

STATUS OF FLOURIDE IN INDIA: A REVIEW

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Abstract: -

The fluoride contamination of the groundwater in India is a well-known phenomenon. However, due to the consumption of groundwater, non-carcinogenic risk evaluations and meta-analyses of fluoride exposure to humans were conducted for the first time in India. In this context, we gathered information on fluoride concentrations in groundwater across India by conducting methodical searches in the databases of different worldwide search engines.

Here, we present a thorough meta-analysis of fluoride data and a meta-regression analysis, as well as a review of the associated health risks. For this, we are considering the 10 states of which we are analyzing and discussing the status of fluoride content present in that state of water. We discovered that the WHO, ICMR, and national

guidelines limit of 1.5 mg/L is exceeded by the pooled concentration of fluoride in India, which is around 2.37 mg/L with a 95% confidence interval (1.46-3.28 mg/L). According to a meta-analysis of the data, fluoride concentrations are 1.85 times greater in rural sections of the nation than they are in metropolitan ones. As rainfall and longitude increased, the amount of fluoride in groundwater reduced significantly. According to the risk assessment for exposure via oral and dermal routes, consumers in most of the regions face a significant non-carcinogenic risk, with children at greater risk than adults (Total hazard quotient > 1). The results are useful in pinpointing the afflicted regions of India, and we advise using safer water sources.

Introduction: -

Fluoride is essential for drinking purposes but it should be kept in the optimum or consumable range so that human beings, plants, animals, etc will not be get affected and can drink the water peacefully. According to a 2012 World Bank report, about 85% of Indians rely on groundwater for drinking, making groundwater quality a significant problem that needs to be addressed independently (REF: (Shekhar and Sarkar, 2013; Sarkar et al., 2016; Saha et al., 2016; Kumar et al., 2017). Without conducting a rigorous risk assessment, groundwater was thought to be generally safe in India and was utilized extensively for drinking (REF: (Ali et al., 2016).

Contrary to popular belief, numerous studies have shown both anthropogenic and geological factors contribute to groundwater pollution. One of the most pressing issues today is the fluoride pollution of groundwater, which has had negative impacts on every continent in the world. Many investigations show the substantial socioeconomic effects of fluoride-related health issues, including dental and fluorosis of the bones in humans. In India, there are a total of 19 states where the people are affected by fluoride in the approximately quantity of 117 lakhs of people (REF: (Ali et al., 2016).

In the last 5 years- 4157 lakhs were released under the National Programme for Prevention & Control of Fluorosis (NPPCF).

Although higher concentrations of fluoride are mostly restricted to arid and semi-arid regions, fluoride levels

in groundwater have been found to exceed WHO (2011) standard limits all over the world maximum amount of fluoride that is permitted in drinking water by the WHO is 1.5 mg/L, in reference with WHO various other councils such as ICMR, BIS, CPHEEO tells the limit of fluoride content around 1 to 1.5 which is within the bounds of the national norm. Fluoride pollution of groundwater is defined as fluoride concentrations above 1.5 mg/L due to geogenic or anthropogenic causes and the optimum range is 0.6 mg/L to 1.5 mg/L (REF: (Shekhar, 2017). As a result, fluoride ingestion might result in painful and disabling disorders if the fluoride content is less than 0.6 or greater than 1.5 mg/L. Fluoride can be ingested by drinking water, food, toothpaste, mouthwash, and other dental products. It can also enter the body through medications, fluoride dust, and fumes from businesses that use hydrofluoric acid and/or salt that contains fluoride.

Evaluations of the several fluoride-affected Indian states:

MAHARASHTRA: In many areas of Maharashtra, fluoride pollution in drinking water is a serious problem. Over 6,000 villages in the state are affected by high fluoride levels in drinking water, according to a report released by the Maharashtra state government in 2019. This puts about 3.2 million people at risk for skeletal fluorosis and dental fluorosis.

. Nanded is one of the worst-affected districts in Maharashtra for fluoride contamination. According to the 2011 Indian Census, Nanded district has a population of about 3.3 million people.

