SOCIO-ECONOMIC STATUS IN PUBLIC VIEW ASSOCIATED WITH THE FLUORIDE IN DRINKING WATER

Abstract

The objective of this chapter is to comprehend the socio-economic status of the rural area within the Mundaragi taluk. This examination is focused on the impact of fluoride in the local drinking water. The research methodology involves cultivating an understanding of water quality, specifically concerning fluoride levels, and recognizing the significance of fluorosis as a health condition. The investigation incorporates the implementation of innovative and exemplary practices in the vicinity of the research area, all centered on ensuring a consistent supply of high-quality water. This current study was carried out to establish a correlation between socio-economic disparities among individuals and the occurrence of fluorosis. The study was conducted across twenty-five villages in the Mundaragi district of Karnataka, pinpointing regions affected by fluorosis. The outcomes were striking, revealing that every single individual within the studied population exhibited symptoms of skeletal and dental fluorosis. Notably, the Mundaragi taluk of the district displayed higher levels of fluoride contamination, particularly a notable instance where a tube well showed a fluoride level of 3.20 mg/litre. This contaminated water source has led to a significant number of people in the area suffering from various forms of fluorosis. In the course of this investigation, a comprehensive survey involving families was conducted to gain insights into the socio-economic characteristics of the affected communities. Additionally, the study aimed to identify the specific types of fluorosis prevalent among the local population. The survey findings

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underscored the prevalence of dental and skeletal fluorosis, accounting for 53% and 47% of the total fluorosis cases, respectively. The statistical analysis revealed distinct trends. Those under the age of 20 predominantly experienced dental fluorosis, while individuals aged 20 and above were more susceptible to skeletal fluorosis and other related non-skeletal fluorosis ailments.

Keywords: Socio-Economic, Fluoride, Drinking Water.

I. PREAMBLE

Fluorosis stands as a medical disorder resulting from the excessive utilization of fluoride in water and food components [4]. This condition notably impacts various aspects of the human body, including the lungs, cells, and limbs. The excessive intake of fluoride contents leads to the manifestation of symptoms that can mimic other diseases, potentially causing an overlap [12]. Of particular concern is the consumption of fluoride-laden water, which emerges as a major contributor to the issue. This excessive fluoride consumption has been associated with adverse effects such as joint pain, deep back discomfort, and alterations in flexibility, often resulting in vertebral issues. Whether attributed to fluorosis or other factors, individuals may experience neck pain and reduced neck mobility, a condition that has been acknowledged in studies conducted by Susheela (2001) and the World Health Organization (WHO, 2006).

According to Suthar et al. (2007), India contains approximately 0.12 billion tons of fluoride, which accounts for around 14% of the total fluoride content. Previous research including UNICEF (1999) and studies conducted within India indicated that initially, about 12 states showed high fluoride levels in groundwater as of 1991. However, this number increased to 17 states by 1999 due to the natural presence of fluoride in geological formations [5, 7]. A detailed list of states affected by elevated fluoride content can be found in Table 1.

A survey conducted by the Government of India revealed that approximately 66 million individuals in the country were afflicted by fluorosis, with 6 million of them being children under the age of 14 [16]. This equates to around 5% of the total Indian population. Presently, the issue of groundwater fluoride contamination is quite severe, affecting about 65% of villages across India (UNICEF, 1999).

Gopalakrishnan [5] conducted a study revealing that approximately 90% of rural inhabitants are currently utilizing groundwater contaminated with fluoride. This contamination constitutes around 50% of the total water source for individuals in India. The predominant sources of this contamination are attributed to geological formations like metamorphic rocks such as gneisses and granite [3, 8], as well as factors acknowledged by the World Health Organization in 2006. Prolonged usage of fluoride-contaminated water (at a level of 1.0 ppm) for cooking purposes has been identified as a potential cause of fluorosis [10].

