

Prevalence of High Fluoride Concentration in Drinking Water in Nellore District, A.p., India: A Biochemical Study to Develop the Relation to Renal Failures

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Abstract: The prevalence of renal fluorosis was determined among the selected villages of Udayagiri mandal, Nellore district of Andhra Pradesh, India, whereas the fluoride concentration in drinking water ranges from 2.37 to 6.74 ppm by SPADNS method. Analysis of the samples showed the fluoride content in abnormal range both in urine and serum of the ten villagers. From these three villages, 90 people were selected for the estimation of their random blood sugar and serum creatinine. All these subjects were showed normal blood pressure as well blood glucose levels. Control subjects showed the creatinine content of 1.43 mg/dl, whereas the disordered subjects showed a value of 2.78 mg/dl, which showed a drastic increase in the serum creatinine value and the loss of renal function. From the results we can observe a significant ($p < 0.001$) increase in the serum creatinine content.

Key words: Biochemical parameters • Fluoride poisoning • Water fluoride • Nellore District • Serum creatinine

INTRODUCTION

Fluoride is beneficial to health if the concentration (CF) of the fluoride ion (F⁻) in drinking water is less than 1.5 mg/L [1]. A higher concentration causes serious health hazards. The disease caused manifests itself in three forms, namely, dental, skeletal and non-skeletal fluorosis [2]. Skeletal fluorosis causes crippling and severe pain and stiffness of the backbone and joints [2]. Even though extensive studies have been conducted, there seems to be no effective cure for these diseases. Therefore, it is desirable to drink water having a fluoride concentration less than certain value. Hence, drinking water with CF > 1.5 mg/L (1 mg / L in India) needs treatment [1]. In India, the states of Andhra Pradesh, Bihar, Chattisgarh, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal are affected by fluoride contamination in water. This involves about 9000 villages affecting 30 million people [3]. As a result, deeper aquifers are used and the water in these aquifers contains a higher level of fluoride [4].

Kidneys are among the most sensitive body organs in their histopathological and functional responses to

excessive amounts of fluoride [5]. They are the primary organs concerned with excretion and retention of fluoride and thus are generally involved in chronic fluoride intoxication. In humans, only a few reports pertaining to kidney involvement in endemic fluorosis are available [6-8]. In contrast to cases of acute intoxication [9], the records of only a few necropsy reports of patients dying of chronic fluoride intoxication are traceable in the literature [10-11]. Fluoride toxicity is the more abundant threat to the common people who are living in the content areas in the globe. Fluoride toxicity will affect all the parts of the human system leads to the altered life span. In India it is the foremost problem in different parts of the country. Andhra Pradesh is also become popular with the curse particularly districts like Nalgonda. All most all the relevant problems with fluoride poisoning was established by the researchers, but the people in and around the Nellore district were more repeatedly targeted by the renal failures without any other disorders like hypertension or diabetes. To identify the relations between the increased fluoride content in the drinking water and the renal failures the study has been established. Serum creatinine is the marker for the measurement of renal problems. Hence, the present study has been designed to asses the

relation between the fluoride water content and the serum and urine creatinine content in the selected fluoride threaten fluoride people of Nellore district (Andhra Pradesh, India).

MATERIALS AND METHODS

The study was conducted in the Nellore district region of Andhra Pradesh, which is geographically southern part of the India near to the Bay of Bengal. Nellore district is the coastal are of south India, which seems to be one of the most fluorosis threaten area of Andhra Pradesh state. From the data of water quality department as well as information from news papers, analysis has been initiated in the Udayagiri mandal of Nellore district. Among the mandal ten villages have been reported to be affected areas of fluorosis.

Selection of Samples: Five hundred individuals from 10 villages in Udayagiri mandal, Nellore district of Andhra Pradesh State were randomly chosen for survey work, which was highlighted by the local newspapers.

Present study was constructed to analyze the samples that are having the renal disorders with the association of fluoride intake. Peoples suffering with regular renal failure with diabetes and hypertension were separated and omitted from the analysis.

Analysis of Water Quality and Fluoride Content:

A total of 10 samples were collected from the selected locations of each village representing the water quality of the whole area. Fluoride concentration was spectrophotometrically determined using Alizarin red-S and SPADNS reagents [12]. Sodium fluoride was used to prepare the standard solution. The main sources of drinking water in these villages are open wells, hand pumps and municipal supply.

Estimation of Serum and Urine Fluoride Content:

From the selected individuals blood and urine samples were collected in non-reactive plastic containers and brought to the laboratory in an ice box. To analyze the level of fluoride in serum, blood was centrifuged and serum separated. Fluoride content of serum and urine was analyzed through SPADNS method.

Estimation of Random Blood Sugar: Random blood glucose measured routinely using an 'One Touch Ultra' blood glucose meter (Accu Chek Glucometer, USA).

Statistical Analysis: Statistical analysis was carried out using SPSS for windows 10.0 software (SPSS Inc., Chicago, IL, USA) and Microsoft Excel. Values were reported as mean \pm standard deviation. SD was not more than 10%.