According to a government survey from 2018, fluoride levels in drinking water varied from 2.5 to 6.8 mg/L in several communities of Nanded. Several villages in Maharashtra's Chandrapur district have reported high fluoride levels in their drinking water. Chandrapur district is one of these fluoride-affected areas. According to a report released by the Maharashtra government in 2019, fluoride poisoning has afflicted 1,200 villages in the Chandrapur area, putting millions of people at risk for skeletal fluorosis and dental fluorosis. According to a report released by the Maharashtra state government in 2019, the Nagpur district of Maharashtra is not particularly affected by fluoride contamination in drinking water compared to other regions of Maharashtra. Only a small number of villages in the Nagpur district have high fluoride levels in their drinking water, putting about 10,000 people at risk for skeletal and dental fluorosis. Fluoride levels range from 6 to 10 ppm as well. (Fig 2 of the pie chart shows a considerable number of cases.)

MADHYA PRADESH: One of the Indian states with a high concentration of fluoride in the groundwater is Madhya Pradesh. A study by the National Rural Health Mission in Kerala in 2015–16 found that the high levels of fluoride in the drinking water put an estimated 4.7 million residents of the state at risk for fluorosis. The centre and western regions of the state, especially the districts of Shivpuri, Dhar, Narsinghpur, Vidisha, and Sehore, are particularly affected by fluoride poisoning. In Madhya Pradesh, there are 51 districts. According to a report by the Central Ground Water Board (CGWB) in 2019,

38 of those districts have been designated as fluoride contaminated. According to the Government of India, fluoride levels in drinking water have been found to be as high as 10-15 mg/L in several Madhya Pradesh communities in 2015. Fluoride levels in groundwater in some places are significantly higher than the Bureau of Indian Standards (BIS) allowed limit of 1.5 mg/L.

KERALA: An investigation by the National Rural Health Mission in Kerala in 2015–16 found that the state's high fluoride levels in drinking water put an estimated 3.3 million residents at risk of developing fluorosis. The exact number of fluorosis sufferers, however, may vary depending on a variety of variables, including age, sex, and the amount of fluoride exposure. It is significant to highlight that Kerala's government has made a number of steps to address the fluorosis problem, including supplying afflicted communities with safe drinking water and launching awareness programs to inform people about the negative effects of fluoride.

BIHAR: Bihar's drinking water has varying amounts of fluoride depending on the region and even the hamlet. Fluoride levels in drinking water have been reported to be as high as 10–20 mg/L in several villages of Bihar, according to a report released by the Ministry of Drinking Water and Sanitation, Government of India, in 2015. The approximate number of persons impacted is 4.91 million.

UTTAR PRADESH: In Uttar Pradesh, the fluoride content of the drinking water varies from area to region and even from village to hamlet. Fluoride levels in drinking water have been

estimated to be as high as 10-20 mg/L in several areas of Uttar Pradesh, according to a report released by the Ministry of Drinking Water and Sanitation, Government of India, in 2015. That the state's high fluoride levels in drinking water put an estimated 1.43 million residents at risk of developing fluorosis.

GUJARAT: Gujarat's drinking water has different amounts of fluoride depending on the region and even the hamlet. Fluoride levels in drinking water have been estimated to be as high as 10–12 mg/L in some areas of Gujarat, according to a report released in 2015 by the Ministry of Drinking Water and Sanitation, Government of India. The state has estimated 1.2 million affected residents approximately.

RAJASTHAN: The largest state in India is Rajasthan. Fluorides have the biggest impact in this state. It covers 3.42 lakh square kilometres. 10.41% of the nation's land area is in this state. The state has little water resources, and 94% of the drinking water is obtained from the ground. Groundwater serves as the state's primary water supply. Fluorosis is brought on by consuming water with excessive fluoride levels. It impacts everyone, including the elderly, the poor, the young, the rural, and the urban. According to a WHO estimate, 20% of the villages worldwide that are affected by fluorides are in India. According to WHO guidelines, fluoride that exceeds the recommended level (0.5 to 1 ppm) is considered hazardous. People in Rajasthan are drinking water that has more fluoride than is safe. Within the state, the most impacted districts include Jhunjhunu, Sikar, Churu, Jodhpur, Udaipur, Nagaur, Jalore,