Guidelines from the Bureau of Indian Standards (BIS-2003) and the Indian Council of Medical Research (ICMR-1975) stipulate the maximum acceptable fluoride level to be 1.0 mg/L, with an upper limit of 1.5 mg/L. In accordance with the World Health Organization's standards (1997), the permissible fluoride limit stands at 1.5 mg/L. The first recorded instance of fluorosis in India dates back to the 1930s, when a case emerged in the Nellore district of Andhra Pradesh. This initial case led to the identification of subsequent symptoms like headaches and joint pains in numerous villages. The inaugural medical assessment of this issue was documented in the "Indian Journal of Medical Research" in 1937, focusing on villages affected by fluoride [14]. This investigation aims to uncover the causative factors behind fluorosis, comprehensively examine its effects and associated socio-economic challenges, and propose effective remedies for the eradication of these problems.

II. SAMPLING AND SELECTION OF LOCATIONS

Twelve villages were chosen from the research area for analysis. Data on water fluoridation levels, remoteness of residences, and socio-economic statuses were gathered for each family's recorded residential postcode zone. The villages selected were as follows: four from Dambal, three from Narayanpur, and three from Kalkeri; two from Hirewaddatti and two from Mundargi; and one each from Harogeri, Mushtiikoppa, Chikkavaddati, Guddada Budiihal, Virupapura, and Meundi. These villages, where fluoride levels exceeded 1.5 ppm, are listed in Table 1.

III. SELECTION OF PARTICIPANTS

Response decisions were gathered for each query: "Yes," "No," and "Don't know." A variety of demographic information was amassed throughout the survey and interview periods, encompassing factors such as age, gender, presence of children within the household, and the postal code of residence (W. Kerry Mummery, et al., 2007 and APHA, 2004). Within the context of the door-to-door survey conducted via questionnaires, 5 participants were selected from small villages, while 10 respondents were drawn from larger villages, resulting in a total of 90 respondents (43 male; 47 female). The preponderance of households were headed by females, potentially attributed to the demise of their husbands. A notable minority of male household heads possessed higher education from colleges. The investigation revealed lower proportions of female household heads attending senior secondary classes in comparison to their male counterparts within the study area. The selection process was randomized and encompassed all directions within the village [15]. Solely adults partook as participants, with each member being affiliated with only one household. The study incorporated both quantitative and qualitative methodologies.

IV. QUANTITATIVE - DOOR TO DOOR SURVEY

A door-to-door survey represents a form of qualitative research where an interviewer engages with a respondent face-to-face at their residence. This method is commonly employed for various purposes, with the primary objective being to delve into specific issues through personalized discussions. In the course of their study, the researchers opted for a door-to-door survey approach. Within this survey strategy, each participant was personally approached at their doorstep, and a structured questionnaire was utilized to conduct an interview. These interviews typically lasted between 12 to 15 minutes, during which the participants were queried across three main domains: their socio-economic status, drinking water sources, and potential indicators of fluorosis. In order to identify signs of fluorosis, participants were requested to perform certain physical movements recognized for revealing skeletal fluorosis symptoms, as outlined in earlier research (Susheela, 2001).

V. QUALITATIVE - GROUP DISCUSSION

A group discussion was carried out using a valuable approach that involves structured and interactive discussions. This method aims to uncover in-depth insights into intricate practices and the underlying rationale behind actions, thoughts, awareness, viewpoints, and attitudes [13]. Each of the twenty selected villages participated in a minimum of one and a maximum of three group discussions. The primary objective was to gauge the level of awareness and gather opinions from families regarding the multifaceted impact of fluorosis on their socio-economic status, and conversely, how their socio-economic conditions have influenced fluorosis. The effectiveness of the group's dialogue heavily relies on the quality of questions posed, as this can significantly influence the nature of the information acquired [13].

VI. QUESTIONNAIRE

Thus, a basic generated questionnaire was presented during the group discussion sessions. Each of these group discussions lasted approximately 45-60 minutes, continuing until the point of data saturation. Data saturation occurs when no novel themes are arising from consecutive rounds of focus groups and interviews [6]. Throughout the sessions, notes were taken simultaneously to enhance the effectiveness of data management.

VII. SURVEY REPORT

In Mundaragi taluk, over 45% of bore wells are found to be contaminated with fluoride levels exceeding 1.5 mg/liter. Among the 25 surveyed locations, 11 of them, accounting for 48% of the total, namely MGK-9, MGK-13, MGK-14, MGK-15, MGK-16, MGK-17, MGK-18, MGK-19, and MGK-20, show significant fluoride pollution. Notably, during the survey, the highest fluoride concentration of 4.63 mg/L was recorded at MGK-20 (Mushtikoppa cross), while the lowest was 0.98 mg/L in Doni (MGT-24) (Srinivasamoorthy et al., 2007).

