International Journal of Design & Nature and Ecodynamics
Vol. 17, No. 4, August, 2022, pp. 607-613
Journal homepage: http://iieta.org/journals/ijdne

Evaluation of Fluoride Concentration in Drinking Water of Some Cities within Anbar Province, Iraq

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https://doi.org/10.18280/ijdne.170416

Received: 16 February 2022
Accepted: 28 June 2022

Keywords:
evaluation, water quality, fluoride, dental fluorosis

ABSTRACT

A fluoride atom (F) has a negatively-charged ion called a fluoride ion. The element fluoride can also be found in a compound called fluoride. Many countries with high rates of dental fluorosis naturally contain high levels of fluoride in their minerals and water supplies. The fluoride ion concentrations were determined by collecting drinking water samples twice a month from (July/2020 - to June/2021) from 4 main cities in Anbar Province in Iraq, during the rainy and dry seasons. The fluoride concentrations were then analyzed and compared with standard guides of the United States Environmental Protection Agency (USEPA) and the World Health Organization (WHO). The objective of this study is to evaluate the fluoride concentrations in Ramadi, Fallujah, Khalidiyah, and Heet cities. The results showed small variations ranging from (0.041 mg/l) to (0.051 mg/l) when these results are compared with Environmental Protection Agency (EPA) and World Health Organization (WHO) standard limitations. the recommended standard limitations of (EPA) and (WHO) for fluoride concentration range from (0.4 - to 1.5) mg/l, therefore the drinking water of these cities is comfortable to drink, but it may cause some problems, such as dental caries, dental fluorosis, colorless teeth yellowish, and blackish teeth. The results are also less than the typical concentration limitations, which, is (0.7 mg/l). To avoid the danger of poisoning, adding fluoride to water is not recommended unless it has been recommended by a professional in the food system or a dentist. However, humans can also get fluoride from sources other than water, and the quantity of fluoride they consume is different from one person to another.

1. INTRODUCTION

Fluorine, which circulates widely in the environment, is an ion with a high electronegative charge. In this way, it can bond with positive elements easily and quickly. In nature, fluorine is not present on its own but is formed relatively as fluoride; it is easily soluble in, air, water and soil [1]. Humans benefit from fluoride; it is important to note; however, high concentration of fluoride ion can cause variety side health effects [1, 2]. Surface water contains less than 1.5 mg/L of fluoride, while groundwater can have a higher fluoride level depending on its location [2]. In addition to their many industrial applications, fluorides are also used to manufacture aluminum, fluoridate drinking water, and manufacture fluoridated dental preparations. Dental caries is not affected by industrial fluoride ingested from treated water. Consumption of blood during lifelong consumption can negatively affect developing teeth, bones, and the brain. Fluoride exposure can result in nausea, vomiting, diarrhea, abdominal pain, and loss of appetite. A coma or death may result from convulsions, twitching, or tremors. Fluorosis is the accumulation of Fluoride in bones and teeth [3]. Artificial fluoride compounds lack calcium and are listed as toxic substances [4]. The fluoride form of calcium is found in natural minerals and hasn't been classified as toxic due to the high lethal dose required for acute death when tested on mammals (LD50 * 3750 mg/kg). In municipal water for human consumption, sodium fluoride, NaF, and fluorosilicic acid, H_2SiF_6, are synthetically synthesized by industrial reactions and have been used as rodenticides, insecticides, and pediculicides with acute oral lethal doses in experimental animals that are comparable to those of arsenic and lead (LD50 at 125 mg/kg due to Fluoride at *60-90 mg/kg) [5].

Water quality characteristics for drinking water are very important and should be considered the first step in protecting human health and safety. Human health is directly linked to the quality of drinking water; thus, water quality characteristics for drinking water will have a negative or positive impact on human health. When the concentration of water quality parameters such as fluoride is within acceptable standard limitations, the human body will be able to resist diseases better and strengthen its resistance. Negative effects occur when the concentration of water quality parameters exceeds acceptable standard limits, these parameters will accumulate in a specific part of a person's body and cause damage [6].

