing minerals, well water may contain up to approximately 10 mg of fluoride per liter, with the highest naturally occurring fluoride level reported to be 2800 mg/liter. Industrial discharges are another source of fluoride introduction into rivers[1].

Groundwater fluoride concentrations vary based on the type of rock the water passes through, usually not exceeding 10 mg/liter [2]. In the Rhine River in the Netherlands, fluoride levels are below 0.2 mg/liter, while in the Meuse River, concentrations range from 0.2 to 1.3 mg/liter due to industrial processes [1]. Certain Chinese villages have reported groundwater fluoride concentrations exceeding 8 mg/liter [3].In Canada, drinking water fluoride levels range from >0.05-0.2 mg/liter in non-fluoridated municipal waters to 0.6-1.1 mg/liter in fluoridated waters. Well water used for drinking purposes has been reported to contain levels of up to 3.3 mg/liter. In the USA, about 0.2% of the population is exposed to fluoride levels exceeding 2.0 mg/liter [2]. In the Netherlands, average fluoride concentrations in all drinking water plants remain below 0.2 mg/liter [1]. In certain African countries with fluoride-rich soils, drinking water levels can reach high concentrations, such as 8 mg/liter in the United Republic of Tanzania [2].Studies have shown that an appropriate balance of fluoride concentration is crucial. Drinking water with fluoride concentrations around 1 mg/liter has been linked to a reduced incidence of dental caries, particularly in children. However, excessive fluoride intake can lead to dental fluorosis, resulting in enamel erosion. Finding a balance between the benefits of fluoride and the risks of dental fluorosis is vital in public health programs (IPCS, 2002)[4]. Research indicates that dental caries decreases as fluoride concentration in water increases. For instance, the average number of Decayed, Missing, or Filled teeth drops from seven at a fluoride concentration of 0.1 mg/liter to around 3.5 at 1.0 mg/liter. However, the decline in dental decay becomes minimal beyond 2.6

mg/liter. On the other hand, dental fluorosis becomes more common as fluoride concentration increases. At 1 mg/liter, approximately 20% of children exhibit mild dental fluorosis, which is usually not noticeable [5]. Dental fluorosis is primarily a cosmetic effect, ranging from barely noticeable to severe staining or pitting of the teeth. It occurs due to elevated fluoride levels during enamel development [6]. Dental fluorosis typically develops in children, not in adults. When observed in adults, it is often due to high fluoride exposure during childhood or adolescence. In this study aims to compare the fluoride levels in drinking water between two schools in Zawia City and assess its impact on the oral health of children attending these schools. By examining these factors, we seek to gain a better understanding of the potential risks associated with varying fluoride concentrations in drinking water and their effects on children's oral health.

MATERIAL AND METHODS

The samples were taken from two schools in Zawia city in two different locations, and the choice of the two schools were randomly selected to determine the fluoride ratio of the water that our children drink and to know its effect on the health of the teeth. In this experimental work, we focused on studying the fluoride ratio in water samples obtained from two different sources.

To conduct this study, water samples were collected from two schools situated in the city of Zawia. The selected schools represented different areas, Zawia and Harsha. The samples were obtained using standardized procedures to ensure accuracy and reliability.The water samples were then analyzed at the Laboratory of Environment Protection and Pollution Control, Zawia Oil Refining Company. The analysis involved measuring the fluoride content in the water samples using established laboratory techniques and instruments. The obtained fluoride ratio was compared with the fluoride health standards set by the WHO [7],[8] to determine the adequacy or excessiveness of fluoride levels.

Here is an organized presentation of the tools, materials, and devices used in this study, as well as the testing method employed:

DR 6000 Spectrophotometer: Used for measuring the absorbance or transmittance of light by a sample to determine its concentration or properties, pH meter, Calibration device. Graduated cylinder, Conical flask, Graduated cup of glass, Magnet, Measuring cylinder, Beaker, Corks and Sample bottle (0.5 ml).

Total hardness indicator (tablet), Aluminum chloride, Calcium hardness indication tablet, NaOH, Spands reagent for fluoride, Iron reagent, Chlorine reagent**,** Indicator potassium chloride, Distilled water.

Method of Testing:

Water Collection: The nearest water faucet was open to the well for five minutes to flush out any stagnant water. Collect the water sample in a clean water container and immediately seal it to prevent contamination. Store the sample in a cool place until further testing.

Laboratory Testing: On the following day, bring the collected water sample to the laboratory for testing. Perform the appropriate tests using the specified tools, materials, and devices mentioned above.