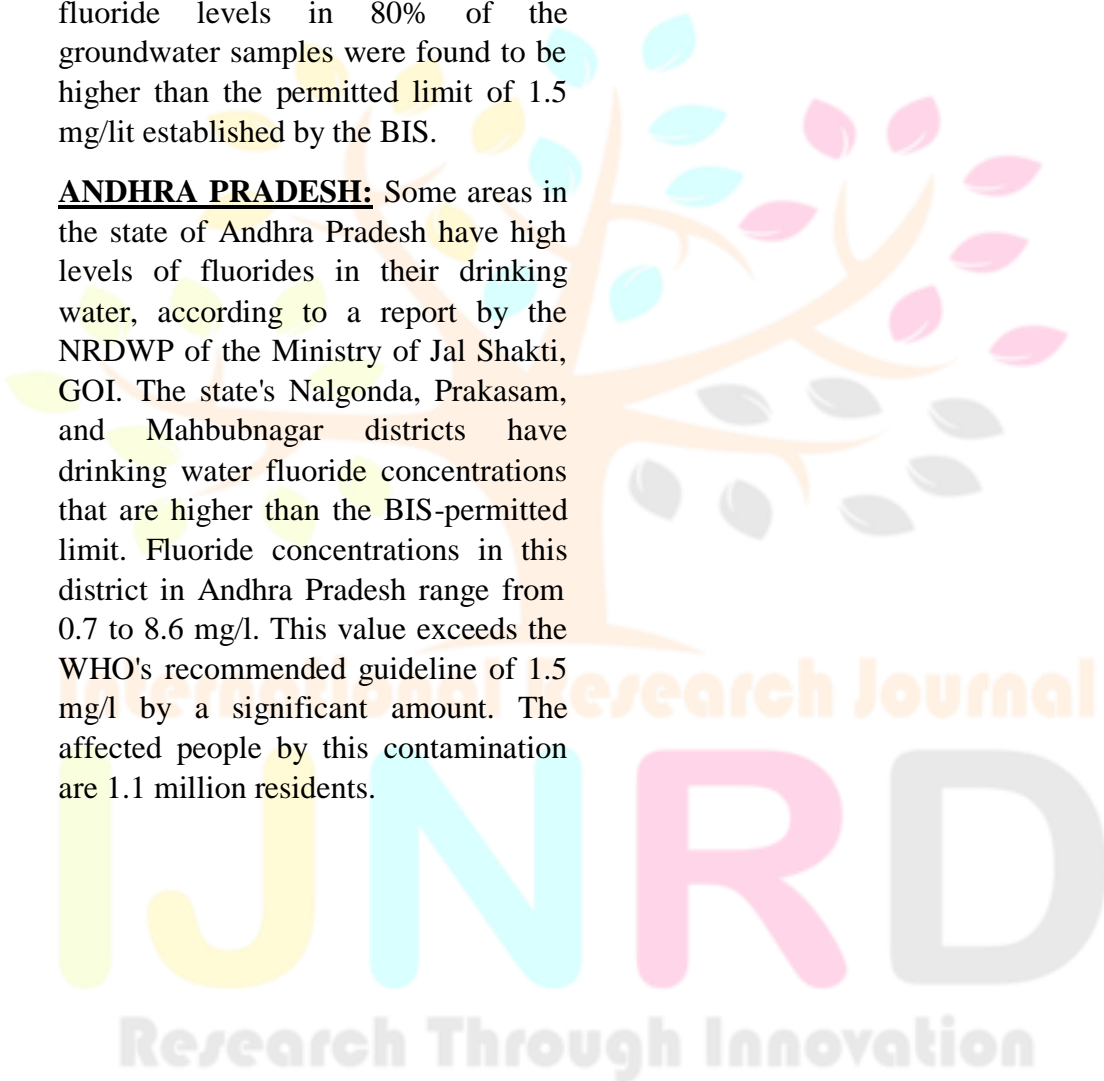
Barmer, Ajmer, Pali, Sirohi, and Dungarpur. The fluoride content in Rajasthan is greater than the allowable limit of 1.5 mg/lit. People in Rajasthan drink water with fluoride concentrations up to 60 ppm. They are extremely health-friendly. The estimated affected residents are 6.1 million people.

TELANGANA: In Telangana, 451 habitations are reportedly afflicted by elevated levels of fluoride in groundwater, with values ranging from 1.5 to 18.5 mg/lit, according to a 2019 report by NRDWP. Over 4000 samples from the state were analysed by the Telangana Ground Water Department in 2017. They discovered that in Nalgonda, fluoride levels were higher than the permissible limit in 36% of the samples taken from the urban and rural districts of Jigon, Medchal, Rangareddy, Siddipet, and Warangal. Yadadris sample had a fluoride level that was up to 46% higher than Nalgonda's. Fluoride-rich granite sheets are currently prevalent throughout the state. The reason the groundwater is fluoride-filled is because the groundwater comes into touch with these rocks. These rocks are found on about 80% of the land. According to certain research, the fluoride concentration of these rocks is quite high, ranging from 1500 to 3200 mg/kg, far exceeding the global average of 810 mg/kg. the number of affected people is 1.93 million residents.