In terms of water quality parameters, fluoride is an important component found naturally in drinking water (surface and groundwater). Fluorides are generally colorless compounds that are soluble in water and can either be solids, liquids, or gases. Fluorides are important industrial chemicals that are used for a number of industrial purposes, including aluminum production, fluoridated drinking water, and making fluoridated dental preparations. Fluoride is found naturally in water sources and is derived from fluorine, which is the thirteenth most common element in the earth's crust. Fluoride

has been shown to prevent and even reverse the early stages of tooth decay [7].

Because fluoride is so effective in enforcing and protecting teeth from dental caries, especially in children under the age of 12 years old, fluoride is very important for bones and teeth. In addition to decreasing the solubility of enamel in bacteria acids, fluoride also contributes to demineralizing enamel, which decays and negatively impacts bacteria [8].

1.1 Fluoride health impacts

It is important to drink water that is of good quality to sustain human life. Human health can be adversely affected if the origin of supplied water is polluted. Good drinking water quality must contain appropriate chemical and minerals content, Fluoride is one of the essential minerals [9-11].

Fluoride concentrations in drinking water are allowed to be no higher than 2 parts per million (ppm) for enamel fluorosis and 4 parts per million (ppm) for skeletal fluorosis, according to the EPA' recommendations. Fluoride concentrations in water resources and health risks associated with them have been investigated globally in several countries [9].

Iran, for instance, collected water samples from 43 villages around Divandarreh city during the cold and hot seasons. During the rainy season, drinking water fluoride concentrations were about from 0.23 to 2.08 mg/l, while during the hot (dry) time, they ranged from 0.1 to 1.95 mg/l. Additionally, 51.16% of wet season samples and 58.13% of dry time samples met the WHO standards (0.5-1.5 mg/l). The findings of the health assessment revealed that children were the results to greater rates of hazard. Fluoride removal in water supply and frequent water quality management can help to reduce non-carcinogenic fluoride's negative health consequences [12]. In other study in the Mosul province, northern of Iraq, it was found that fluoride concentrations ranged between (0.075) mg/l to (0.225) mg/l, a mean of (0.147) mg/l, and all water samples had lower fluoride concentrations than the guideline levels. Additionally, all fluoride measurements in the drinking water of Mosul city were lower than EPA's recommended 0.7 mg/l, according to the results [13]. To avoid consuming an extra quantity of fluoride, fluoridation processes should not be performed only when it has been recommended by experts in food, healthcare, and dentists' experts. Furthermore, fluoride can be obtained from other sources than water, and the amount of fluoride consumed by different people varies [13].

Fluoride in drinking water has been found to be effective in treating dental fluorosis in the Saudi Arabia و southwest region, different kinds of water including bottles, wells and treatment plants. The results showed that fluoride levels varied between 0.03 and 3.8 mg/l [14].

Drinking water with fluoride concentrations more than 1.5 mg/l increases the probability of dental fluorosis, although increasing fluoride concentrations may also cause skeletal fluorosis [2]. However, fluoride levels in drinking water play significant role in improving oral health by reducing tooth decay. A study in the USA found that fluoridated water reduces dental decay by 20 to 40% when applied at an optimal level. According to a study conducted in England, fluoridating water can lower tooth decay by 44% among preschoolers aged around five years old [15, 16]. The most common source of systemic intake of fluoride is water, which is responsible for about 75 percent of people who consume fluoride in their diets [17].