Experimental Procedure: First Initiate the Fluoride Program 195 and then extract a 40 ml sample and transfer it to a Graduated cylinder, after that extract 40 ml of distilled water. Add 2 ml of the spands reagent for fluoride to both the sample water and distilled water. Then observe any reactions and the emission of fumes. After complete the timer press read and then the result appears on screen figure(1).

Figure (1) fluoride results (A) fluoride level in Emhemmed Alajeily (B) fluoride level in Altaher Alzawi

Survey

questionnaires were distributed to the two schools and a paper containing 13 questions per 100 sheets distributed equally 50 sheets per school (A and B) . There were questions for responsible better than principals about the water well. The entire questionnaire was compiled without any loss and we then analyzed the statistics. Statistical tests were conducted to ensure that there were statistically significant differences between the two study samples. Since the questions or data are not quantitative, the Mann-Whitney test, which is used to compare two independent mediums, was performed.

Statistical tests were conducted using the SPSS program. The tests were two-sided and therefore the results of the significance were compared with the level of significance 0.025 instead of 0.05, which is used for the tests of one party . Thus the following results were obtained.

RESULTS AND DISCUSSION

First: Study the results of water samples analysis

Fluoride occurs naturally in the earth's water systems[9].Groundwater can have a fluoride content that far exceeds the level recommended for human health, so adjustment of fluoride levels is necessary to ensure that drinking water does not impact human health [10]. This paper reviews the health concerns associated with drinking water that contains too much or too little fluoride[11][12].

Table 1: Analysis Results of Water QualitySample (A) Emhemmed Alajeily

Test	result	measuring unit	Maximum
PH	7.85	-	6.5-8.5
Conductivity	1451	s/cm	-
TDS	958	ppm	1200
Hardness	360	ppm	500
Calcium (ca)	5	ppm	200
Magnesium (mg)	355	ppm	150
Chlorine residual (cl2)	0.01	ppm	0.5
fluoride	**0.01**	ppm	1.5
Iron (fe)	0.1	ppm	0.3
Chlorides (cl)	318	ppm	250
Salt	0.6		

Table 2: Analysis Results Of Water QualitySample (B) Altaher Alzawi

Test	result	measuring unit	Maximum
PH	7.9	-	6.5-8.5
Conductivity	745	s/cm	-
TDS	480	ppm	1200
Hardness	245	ppm	500
Calcium (ca)	11	ppm	200
Magnesium (mg)	234	ppm	150
Chlorine residual (cl2)	0.0	ppm	0.5
fluoride	**0.36**	ppm	1.5
Iron (fe)	0.1	ppm	0.3
Chlorides (cl)	170.4	ppm	250
Salt	0.1		

Based on the previous results:

pH: Both table of results indicate water within the acceptable pH range of 6.5-8.5, suggesting neutrality or slight alkalinity. Therefore, there is no significant difference in terms of pH between the two sets. Conductivity and TDS: The table (1) of results shows higher conductivity and TDS values compared to the table (2). This indicates an increased concentration of dissolved ions and solids in the water, suggesting a potential decrease in water quality. Hardness: The table (1) of results also shows higher hardness levels, indicating a greater presence of minerals in the water. This could have implications for water taste and the formation of scale in pipes and appliances. Calcium and Magnesium: The table (1) of results reveals a decrease in calcium concentration but an increase in magnesium concentration. Both minerals are essential for human health, and their levels should be within recommended limits. However, the specific implications of these changes depend on the overall balance of minerals in the water. Chlorine Residual and Fluoride: Both of results indicate low levels of chlorine residual and fluoride, which are positive indicators for drinking water safety. Iron and Chlorides: The iron concentration remains consistent between the two table, suggesting a stable presence. However, the table (1) shows an increase in chloride levels, which could affect water taste and potential corrosion of plumbing systems.Salt: The table (1) of results shows a significant increase in salt concentration. High salt levels in drinking water can have adverse health effects, particularly for individuals with certain medical conditions.

In this study, we also found very low fluoride concentrations, approximately 0.3 in the Harsha area and 0.01 in the Judaim area. These results may be due to the presence of numerous industrial processes. Groundwater fluoride concentrations vary depending on the type of rock the water passes through but typically do not exceed 10 mg/liter[2]. In the Netherlands' Rhine River, fluoride levels are below 0.2 mg/liter. In the Meuse River, concentrations fluctuate between 0.2 and 1.3 mg/liter due to industrial processes [1]. The study generally indicates that fluoride concentrations in the Harsha and Judaim areas are low . This can be attributed to local environmental and industrial factors that affect fluoride concentrations in the groundwater in the area. However, a more accurate assessment of potential health risks associated with these lower concentrations is required, along with a study on the effect of socioeconomic status on fluoride intake, to determine appropriate steps to ensure the safety of drinking water in the area. Based on these results, the table (2) of data appears to be more favorable for drinking water quality compared to the table (1). The higher conductivity, TDS, hardness, magnesium, and chloride levels in the table (1) may indicate potential concerns regarding water taste, scale formation, and corrosion. Additionally, the significant increase in salt concentration raises health concerns. The observed phenomenon can be attributed to the influence exerted by the presence of seawater.

