Rocz Panstw Zakl Hig 2015;66(4):379-382

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ORIGINAL ARTICLE

PREVALENCE OF SKELETAL FLUOROSIS IN FISHERMEN FROM THE KUTCH COAST, GUJARAT, INDIA

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ABSTRACT

Background. In health terms, consuming fluoride is well recognised to be a double-edged sword. Consumption of optimal amounts is beneficial to health, however an excess constitutes a health hazard.

Objectives. To assess the prevalence of skeletal fluorosis in fishermen from the Kutch coast, Gujarat, India.

Materials and method. A descriptive cross-sectional survey was conducted on 653 fishermen from the Kutch District, Gujarat, India, from October 2014 to December 2014. Clinical skeletal fluorosis was assessed using three diagnostic tests. Drinking water fluoride concentrations in different regions of the study area were determined. General information regarding age, gender and adverse habits were also collected. The *Chi square* test was used for comparisons and the confidence level and critical p-value were set at 95% and 5% respectively.

Results. Fluoride concentrations in water from the study area ranged between 3.4- 6.9 ppm. The prevalence of skeletal fluorosis was 30.3%, out of which, the majority of the subjects had mild skeletal fluorosis (18.4%). This condition was found to be significantly associated with age and gender along with tobacco and alcohol consumption; depending on the habit's duration.

Conclusion. Being a public health problem in the fishermen community, skeletal fluorosis requires *a-priori* attention. Measures for preventing this disease should be undertaken on a communitywide basis.

Key words: *fishing industry, prevalence, fluoride poisoning*

INTRODUCTION

Fluorosis is an important public health problem in 24 countries, including India, which lies in the geographical fluoride belt that extends from Turkey to China and Japan through Iraq, Iran and Afghanistan. Endemic fluorosis is prevalent in India since 1937 [1]. The available data suggest that 15 States in India are endemic for fluorosis (fluoride level in drinking water >1.5 mg/l), five of these have category III (>50% of the districts affected) which includes Gujarat [15]. In Gujarat, 18 districts have high water fluoride content. Kutch coast is one of the affected district of Gujarat [8].

Acute to chronic skeletal fluorosis is a result of exposure to very high fluoride over a prolonged period. Early stages of skeletal fluorosis start with pain in bones and joints, muscle weakness, sporadic pain stiffness of joints and chronic fatigue. During later stages, calcification of the bones takes place, osteoporosis in long bones, and symptoms of osteosclerosis where the bones become denser and develop abnormal crystalline structure. In the advanced stage the bones and joints become completely weak and moving them is difficult. The vertebrae in the spine fuse together and the patient is left crippled which is the final stage. Skeletal fluorosis is usually not recognized until the disease reaches an

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advanced stage [4]. General skeletal fluorosis directly affects the economy of villagers (mostly tribal population) as it causes illness and debilitation not only in humans but, also in their domestic animals, on which they depend for their basic income. Skeletal fluorosis leads to impairment, disability and subsequently makes the affected subject handicap. Therefore, they are unable to get employment or labour for their daily livelihood, lead their life as dependents on others [5].

Kutch is the largest district in India with a total area of 45652 km^2. Kutch has 400 km coastline that constitutes 1/4 of Gujarat's coastline and 1/20 of India's coastline. The Kutch coast and fishing community are well known in India. Owing to high water fluoride content at Kutch district [8] and high prevalence of dental fluorosis reported among fishermen of Kutch coast [2], the present study was undertaken to assess the prevalence of skeletal fluorosis in fishermen from the Kutch coast, Gujarat, India.

MATERIALS AND METHODS

Study design, population and duration

A descriptive cross-sectional survey was conducted to assess the prevalence of the skeletal fluorosis among fishermen community of Kutch District, Gujarat, India, from October to December 2014.

Informed consent

After explaining the purpose and details of the study, a written informed consent was obtained from all the subjects who were willing to participate.

Inclusion criteria

1. Subjects who were born and brought up at the study area.
2. Subjects more than 15 years of age.
3. Subjects who were willing to participate.

Exclusion criteria

1. Subjects on medications that may influence bone metabolism, any metabolic and inflammatory bone disease.
2. Subjects with any systemic diseases.
3. Sick individuals and individuals with debilitating diseases.