Some countries are unaware of the significance of having an optimal fluoride level in their drinking water. A reverse osmosis system was monitored at chosen sample locations in Malaysia to assess fluoride concentrations at influent and effluent, the influent average fluoride concentration was 2.92 mg/l [9]. Except for USEPA's (the United States Environmental Protection Agency) standard, the concentrations were higher than the permissible limits. Fluoride concentrations in the effluent average fluoride concentration of a reverse osmosis systems was lower than influent with concentrations of 0.826 mg/l. The concentrations detected were less the acceptable limits for all guides, except for the National Drinking Water Quality standard (NDWQs) [9].

1.2 The objective of the study

1- Determine the fluoride concentration of drinking water in Ramadi, Fallujah, Khalidiyah, and Heet cities.

2- Comparison of fluoride concentration with the typical (world and local) standard limits in order to determine whether the water is suitable for drinking (according to fluoride concentration).

2. FLUORIDE SOURCES

There is a wide range of sensitivity to fluoride in aquatic organisms. Above a certain concentration, it can affect their growth, activity, and survival. High levels of fluoride in plants can cause clear yellow of leaves and reduced flowering and growth, as evidenced by research in which fluoride was accumulated on leaves. Lab studies showed that, high levels of fluoride levels beyond a certain threshold had an effect on chicken life or growth. The effects of fluoride consumption on bodyweight, teeth, joints, bones, dairy production, and reproduction have been observed in deer, cattle, and sheep. The most dangerous impacts of fluoride are its deposition in bones through long-period excessive exposure, resulting in skeletal fluorosis and bone fractures [18]. There is an "optimum" fluoride concentration in potable water that will protect teeth from dental caries while causing the least amount of dental fluorosis. There is a many kind of fluoridated products, including fluoridation of water, milk, toothpaste, mouth solutions, salt, gels and supplements [19].

A number of previous studies have investigated the correlation between human health and fluoride in drinking water, one of these studies included many children living in cities supplied by the water that has variable fluoride levels. It appears that fluoride concentration decreases the incidence of dental caries with a maximum ratio of about (60%) when the water contains less than (1.0 mg/l) of fluoride, while dental caries cases increase when the fluoride concentration decreases. Moreover, some studies are showing a critical decline in dental caries cases in children drinking water with fluoride concentrations of between 0.0-7.0 mg/l while the incidence of dental caries is decreasing with fluoride concentrations between 0.7-1.2 mg/l; at the same time, these studies are showing an increase in (dental mottling) and the condition known as (dental fluorosis) because of increasing fluoride in potable water. Dental mottling, dental fluorosis) cases increase when fluoride concentration is more than (1.0 mg/l), however, according to study, 13.5% of children who drink water containing a fluoride concentration of less than

(0.3 mg/l) are infected with this disease, and this number increases to 41.1% when fluoride concentration increases to (1.2 mg/l). There is atypical fluoride in potable water that proves beneficial for humans because it decreases (dental caries) cases, and at the same time reduces (dental fluorosis), the typical fluoride concentration that is temperature-dependent [19]. In contrast, researchers researching the effects of fluoride on human health found that high fluoride doses could cause adverse effects such as (skeletal fluorosis), (bone fractures), (thyroid function), (children's inelegance), (reproductive effects), (birth effects), (chronic renal failure). When fluoride concentration in drinking water increases, the incisiveness of injury increases, for example, fluoride concentration of (3-6) mg/l can cause (skeletal fluorosis), but (skeletal fluorosis) can lead to (skeletal crippling) when the concentration is greater than (10 mg/l) [20].

3. MATERIAL AND METHODS

This study aims to collect samples of drinking water and source water in Ramadi city and nearby areas such as Heet, Fallujah, and Khalidiyah. Between July 2020 and June 2021, samples were taken twice a month, (see the Table 1), and then were tested and analyzed with a spectrophotometer device (spectrophotometric method) [21]. Based on the temperature of Ramadi, we compared fluoride concentrations to the typical and local standards to determine whether the water was suitable for drinking (according to fluoride concentration).