Considering these findings, it is expected that the table (2) of results represents water that is more suitable for drinking, as it falls within the recommended limits for various parameters. However, further investigation and analysis would be necessary to fully understand the implications of these results on the overall water quality and its potential impact on human health. It is important to note that these conclusions are based solely on the provided results, and a comprehensive assessment of water quality requires considering additional factors, local regulations, and specific health guidelines.

Second: study the results of A questionnaire answers .

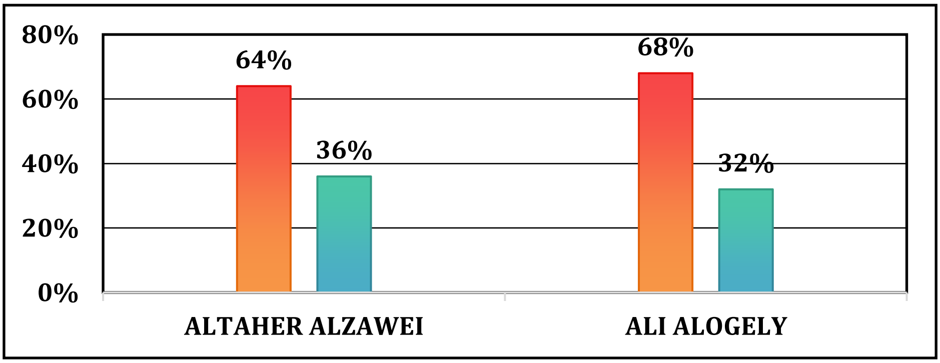

Figure (2): Bar graph illustrating the percentage of students with awareness of the water sources within the school

we can observe that the bar chart compares the proportions of students who have knowledge of two different water sources: Altaher Alzawei and Emhamed Al Ajili.For Altaher Alzawei, approximately 64% of students have knowledge of this water source, while around 36% they do not. In the case of Emhamed Al Ajili, approximately 68% of students have knowledge of this water source, while approximately 32% they do not.

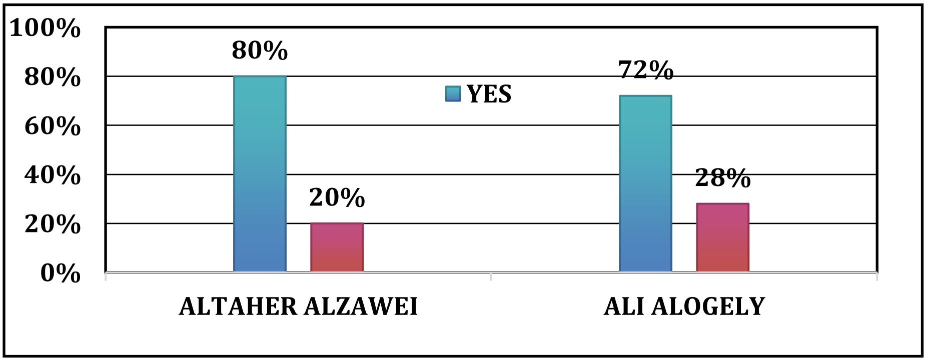

Figure (3): Bar graph depicting the utilization of tap water for drinking purposes

The chart indicates that a higher percentage of Altaher Alzawei students, approximately 80%, use water for drinking purposes, while around 20% do not. On the other hand, approximately 72% of Emhamed Al Ajili students used wall water for drinking purposes, while approximately 28%

do not.