Survey proforma

Survey proforma designed in English was consisting of:

a. General information: demographic data, tobacco use and alcohol use.
b. The three diagnostic tests to assess the clinical features of skeletal fluorosis:
   i. Touching the toes without bending the knees;
   ii. Touching the chest with the chin;
   iii. Stretching the arms sideways & folding the arms to touch the back of the head.

Subjects who could perform any of the three tests were taken under "mild" category, those who could perform two tests and the ones who were not able to perform any of the three tests were included in "moderate" or "severe" category of skeletal fluorosis respectively [13,14].

Training and calibration

All the examinations were carried out by a single qualified examiner. Training sessions and calibration of examiner were conducted by the two consultants until an acceptable level of consistency in diagnosis was reached. The intra-examiner reliability were assessed using Kappa statistics, which was found to be 97.7%.

Pilot survey

A pilot study was carried out among 50 fishermen subjects to determine the feasibility and practicability of the study and the time required for examination of each subject. It helped to know the practical difficulties while conducting the survey. It took around 2-3 min to assess each subject. The prevalence of skeletal fluorosis was found to be 38%.

Sample size calculation

Depending on the prevalence of skeletal fluorosis obtained (38%), 95% confidence level and 10% allowable error, the minimum sample size was determined to be 653.

Sampling design

Multistage random sampling was employed to select the study population. Kutch coast is divided into four zones from which one zone (Anjar, Mundra) was randomly selected. From the selected zone, a taluka (Mundra) was randomly selected. From the selected taluka, 2 villages (Bhadreshwar and Luni) were randomly selected. Subjects were randomly selected starting from the reference point.

Determination of water fluoride concentration

Drinking water fluoride concentration in different regions of study area was determined [11].

Clinical examination

The examiner visited the villages on the predetermined dates according to the schedule. The participants were asked to sign a written informed consent form and were asked to perform the three diagnostic tests for skeletal fluorosis.

Table 1. Distribution of study subjects by age and gender

Variables	Number (n)	Percent (%)
Age (Years)		
15-24	19	2.9
25-34	121	18.5
35-44	242	37.1
45-54	245	37.5
55-64	26	3.9
Gender		
Male	382	58.5
Female	271	41.5
Total	653	100

Table 2. Prevalence of skeletal fluorosis by age and gender

Variables	Skeletal fluorosis n (%)				p- value
	None	Mild	Moderate	Severe	
Age (Years)					
15-24 (n=19)	10 (52.6)	6 (31.6)	3 (15.8)	0	0,023*
25-34 (n=121)	95 (78.5)	21 (17.4)	4 (3.3)	1 (0.8)	
35-44 (n=242)	183 (75.6)	38 (15.7)	17 (7)	4 (1.7)	
45-54 (n=245)	156 (63.7)	51 (20.8)	27 (11)	11 (4.5)	
55-64 (n=26)	11 (42.3)	4 (15.4)	8 (30.8)	3 (11.5)	
Gender					
Male (n=382)	252 (65.9)	77 (20.2)	38 (9.9)	15 (3.9)	0.044*
Female (n=271)	203 (74.9)	43 (15.8)	21 (7.7)	4 (1.5)	
Total (n=653)	455 (69.7)	120 (18.4)	59 (9)	19 (2.9)	

Test applied: *Chi* square test, *statistically significant difference at p<0.05.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor page of SPSS version 11.5 (SPSS Inc., Chicago, Illinois, USA). *Chi* square test was used for comparisons. Confidence level and p-value were set at 95% and 5% respectively.

RESULTS

The water fluoride concentration in the study area was assessed to be in the range of 3.4- 6.9ppm. Among all, majority of the study participants were in the age range of 35-54 years and were males (58.5%) (Table 1). Prevalence of skeletal fluorosis was observed as 30.3%, out of which, majority of the participants had mild skeletal fluorosis (18.4%). Severe skeletal fluorosis affected very small proportion (2.9%) of participants. Statistically significant (p=0.023) increase in the prevalence of skeletal fluorosis was observed with increase in age.