RESULTS AND DISCUSSION

Udayagiri mandal of Nellore district andhra Pradesh, India seems to be more threaten area of fluoride toxicity in drinking water was noticed recently. A sum of total ten fluoride affected villages has been find out with the help of water control department and the water samples has been taken for the analysis of water fluoride content. Water samples from different bore wells of ten villages showed a maximum range of 2.37 to 6.74 ppm by SPADNS method (Table 1). Among the selected ten villages three are showing high levels of fluoride content in their drinking water (ranges 4-7 ppm). Particularly Varikunta padu showing a maximum fluoride content of 6.74 ppm. These three villages namely, Varikunta padu (6.74 ppm), Kolangadi palli (5.12 ppm) and Gangireddy palli (4.43 ppm) were take for the further entire study. Almost all the selected villages are higher than the permissible level of 1 ppm according to WHO [13].

Analysis of the samples showed the fluoride content in abnormal range both in urine and serum (Table 2). The generally accepted average normal serum fluoride value is 8 μ M (0.15 ppm.) as found by Singer and Armstrong [14]. Incase of urine fluoride acceptable point is 1 mg per liter. But, in the case of the selected objects it seems to be more when compared to the normal value. Particularly Kolangadi palli people showed a maximum of 2.27 ppm of serum fluoride and in case of urine fluoride Varikuntapadu people are showing a maximum range of 4.00 mg where the normal values of serum and urinary fluoride are 0.15 ppm and 1 mg, respectively.

A detailed questionnaire has been prepared and data has been gathered from the villagers of selected three villages (Questionnaire not enclosed). This includes the personal details like age, sex, duration of stay in the specified area, drinking water source and parental history and present or previous experience of diseases like diabetes and hypertension. It helped us to omit the people suffering with hypertension or diabetes, whereas they may be chance of getting the renal failures with the hypertension or diabetes. After screening of the data we have selected a sum of 90 people, who are never suffered with hypertension or diabetes.

Table 1: Flouride contents in water samples of the selected ten villages in and around Udayagiri Taluk (Nellor edistrict, A.P., India)

Name of the village	Flouride content in water
Turkapalli	4.01±0.83
Pakeerpalem	4.00±0.66
Varikunta padu	6.74±1.24
Bijjam palli	2.92±1.02
Masi peta	2.37 ±0.98
Singa reddy palli	2.98 ±1.31
Boda banda	3.47±0.88
Kolangadi palli	5.12±1.56
Gangireddy palli	4.43±1.98
Basine palli	3.12±1.22

Table 2: Flouride contents in serum and urine samples of the selected ten villages people in and around Udayagiri Taluk (Nellor edistrict, A.P., India)

Name of the village	Flouride content in Serum	Flouride content in Urine
Turkapalli	1.47±0.61	2.13±0.89
Pakeerpalem	2.10±0.95	2.22±1.02
Varikunta padu	2.2±0.45	4.00±1.85
Bijjam palli	1.50±0.35	2.12±0.42
Masi peta	1.91±0.97	1.07±0.62
Singa reddy palli	1.05±0.33	2.10±0.15
Boda banda	2.19±0.21	1.23±0.67
Kolangadi palli	2.27±0.49	2.26±0.89
Gangireddy palli	2.13±0.61	2.00±0.46
Basine palli	2.10±0.29	2.12±0.51

Table 3: Analysis of the blood pressure, random blood sugar and serum creatinine of the normal and fluoride affected peoples

	Blood Pressure	Random Blood Sugar	Serum Creatinine
Control (n=50)	120/80±10	173.58±15.83	1.43±0.35
Flouride affected (n=90)	130/90±10	175.59±18.06	2.78±0.24
SEM	NS	3.475 ^{NS}	0.412
Significance	P<0.001	P<0.001	P<0.001

NS: Non-significant

After selection we have collected their urine and serum samples for the assay of fluoride content. While collecting the samples we have noticed their details like height, weight, waist and hip ratio and other details (Data entry sheet enclosed). Even though the selection was done specifically remove the hypertension and diabetic people, again a cross check has been made to know the random blood glucose levels as well as blood pressure of the selected 90 fluoride threaten individuals (Table 3). Blood pressure was measured with the help of

a local rural medical practitioner. Random blood glucose level was assayed with the help of one pick gluometer. These results showed that the values are not significant ($p<0.001$) and there was not much change when compared to that of control value. Mean value of RBS showed to be 175 mg/dl, whereas control mean value is 173 mg/dl (Table 3). Similar types of studies under fluoride toxicity with reference to dental and skelaetal fluorosis has been made by several workers [15-19].

Measuring serum creatinine is a useful and inexpensive method of evaluating renal dysfunction. Creatinine is a non-protein waste product of creatine phosphate metabolism by skeletal muscle tissue. Creatinine production is continuous and is proportional to muscle mass. Creatinine is freely filtered and therefore the serum creatinine level depends on the Glomerular Filtration Rate (GFR). Renal dysfunction diminishes the ability to filter creatinine and the serum creatinine rises. If the serum creatinine level doubles, the GFR is considered to have been halved. A threefold increase is considered to reflect a 75% loss of kidney function. Present study reveals that there was a drastic increase, almost doubled with the control value indicates the loss of renal function and symptoms of renal failure (Table 3). Control subjects showed the creatinine content of 1.43 mg/dl, whereas the disordered subjects showed a value of 2.78 mg/dl, which shows a drastic increase in the serum creatinine value and the loss of renal function. From the results we can observe a significant ($p<0.001$) increase in the serum creatinine content.

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