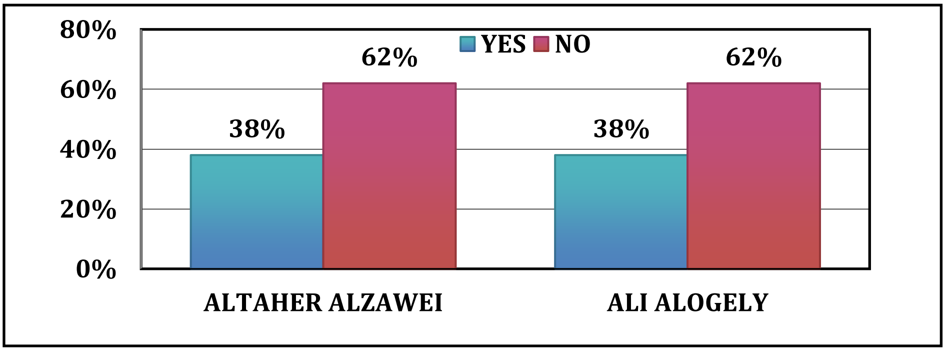

Figure (4): Bar graph illustrating the prevalence of tooth pain

The data from the chart indicates that a significant proportion of students in both schools, approximately 62%, do not report suffering from tooth pain. This suggests that a majority of the students surveyed have not experienced dental discomfort or sensitivity. On the other hand, approximately 38% of the students in both schools reported having tooth pain.

Tooth pain can be caused by various factors, including tooth decay, gum disease, dental trauma, or tooth sensitivity. It is important to note that the chart does not provide specific information about the underlying causes of tooth pain in the surveyed students. Further investigation would be required to identify the specific reasons for tooth pain and develop appropriate interventions or dental care strategies.

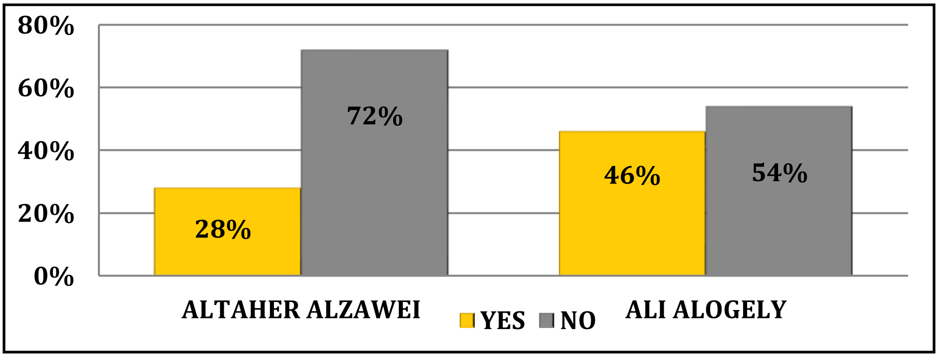

Figure (5): Bar graph depicting the respondents' beliefs on the association between water quality and oral diseases

The chart above highlights that when asked about the relationship between water and oral diseases, the majority of students in both schools responded with "did not know." This lack of knowledge regarding the link between water and oral diseases is identified as one of the challenges faced in the study. Understanding the relationship between water quality and oral diseases is important for promoting oral health and implementing preventive measures. It appears that the students surveyed lacked awareness or information regarding this association. This knowledge gap can hinder efforts to address oral health issues related to water sources effectively. By improving understanding and awareness of the relationship between water and oral diseases, students can take appropriate preventive measures, such as using fluoride-treated water or practicing good oral hygiene, to maintain optimal oral health.

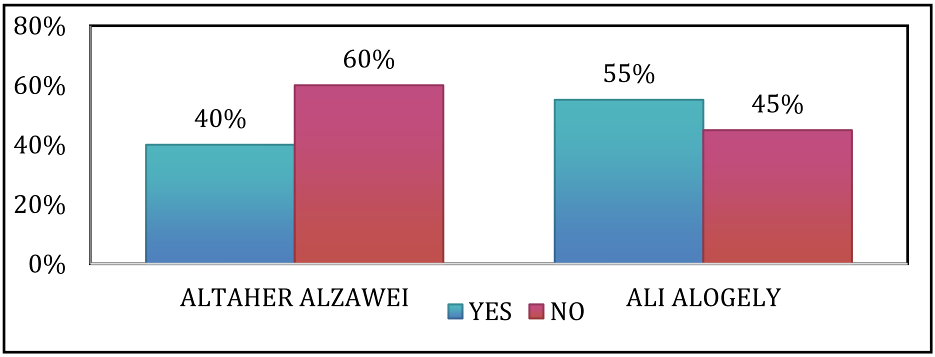

Figure (6): Bar graph illustrating the prevalence of tooth decay among respondents

The bar chart comparing the proportions of students with tooth decay in Altaher Alzawei and Emhamed Al Ajili schools reveals interesting findings. In Altaher Alzawei, approximately 40% of students have tooth decay, while around 60% do not have tooth decay. This suggests that a significant proportion of students in this school are currently experiencing tooth decay or have had previous instances of tooth decay. On the other hand, in Emhamed Al Ajili, a higher percentage of students, approximately 55%, have tooth decay, while approximately 45% do not have tooth decay. This indicates a larger prevalence of tooth decay among students in Emhamed Al Ajili compared to Altaher Alzawei.