Within the study group of 90 respondents, there are 21 family units comprising a total of 275 individuals who depend on agricultural practices for their livelihood. Farming constitutes the primary source of income, followed by agricultural labor. Some individuals are engaged in skilled work such as selling seeds and providing services. Out of the 90 households, only 37 own land, averaging 2.3 acres per household. Among the entire group, 40 households (44%) possess assets [16]. When using a scoring system, it becomes apparent that among the respondents, 40 are classified as having mild fluorosis, 28 with moderate, and 22 with severe forms of fluorosis (Figure 1).

As reported by the participants, the most prevalent issues faced by villagers in the study area due to fluorosis include body joint pain and stiffness, gastrointestinal problems, difficulty in performing sit-ups, and limited arm movement. In severe cases, some individuals expressed an inability to walk without support and even mentioned reliance on wheelchairs.

Table 1: Detailed List of States Affected by Elevated Fluoride Content in the Study Area

Sl. No	Sampling Locations	Code	Fluoride (mg/L)	Effect
1	Bannikodu	MGK-1	0.98	Promotes dental health Prevents tooth decay
2	Belludi	MGK -2	0.98	
3	Budhal	MGK -3	0.98	
4	Bullapura	MGK -4	0.97	
5	Byaladahalli	MGK -5	1.03	

6	Chikkabidare	MGK -6	1.02	
7	Gangarasi	MGK -7	1.28	
8	Govinal	MGK -8	1.10	
9	Jigali	MGK -9	2.00	Dental Fluorosis
10	Kamalapura	MGK -10	1.33	Promotes dental health
11	Kumbluru	MGK -11	1.90	Dental Fluorosis
12	Malebennu	MGK -12	1.78	
13	Nittur	MGK -13	2.17	
14	Kunebelekere	MGK -14	3.14	
15	Kunebelekere road	MGK -15	2.14	
16	Bevinahalli	MGK -16	2.99	
17	Deverabelekere	MGK -17	2.53	
18	Hanagawadi	MGK -18	2.33	
19	Mittlakatte	MGK -19	2.14	
20	Rajanahalli	MGK -20	1.63	Skeletal Fluorosis
21	Salakatte	MGK -21	1.55	Dental Fluorosis
22	Thmlapura	MGK -22	0.98	Prevents tooth decay
23	Ukkadagatri	MGK -23	1.00	
24	Sarati	MGK -24	0.86	
25	Yelavatti	MGK -25	0.96	

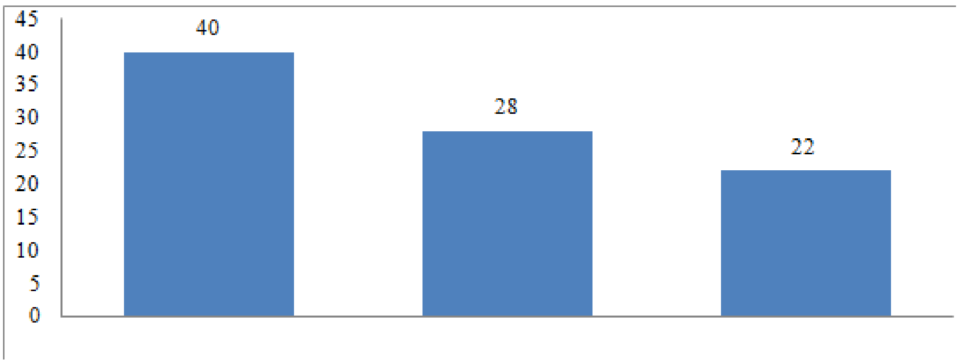

Figure 1: Self-Reports of Respondents' Drinking Water Sources

The majority of participants surveyed in the specified area are aware of the adverse impact of fluoride content in groundwater on their health. Many of these individuals are also conscious that recent evaluations have been conducted to assess fluoride levels in the groundwater sources within their villages. However, it is worth noting that only a small number of participants have expressed that there is no remedy for fluorosis. Consequently, due to this lack of awareness, they continue to allocate funds towards medical treatments instead of investing in access to clean water.