3.1 Study area

Figure 1 shows the geographical Location of study area, close to the Jordanian, Syrian, and Saudi borders. The total study area is about 21101 square kilometers, and have a population of about 750,000 people. Ramadi city represents the center of Anbar province, it is moderately developed, with a population of over 470,000 persons. Ramadi city is about (7829) square kilometers [22, 23]. Fallujah city represents the one of important cities of Anbar province, it is moderately civilized, with a population of over 330,000 persons. City area is about (4205) square kilometers. Khalidiyah city represents the one of important cities of Anbar province, it is moderately civilized, with a population of over 60,000 persons. City area is about (714) square kilometers Heet city represents the one of important cities of Anbar province, it is moderately civilized, with a population of over 90,000 persons. City area is about (8353) square kilometers [24]. Euphrates flow through the four cities, the main source of drinking water supply in the study area is Euphrates river [25].

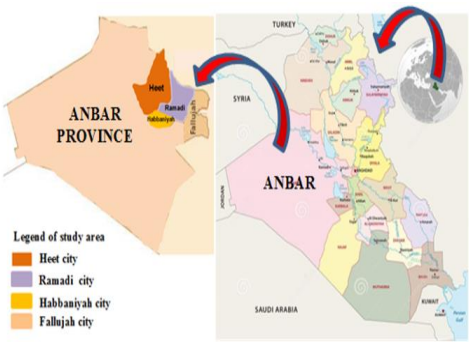

Figure 1. Study area

4. RESULTS AND DISCUSSION

Laboratory test results for drinking water samples indicate that fluoride concentrations converged along the study period (July 2020 - June 2021) for all study areas. Table 1 and Figures 2, 3, 4, and 5 show the fluoride concentrations in the Ramadi, Fallujah, Khalidiyah, and Heet cities, respectively.

Table 1. Fluoride concentration in drinking water for different cities

Date	Average Fluoride Concentration (mg/l)			
	Heet city	Ramadi city	Khalidiyah city	Fallujah city
02-July-2020	0.047	0.047	00.048	0.048
03-August-2020	0.045	0.048	0.046	0.043
01-September-2020	0.044	0.046	0.044	0.042
03-October-2020	0.044	0.046	0.042	0.041
07-November-2020	0.049	0.05	0.041	0.041
04-December-2020	0.049	0.05	0.041	0.041
03-January-2021	0.048	0.05	0.041	0.042
02-February-2021	0.05	0.05	0.041	0.043
05-March-2021	0.05	0.048	0.042	0.044
04-April-2021	0.047	0.05	0.044	0.042
03-May-2021	0.044	0.049	0.043	0.045
06-June-2021	0.042	0.049	0.045	0.041
Min	0.042	0.046	0.041	0.041
Max	0.050	0.050	0.048	0.048
Average	0.047	0.049	0.043	0.043
SD	0.003	0.002	0.002	0.002

Fluoride concentrations in drinking water of Heet city have varied from (0.042 mg/l) in June of (2021) to (0.050 mg/l) in February and March of (2021) with annual average concentration of (0.047 mg/l).

However, fluoride has the same concentration of (0.044 mg/l) in (September and October of (2020), and May (2021). It was also found that fluoride concentration has a little increasing of (0.047 mg/l) in July, (2020) and April (2021), while January (2021) has a little increasing of (0.048 mg/l). Moreover, fluoride concentration was (0.049 mg/l) in (November and December of 2020). All samples taken from the same source appeared that the fluoride concentration is convergent and congruent for other samples collected at the same time in other cities; this happened because of dependent (Euphrates river) as a unique source supply of drinking water.

In Ramadi, fluoride concentrations varied from (0.046 mg/l) in September and October of 2020 to (0.050 mg/l) in November and December, as well as January, February, and April of 2021. However, in the July 2020, August of 2020, and March of 2021, fluoride concentrations are (0.047 mg/l) and (0.048 mg/l), respectively. While fluoride concentrations are (0.049 mg/l) in May and June of 2021.