KARNATAKA: According to the NHM's 2020 report, over 1.2 million people in the state of Karnataka are affected by high fluoride levels in drinking water, including the districts of Tumkur, Mandya, Mysuru, Hassan, Chikkaballapura, Kolar, and Bengaluru

Rural. In accordance with another KSPCB report, the state's major problem is the board claims that the greatest concentration levels of groundwater are found in districts like Tumkur, Chitradurga, and Davanagere. Fluoride concentrations in some areas can reach 10–20 mg/lit. Long-term fluoride pollution can cause skeletal and dental fluorosis & fluoride contamination. In this research, the fluoride levels in 80% of the groundwater samples were found to be higher than the permitted limit of 1.5 mg/lit established by the BIS.

ANDHRA PRADESH: Some areas in the state of Andhra Pradesh have high levels of fluorides in their drinking water, according to a report by the NRDWP of the Ministry of Jal Shakti, GOI. The state's Nalgonda, Prakasam, and Mahbubnagar districts have drinking water fluoride concentrations that are higher than the BIS-permitted limit. Fluoride concentrations in this district in Andhra Pradesh range from 0.7 to 8.6 mg/l. This value exceeds the WHO's recommended guideline of 1.5 mg/l by a significant amount. The affected people by this contamination are 1.1 million residents.