A significant portion of the respondents believe that individuals with higher economic status do not face an equivalent level of risk, as they can afford to employ de-fluoridation techniques such as water filters for their groundwater. Among the participants, 82% (approximately 74 individuals) rely on bore wells for their drinking water; while a mere 14%

(13 individuals) depend on the piped water supply. A minority of around 4% (roughly 4 individuals) draw from alternative sources like open wells for their drinking water.

Of the 82% who utilize bore wells, 44%, 32%, and 23% experience mild, moderate, and severe fluorosis respectively. Among the 14% who rely on pipeline water supply, 86%, 11%, and 3% face mild, moderate, and severe fluorosis respectively [17].

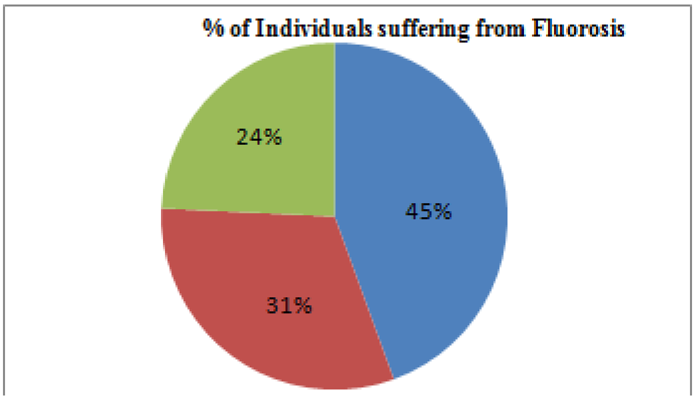

Figure 2: % of Individuals Suffering from Fluorosis

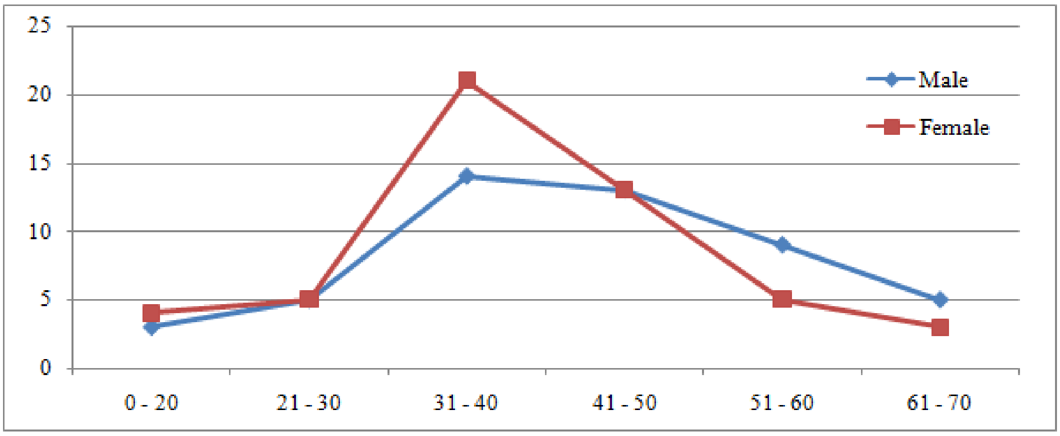

Figure 3: % of Male and Female Members Suffering Fluorosis at Different Age Group

Figure 2 and 3 illustrate the projection that the prevalence of severe fluorosis among individuals exhibits a sharp increase with advancing age, particularly after reaching 35 years of age. Notably, the severity of fluorosis more than doubles after the age of 55. The age bracket of 41 to 50 holds the highest concentration of concerns, encompassing 53.6% of males and 46.4% of females within the specific age cohort. Additionally, within the age group of 21-40, a greater incidence of fluoride-related issues is observed among females (57.5%), while at the age of 45, the prevalence of problems tilts towards males (62.6%). However, after attaining the age of 65, the occurrence of fluorosis-related problems among females diminishes significantly to 0.8% [25,26,27].