During October, November, and December of (2020), the fluoride concentration in Fallujah city's drinking water varied from (0.041 mg/l) to (0.048 mg/l). Fluoride concentrations in September (2020), January, and April (2021) were 0.042/l; fluoride concentrations in August (2020) and February (2021) are (0.043 mg/l). With regard to the (March of 2021) fluoride levels have a little Increasing of (0.044 mg/l), while (May of

2021) has a little Increasing of (0.045 mg/l). On the other hand, fluoride concentration has reached (0.048 mg/l) in the July of 2020.

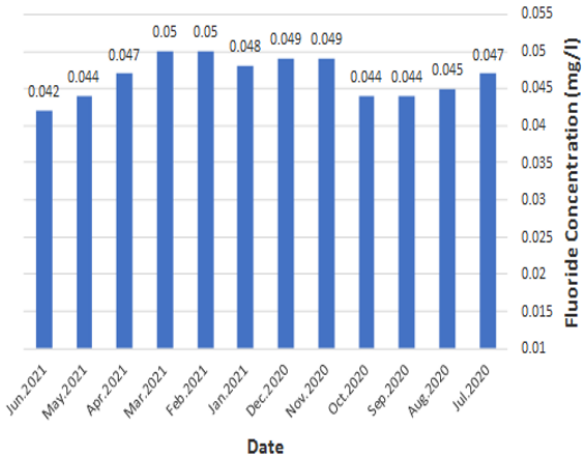

Figure 2. Fluoride concentration in drinking water of Heet city

Figure 3. Fluoride concentration in drinking water of Ramadi city

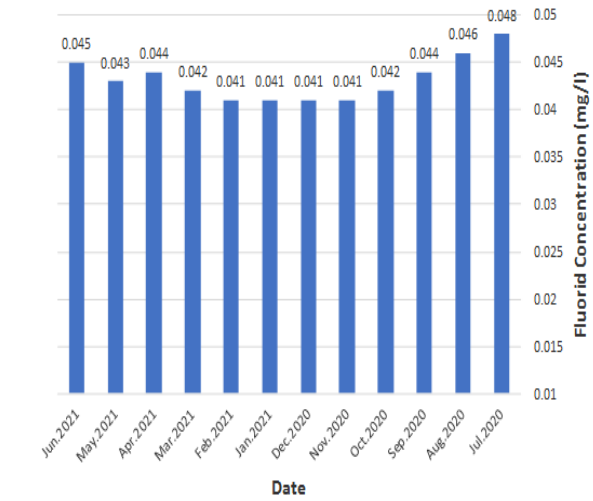

Figure 4. Fluoride concentration in drinking water of Khalidiyah city

In Khalidiyah city, fluoride concentration in drinking water varies from (0.041 mg/l) in November and December of 2020, and in January and February of (2021) to (0.048 mg/l) in July of (2020). However, October of (2020) and March of (2021)) have concentrations of (0.042 mg/l). In addition, there was a little Increasing of (0.043 mg/l) in May of (2021), while (September of 2020 and March of 2021) have a little Increasing of (0.044 mg/l). Furthermore, fluoride concentration in (June of (2021) was (0.045 mg/l), while in (August (2020), fluoride concentration has reached (0.046 mg/l).