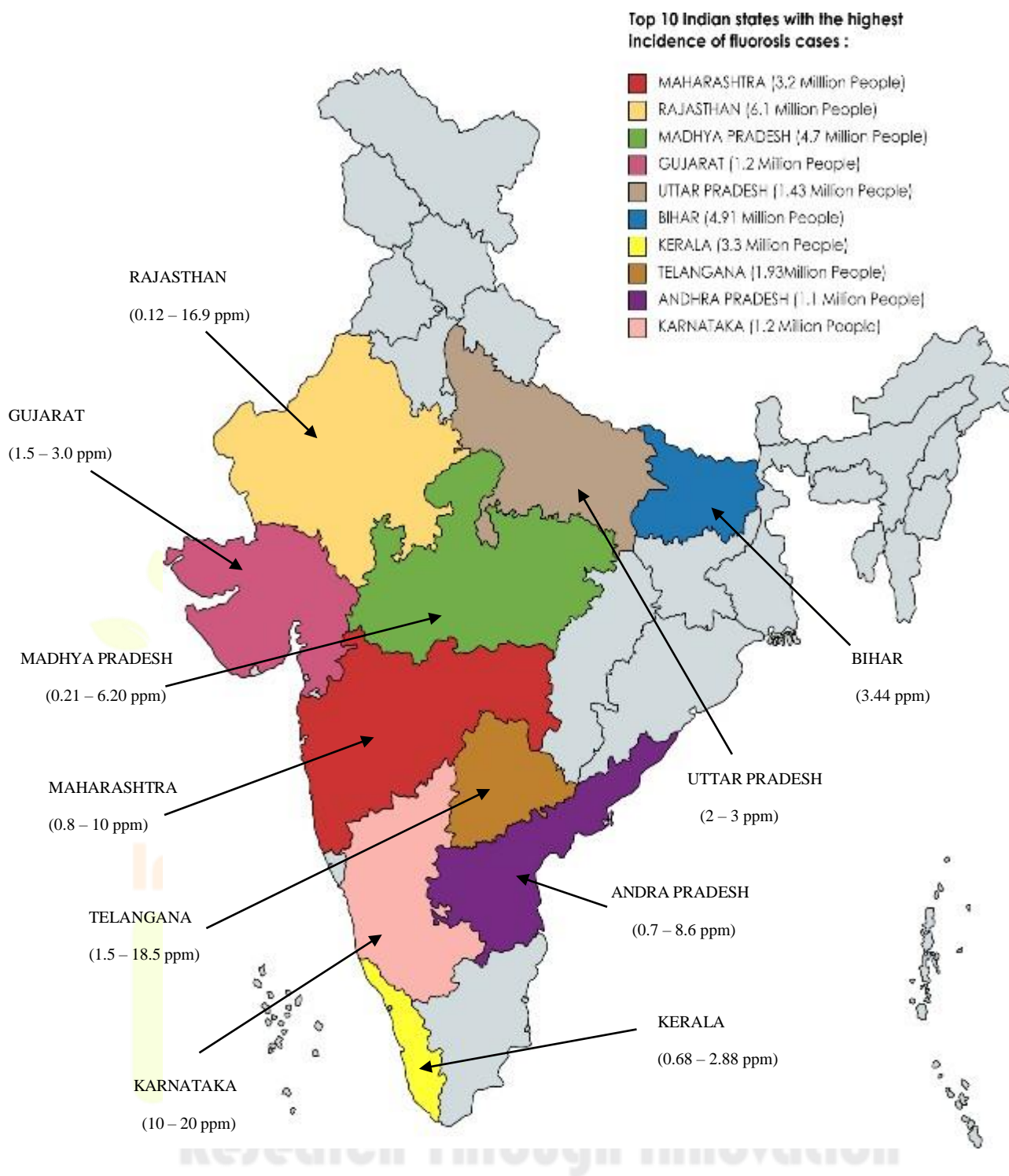


Fig 1: Various states of the Nation showing the Affected residents.

Cities in the state of Maharashtra where the most people have fluorosis

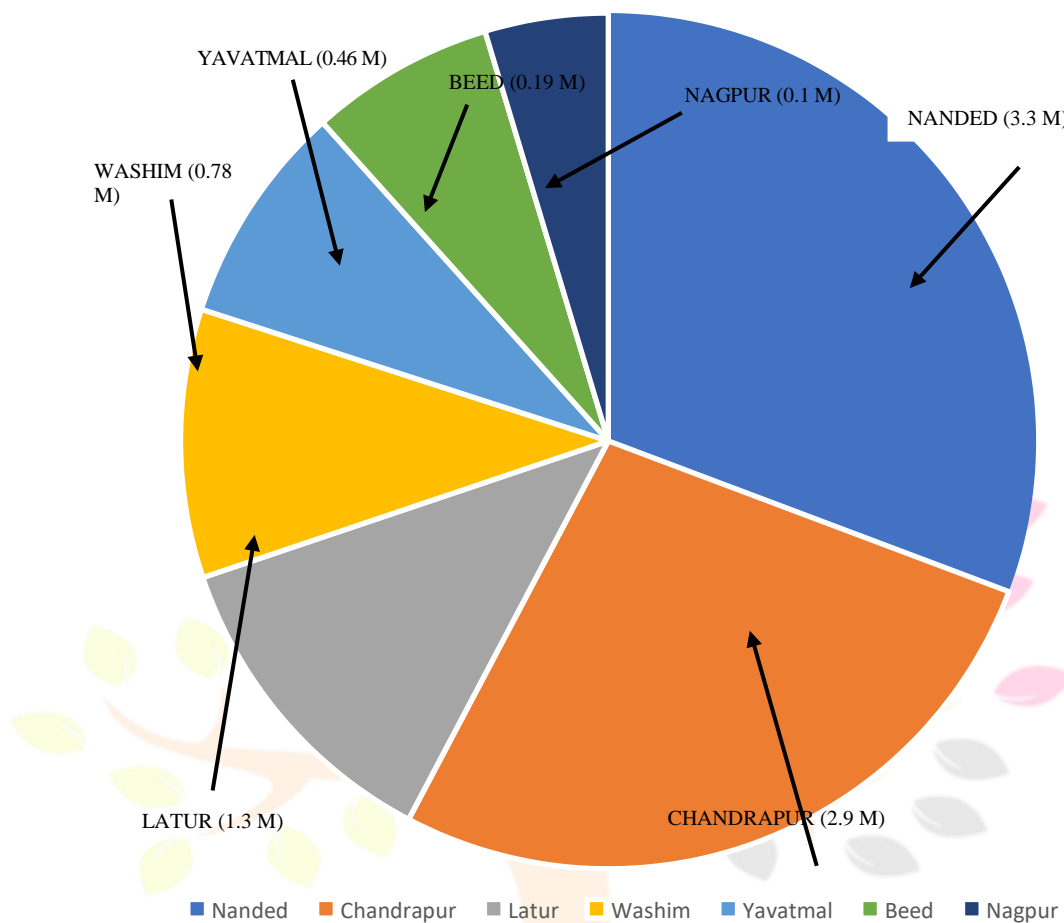


Fig 2: Affected residents in Maharashtra

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