Table 3. Prevalence of skeletal fluorosis by adverse habits

Variables	Skeletal fluorosis n (%)				Total n (%)	p-value
	None	Mild	Moderate	Severe		
Adverse habits						
None	113 (91.9)	4 (3.3)	4 (3.3)	2 (1.6)	123 (18.8)	0.015*
Tobacco	237 (69.5)	67 (19.6)	30 (8.8)	7 (2.1)	341 (52.2)	
Alcohol	45 (67.2)	10 (14.9)	9 (13.4)	3 (4.5)	67 (10.3)	
Both tobacco and alcohol	60 (49.2)	39 (31.9)	16 (13.1)	7 (5.7)	122 (18.7)	
Duration of adverse habits						
<5 years	196 (88.7)	15 (6.8)	9 (4.1)	1 (0.5)	221 (33.8)	0.03*
5-10 years	174 (75.3)	31 (13.4)	17 (7.4)	9 (3.9)	231 (35.4)	
>10 years	85 (42.3)	74 (36.8)	33 (16.4)	9 (4.5)	201 (30.8)	
Total	455 (69.7)	120 (18.4)	59 (9)	19 (2.9)	653 (100)	

Test applied: *Chi* square test, *statistically significant difference at p<0.05.

More than half of the subjects (57.7%) in the age group of 55-64 years were affected with skeletal fluorosis, out of which majority (30.8%) had moderate skeletal fluorosis. Males exhibited significantly (p=0.044) greater prevalence of mild (20.2%), moderate (9.9%) and severe (3.9%) skeletal fluorosis than females (Mild: 15.8%, Moderate: 7.7%, Severe: 1.5%) (Table 2). When skeletal fluorosis was assessed according to adverse habits and duration of habits, significant associations were observed. Maximum prevalence of skeletal fluorosis was observed among those who had both tobacco and alcohol habits (50.8%). Proportion of subjects with skeletal fluorosis also augmented significantly (p=0.03) with increase in duration of adverse habits (Table 3).

DISCUSSION

The present study aimed to assess the prevalence of skeletal fluorosis among fishermen population in the coastal region of Kutch, Gujarat, India. A total of 653 fishermen participated in the study.

Thorough literature search did not divulge any evidence of skeletal fluorosis among fishermen population. Hence the findings of present study are compared with results of general populations.

Around 30% of present study population suffered from skeletal fluorosis which corresponds to the high water fluoride content of the study area. The prevalence found in the present study was higher than that reported at Southern Rajasthan (22%) [6]. The difference may be attributed to difference in concentration of water fluoride

and difference in eligibility criteria of the subject selected. A study conducted at Wonji Shoa sugar factory in Ethiopia showed the clinical prevalence of skeletal fluorosis in the range of 20.6% to 40.2%. The radiological prevalence in the same population was noted as 70.3% [3].

Significant escalation of skeletal fluorosis with increasing age in the present study corroborates with the previous studies [6, 10, 12]. The significant age difference might be due to the increase in duration of exposure to fluoride with increasing age. Genderwise comparisons of skeletal fluorosis in the present study elicited male preponderance which is in agreement with previous studies [6, 7, 10, 12]. One possible explanation might be that men drink more water than women to compensate for fluid loss during field work. They also drink more wine and tea, both of which can increase fluoride intake.

Association of skeletal fluorosis and adverse habits observed in fishermen in this study confirm the findings of *Hussain* et al. (2010) [9] among the residents of central Rajasthan. Also significant association was observed with the duration of exposure to tobacco and alcohol. This shows that fluoride sources other than water also contribute to the occurrence of fluorosis.

For the reason that fishermen are exposed to sun over a long period of time and owing to their strenuous nature of work, water consumption tends to be more. Hence, provision of defluoridated drinking water and health education aimed at abating fluorosis are highly desirable among the fishermen community. The present study also significantly expands our knowledge of fluorosis.

CONCLUSIONS

Prevalence of skeletal fluorosis in the fisherman community of Kutch Coast, Gujarat, India was found to be 30.3%. Significant augmentation in the prevalence of skeletal fluorosis was observed with increasing age and presence of adverse habits. Need of the hour is the development of an innovative approach for fluorosis mitigation in this high risk studied group. Promotion of consumption of fluoride water, either defluoridated water or water from alternative low fluoride sources should be emphasized. Significant association of skeletal fluorosis with adverse habits also demands conception of awareness about the fact among the general public. More detailed multicentric studies are warranted in fishermen groups of endemic fluoride areas.

Acknowledgement

The author would like to express his appreciation to King Saud University, Vice Deanship of Research Chairs, Kingdom of Saudi Arabia, Riyadh for funding this research.

Conflict of interest

The author declare no conflict of interest.

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Received: 20.05.2015
Accepted: 21.09.2015