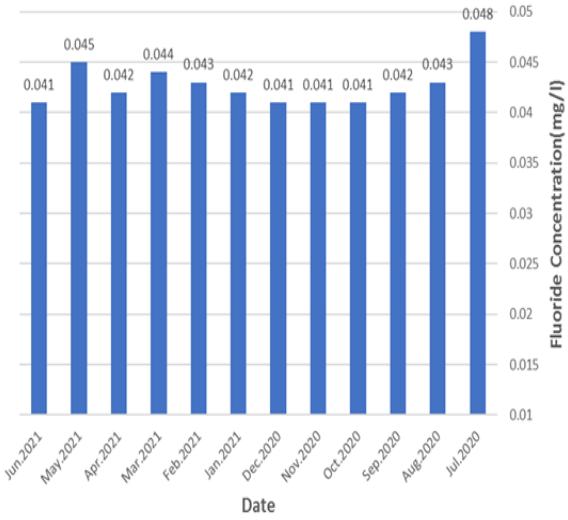

Figure 5. Fluoride concentration in drinking water of Fallujah city

5. DETERMINE THE TYPICAL FLUORIDE CONCENTRATIONS

The typical fluoride concentration in drinking water can be proportionally inversive with total average temperature when the total average temperature increases the typical fluoride concentration decrease, because of that the human needs to drink additional water quantities when the total average temperature increases to add the lost water by sweating, therefore the people who live in hot cities will get fluoride concentration more than people lives in cold cities. Therefore, the typical fluoride concentration in hot areas is less than the cold areas. According to Engineering Protection Agency (EPA), the optimum fluoride concentration in potable treated water is about (0.7 to 1.2) mg/l and the actual value can be determined by knowing the total average maximum air temperature for the studied city at less for the previous five years [26].

Table 2. The variation of minimum, maximum and typical fluoride concentration in drinking water with variation of annual average value of maximum temperature according to (EPA)

Fluoride Concentration (mg/l) Standard Limitation			Annual Average of Maximum Air Temperature (°C)
Maximum	Typical	Min	
1.7	1.2	0.9	12.05 - 10
1.5	1.1	0.8	14.61 - 12.11
1.3	1.0	0.8	17.66 - 14.66
1.2	0.9	0.7	21.44 - 17.72
1.0	0.8	0.7	26.22 - 21.5
0.8	0.7	0.6	32.5 - 26. 27

Table 3. Monthly average value of maximum air temperature of Heet, Ramadi, Khalidiyah, and Fallujah cities for five years

Year	Average Annual Air Temperature (°C)			
	Heet city	Ramadi city	Khalidiyah city	Fallujah city
2017	28.8	29.6	29.7	29.8
2018	27.7	28.5	28.8	28.8
2019	29.8	30.5	30.6	30.8
2020	29.1	30.3	30.4	30.5
2021	26.3	27.0	27.3	27.5
Average	28.3	29.2	29.4	29.5

Table 2 shows the variation of minimum, maximum, and typical fluoride concentration in drinkable water with a variation of the annual average value of maximum temperature for the city that desires to determine the typical fluoride concentration. The therapeutic dosage of fluoride is thought to be about (1 mg/l as F1-), while dosages slightly higher have been associated with mottling of teeth and tooth loss [27]. The average annual air temperature (°C) for Heet, Ramadi, Khalidiyah, and Fallujah cities through five years (2017-2021) were, as shown in Table 3 [28].

From Table 3, it can be seen that the total average value of maximum air temperature through the five years was (29.1°C), return to Table 2, the minimum, typical and maximum fluoride concentration is (0.6, 0.7, and 0.8 mg/l), respectively. Since Ramadi city is near Fallujah, Khalidiyah, and Heet city, it can consider the minimum, typical, and maximum fluoride concentrations for other cities are the same, taking into consideration the annual average of maximum temperature for other cities within (29.7°C).

6. FLUORIDATION

Rising the fluoride concentration in drinking water called fluoridation, adding compound contains fluoride such as (sodium silicofluoride, sodium fluoride, and hydroflosilisice acid) to drinking water as final treatment method before pumping to population, fluoridation is not applied to the drinking water of Ramadi, Fallujah, Khalidiyah and Heet city because of the:

Decreasing the fluoride concentration from the typical fluoride concentration in drinking water is not recommended even the specialist in feeding and dentist science decide there are (dental caries) cases of infection especially with children. Excessive fluoride consumption can cause dental fluorosis, which prevents the natural maturation process of the enamel, but only in the children between the ages of 6 and 8 years, while their teeth are still developing. The extensive utilization of fluoride compounds other than drinkable water is largely ascribed to the increase in the prevalence of dental fluorosis during the last 30 to 40 years. Fluoride is naturally found in high quantities in minerals and water in certain parts of the world, such as China, where dental fluorosis is widespread. The high fluoride that is absorbed into bone causes extremely severe skeletal fluorosis-related impacts on bones [29].