Furthermore, an analysis of statistical correlations involving age groups and the proportion of fluorosis cases reveals a positive connection. This implies that the higher the number of individuals aged above 30, the greater the proportion [1] of individuals afflicted with skeletal and non-skeletal fluorosis within families (see Figure 4). A discernible correlation exists between the overall percentage of fluorosis sufferers within families and the count of males, females, and total family members aged over 30 years, signifying a substantial positive relationship. This suggests that the instances of skeletal and non-skeletal fluorosis are concentrated within the age range of 30-50 years.

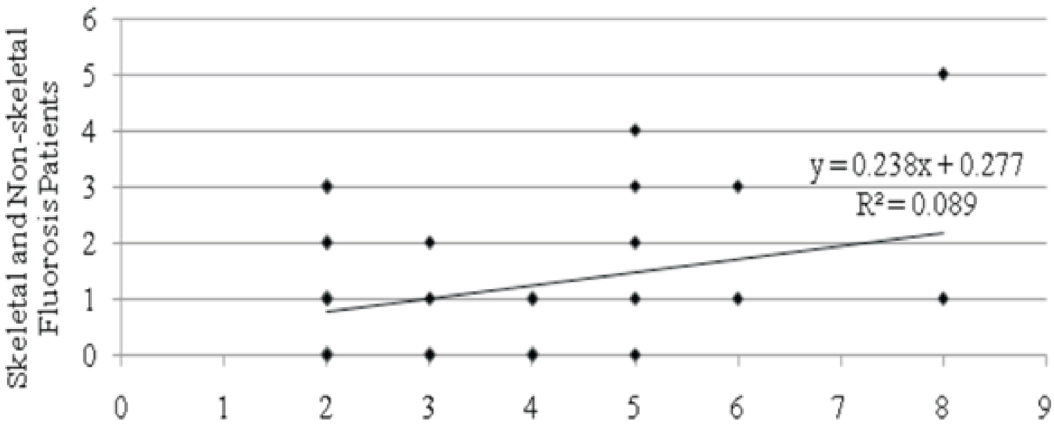

Figure 4: Relationship between Number of Skeletal and Non-Skeletal Fluorosis Disease Found in between 30 to 50 Age

VIII. SUGGESTIONS

Numerous obstacles obstruct the progress of the agenda. A significant portion of the population in Harihar taluk is afflicted by skeletal fluorosis, a condition arising from prolonged consumption of groundwater for drinking purposes. Consequently, individuals grapple with a multitude of health-related and socio-economic challenges within their families. To address these pressing issues, regular assessments of fluoride and other variables must be conducted on water sourced from tube wells. Collaborative efforts between UNICEF and the PHE section in Gadag should facilitate dental examinations at the primary level. Hazardous bore well locations ought to be marked with a prominent red color to signify danger. The provision of fluoride-free water and installation of taps across various parts of the village are imperative. The establishment of a water filtration plant is recommended, accompanied by medical interventions aimed at identifying individuals displaying primary indicators of Fluorosis. Ultimately, public awareness programs need to be organized to enlighten the community.

IX. CONCLUSION DRAWN FROM THE SURVEY

The study reveals that dental and skeletal fluorosis could significantly contribute to preventing and managing fluorosis within the community. Due to the lack of clean drinking water, individuals are compelled to consume fluoride-contaminated groundwater exceeding safe limits. Analysis indicates that a majority of the participants suffer from varying degrees of dental and skeletal fluorosis. The local community believes that fluorosis has negatively impacted their health, leading to reduced work efficiency, income, and quality of life. Additionally, the severity of fluoride's effects varies based on factors such as gender, age, weight, education, and income of the respondents.

To address this issue, several measures are recommended, including the distribution of safe drinking water alternatives, implementation of remedial treatments, provision of fluoride filters, and raising awareness among the community. Collaborative efforts involving medical professionals, NGOs, and local organizations are essential to tackle this pressing concern in the area. The current study anticipates identifying key determinants for effective de-fluoridation initiatives, both innovative and traditional, in the study area. This underscores the urgent necessity to establish a reliable supply of fluoride-free drinking water, potentially through pipelines and other feasible solutions.

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