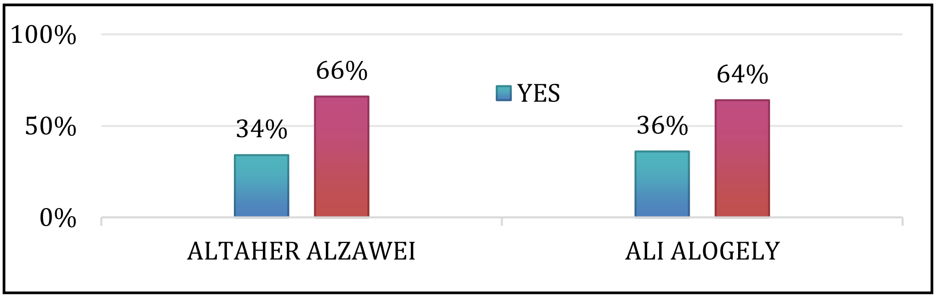

Figure (7): Bar graph representing the frequency of dental calculus occurrence on respondents' teeth

The chart reveals that approximately 66% of students in both Altaher Alzawei and Emhamed Al Ajili schools do not notice the presence of dental calculus on their teeth, while around 34% do notice its presence. Dental calculus, also known as tartar, is a hardened form of dental plaque that forms on teeth due to the mineralization of plaque over time. The fact that a majority of students in both schools do not notice the presence of dental calculus suggests that they may have limited awareness of this oral health issue.

Several factors may contribute to these findings such as Lack of Knowledge and Oral Hygiene Practices. These findings highlight the importance of oral health education and regular dental check-ups. By increasing students' knowledge about dental calculus and promoting proper oral hygiene practices, they can become more aware of the presence of dental calculus and take appropriate steps to maintain optimal oral health.

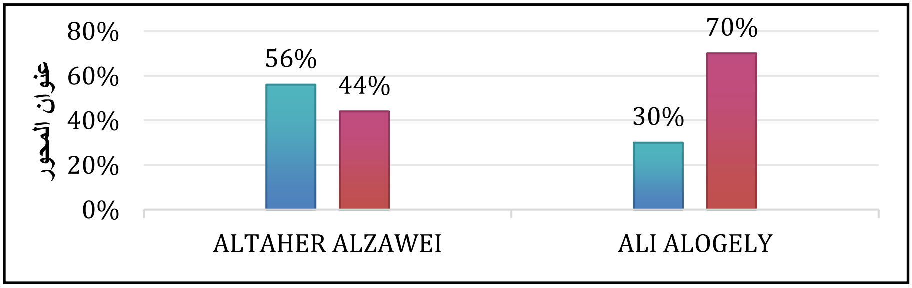

Figure (8): Bar graph illustrating the observation of tooth color changes or discoloration among respondents

The bar chart comparing the proportions of students with tooth discoloration in Altaher Alzawei and Emhamed Al Ajili schools provides interesting insights into the prevalence of this issue among the students. In Altaher Alzawei, approximately 56% of students have tooth discoloration, while around 44% do not have tooth discoloration. This indicates that a significant proportion of students in this school are experiencing some form of tooth discoloration, which can affect the appearance and aesthetics of their teeth. On the other hand, in Emhamed Al Ajili, a lower percentage of students, approximately 30%, have tooth discoloration, while approximately 70% do not have tooth discoloration. This suggests that tooth discoloration is less prevalent among students in Emhamed Al Ajili compared to Altaher Alzawei.

It is important to note that the specific causes of tooth discoloration among the students in each school cannot be determined solely based on the provided data. Further research and investigation are needed to identify the underlying factors contributing to tooth discoloration and develop appropriate interventions or dental care strategies.

CONCLUSION AND RECOMMENDATION

In conclusion, the study revealed very low fluoride concentrations, around 0.3 in the Harsha area and 0.01 in the Judaim area. The assessment of fluoride levels in water, coupled with observations on tooth decay, tooth pain, awareness of oral diseases, dental calculus, and tooth discoloration, underscores the critical need for comprehensive oral health education, access to dental care services, and the promotion of proper oral hygiene practices. Addressing these aspects can significantly enhance oral health outcomes and the overall well-being of students in schools. Nonetheless, further investigation is required to grasp the full implications of these findings on water quality and human health.

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