In certain areas of the world where high levels of fluoride are naturally present, skeletal fluorosis is widespread, mainly due to an increased intake of fluoride from foodstuffs and drinking water. However, other factors, such as nutrition and climate, may also be important [30]. Skeletal fluorosis is common in places of the world where high amounts of fluoride are naturally prevalent, owing to elevated fluoride consumption from foods and drinking water. However, other variables, like climate and nutrition, may have a significant impact [30].

Decrease these infections by increasing fluoride concentration to reach the typical concentration in drinking water, it should be careful when taking the decision of fluoridation to increase fluoride concentration because of:

People get fluoride from many sources such as (food, toothpaste); therefore, the World Health Organization (WHO) when defining the Guideline value (1.5 mg/l) has explained that when local standard limitation is determined, it is necessary to consider the drinking water quantity and the other fluoride sources which taken by people. In addition, when the quantity which taken from other sources reach (6 mg/l) it should put the local standard limitation less than the guideline value (1.5 mg/l) [31, 32].

The quantity of fluoride taken by people varies from person to person, some researches and studies said that it is about (0.05 - 7.51 mg/day). This variation is the result of human age, food system variation by food quality and quantity, fluoride concentration in potable water, and variation of temperature [32].

The danger of taking the extra dosage of fluoride which caused (bad allergic-side effect), which can happen when supplied all people with drinking water contains the same fluoride concentration adding by fluoridation. The variation of fluoride quantity leads to Variation of typical fluoride concentration dosage may be more than the typical dosage or less than the typical dosage for these people [33]. For example, a person taken a fluoride concentration of (0.05 mg/kg/day) will decrease dental caries without causing any harmful such as (dental fluorosis) [34], which means a person weight (70 kg) needs fluoride concentration of (30.5 mg/day) and if this person gets (1.5 mg/day) from food sources and (1.4 mg/day) from drinking water source (daily drinking water equal to 2 liters) [32]. Moreover, fluoride concentration is raised to typical concentration by fluoridation to (0.7 mg/l), then this person will get (2.9 mg/day), so this person needs additional quantity of (0.6 mg/day). While another person in the same weight gets fluoride of (2.7 mg/day) from food sources and (1.4 mg/day) from drinking water will get (4.1 mg/day); therefore, this person gets an extra dosage of (0.6 mg/day). The daily quantity of fluoride taken by humans from food can be calculated from food quantity and fluoride concentration in each type of food, for example, if fluoride concentration in fish is about (0.1 - 30 mg/kg), he will get (3 mg) of fluoride, so (2 - 3) cups of tea contain approximately (0.4 - 0.8) mg/l. When humans take a fluoride dosage of (3 - 7 mg/kg) as one dosage that will cause critical poison and dosage of (20 - 100 mg/kg) will cause death [32]. Between the standard limitation and poison limitation, the value that affects human health in different forms and different levels, for example, human that get fluoride concentration of (0.2 - 0.35 mg/kg) of his weight will be infected by (skeletal failure) in the short time period. There is modern research and studies that faced animadversion and objections to fluoridation because of healthy, economical, and ethical reasons [32]. Elevated fluoride consumption may also have large serious harmful consequences for skeletal tissues. It was found that a net fluoride consumption of 14 mg/day may cause carries and definite excess risk of deleterious skeletal effects, a total fluoride intake above 6 mg/day result in an elevated probability of skeletal impacts [35].

A disease known as skeletal fluorosis can be caused by excessive fluoride exposure. These conditions can affect bones and joints over time, causing pain and damage. Fractures are more likely to occur if bones become hard and less elastic. The condition Fluorosis occurs when a person consumes too much fluoride. In people exposed to high concentrations of fluoride, dental fluorosis develops much earlier than skeletal fluorosis [35]. An essential trace element becomes potentially toxic when its safe and sufficient exposure levels are exceeded. A classic example of this is fluoride, which plays a fundamental role in our physical health and growth. As an example, drinking water with fluoride levels between 0.50 and 1.0 ppm prevents dental caries while excessive consumption leads to fluorosis, for example. The main causes of fluorosis are fluorine in the environment and in drinking water sources. The threat of fluorosis has not been eradicated from 24 nations, including India, despite fluorosis being a notable medical problem [36]. However, according to recent studies, consumption of fluoride at concentrations of 1.5 ppm is a major cause of skeletal fluorosis. In rural areas, fluoride levels were found to be higher than the WHO permissible limits in 80% of villages, and people living in these areas are at risk of skeletal fluorosis. In Africa and Asia, epidemic fluorosis affects approximately 100 million people. Since there are no specific treatments available so far to treat skeletal fluorosis effectively, prevention is one of the safest and best approaches to fight fluorosis [36].

7. CONCLUSION

Fluoride concentration in drinking water for Ramadi, Fallujah, Khalidiyah, and Heet city for a year of study is of small limit variations about (0.04 - 0.059 mg/l). Fluoride concentration in drinking water for Ramadi, Fallujah, Khalidiyah, and Heet city for a year of study is less than the local standard limitation of (1.0 mg/l) which was determined by (Iraqi Environmental Protection and Improvement Office) [37].

Fluoride concentration in drinking water for Ramadi, Fallujah, Khalidiyah, and Heet city for a year of study is less than the typical fluoride concentration determined by the (EPA) according to climate conditions. Fluoride concentration in drinking water for Ramadi, Fallujah, Khalidiyah, and Heet city for a year of study is less than the maximum acceptable limitation according to (EPA) that can cause increasing (Dental Fluorosis) cases. Fluoride concentration in drinking water for Ramadi, Fallujah, Khalidiyah, and Heet city for a year of study is less than the Guideline value (1.5 mg/l) determined by (WHO) [30].

Drinking water for Ramadi, Fallujah, Khalidiyah, and Heet cities have a fluoride concentration less than the local and world standard limitation, so the drinking water is an actionable for drinking water for this specified parameter.

Excluding fluoridation to increase fluoride concentration in potable water, only if the specialist determines (Dental caries) cases and they advise increasing fluoride concentration in potable water followed by health and food expert assurance. In addition, an extra dosage of fluoride concentration cannot be taken an when fluoridation applied because of probably getting fluoride from other sources and variation of fluoride concentration that taken from person to person.

8. RECOMMENDATIONS

The necessity of fluoride concentration quantity survey from health and environmental organization in drinking water because of it is the effect upon human health. Study (Dental Caries) cases if found for children (less than 12 years) to determine the effect of decreasing fluoride concentration in drinking water in Ramadi, Fallujah, Khalidiyah, and Heet city for a year of study.

Study (Dental fluorosis) cases if found in high fluoride concentration areas in order to determine the effect of increasing fluoride concentration in drinking water and alarming dangerous of extra fluoride concentration upon human health and the necessity of diseases survey because of maximum fluoride concentration in drinking water.

When survey that drinking water has fluoride concentration more than standard limitation, then it should be treated by Defluoridation, where water flows through the granular medium of an activated alumina or supply people with bottled water [34].

Guide the people who suffer from (Dental caries) to apply (Topical application) which the researchers prove it is important to protect the tooth from (Dental caries), where subjecting the tooth to material that contains fluoride such as Toothpaste and gel [30].

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