

*Supplementary Information*

*for*

## Occurrence and distribution of fluoride in groundwater and drinking water vulnerability of a tropical dry region of Andhra Pradesh, India

Table S1: Global occurrence of fluoride contamination in water and associated health effects

Sl. No.	Region	Source	F content	Health effect	Economy	Reference	Remarks	Sustainable solution
1	Karonga, Malawi	Groundwater	0.30 to 2.0 mg/L	Dental fluorosis	International trade, fishing, agriculture etc.,	Mapoma et al., 2017	<ul style="list-style-type: none"> <li>F-may come from carbonate dissolution, evaporite sources and human activities.</li> <li>Presumable source of F-in groundwater is dissolution of fluorite(<math>\text{CaF}_2</math>).</li> </ul>	NA
2	South Iran	Groundwater	0.8 to 3.0 mg/L	NA	NA	Battaleb-Looie et al., 2012a	<ul style="list-style-type: none"> <li>The high concentration of fluoride in some limestone samples was due to the presence of</li> </ul>	NA

							inter bedded layers of marl.	
3	Vyeboom region, Limpopo province, South Africa	Groundwater	0.44–0.9 mg/L	Skeletal fluorosis	Agricultural practices, industrial activities	Mutleni et al., 2023	<ul style="list-style-type: none"> <li>Hazard quotient and Hazard index exceeded 1 for children, suggesting non-carcinogenic health risks.</li> </ul>	Good for domestic use not for drinking. Water treatment techniques need to implement.
4	Ethiopia	Groundwater	0.01 to 13 mg/l	Dental and skeletal fluorosis	NA	Tekle-Haimanot et al., (2006)	<ul style="list-style-type: none"> <li>The most effective approach to the fluoride problem in Ethiopia and the other East Africa countries would be the supply of treated surface water to large population and simple and low-cost defluoridation plants for smaller communities.</li> </ul>	NA
5	Riyadh, Saudi Arabia	Groundwater wells,	0.84 to 1.13mg/L	NA	NA	Alabdula'aly A. I. (1997)	<ul style="list-style-type: none"> <li>Samples were collected from the home water</li> </ul>	Fluoridation is recommended in water treatment

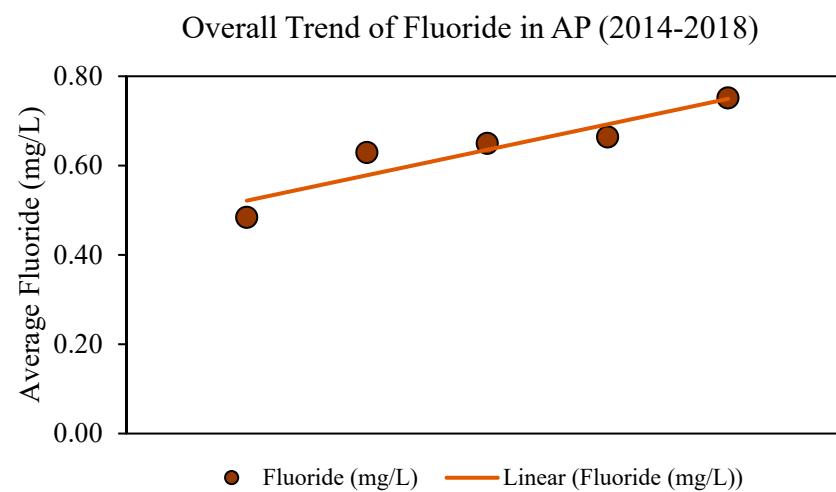
		treatment plants					<p>meters, public buildings with the assistance of Riyadh water authority personnel.</p> <ul style="list-style-type: none"> <li>Fluoride levels were determined in water distribution network, bottled water.</li> </ul>	<p>plant (Riyadh drinking water supply)</p> <p>Removal of TDS in raw water</p>
6	Valjevo, Veliko Gradiste, Kacarevo and Vranjska Banja municipalities in Serbia	Well water and tap water	0.10, 0.15, 0.79 and 11 ppm in well water, 0.07, 0.10, 0.17 and 0.15 ppm in tap water. On average in Valjevo, Veliko Gradiste, Kacarevo and Vranjska Banja, respectively.	Dental Fluorosis	NA	Mandinic et al., 2010	<ul style="list-style-type: none"> <li>Focused on correlating fluoride in hair, well water, and tap water with dental fluorosis prevalence in schoolchildren, the study highlights the significance of local geological factors.</li> </ul>	NA
7	Tibet	Surface and underground water	0.02 to 0.18 mg /L	Dental fluorosis	NA	Cao J et al., 2000	<ul style="list-style-type: none"> <li>Identifying high-fluoride "brick tea" In Tibet causinf dental flourosis.</li> </ul>	Raising awareness for alternative tea choices is key to addressing

								dental health concerns.
8	Sihong County and Jiangsu Province, China	Boreholes and shallow wells	water fluoride: 2.47±0.79 mg/L range: 0.57–4.50 mg/L	Reduced IQ level in children & dental fluorosis	NA	Xiang et al., 2003	<ul style="list-style-type: none"> <li>• an inverse correlation between intelligence and dietary fluoride from either contaminated food or drinking water.</li> <li>• The reason why there was the tendency for IQ to decrease with increasing age is not clear.</li> </ul>	In areas with endemic fluorosis, the study recommends keeping drinking water fluoride levels below 1.0 mg/L to prevent adverse effects on children's intelligence development.
9	Babil Iraq	drinking tap water (originally from the Euphrates River)	0.129 to 0.260 mg/L	Dental fluorosis Tooth decay	NA	Matloob., 2011	<ul style="list-style-type: none"> <li>• Euphrates water levels dropped, increasing river salinity, restricting affordable clean water.</li> <li>• Fluoride exposure hinges on water concentration, intake, and food levels</li> </ul>	To prevent dental caries, drank water should be fluoridated was mentioned
10	Azores, Portugal	groundwater	0.17 mg/L and 2 mg/L,	Dental fluorosis	NA	S.Cordeiro et al., 2012	<ul style="list-style-type: none"> <li>• High fluoride content in</li> </ul>	

							<p>volcanic rock aquifers is exploited for public water supply.</p> <ul style="list-style-type: none"> <li>• Fluoride enrichment in perched aquifers is mainly due to silicate weathering.</li> <li>• High F contents are observed in mineral discharges with a volcanic source.</li> </ul>	
11	Mexico, Sonora	Ground water	0.53 and 7.59 mg/L	Fluorosis	NA	Valenzuela-Va'squez et al., (2006)	<ul style="list-style-type: none"> <li>• Groundwater chemical analysis from shallow dug wells and deep wells showed a salinity stratification since the salt content decreases as depth increases. This is associated with infiltration of greatly</li> </ul>	NA

							mineralized surface water from percolation of irrigation water	
12	Wisconsin	Groundwater	0.01 to 7.60 mg/l	Dental fluorosis	NA	Ozsvath, (2006)	<ul style="list-style-type: none"> <li>High-fluoride groundwater has been reported most often in crystalline basement aquifers, active volcanic zones with geothermal sources, and arid, sedimentary basins</li> </ul>	NA
13	Texas	Groundwater	>4mg/L	Skeletal fluorosis	Agriculture and industry	Hudak PF, Sanmanee S (2003)	<ul style="list-style-type: none"> <li>The geologic and human sources have affected solute concentrations in the Woodbine aquifer.</li> <li>Nitrate problems, influenced by human activity, have been tempered by</li> </ul>	NA

							low recharge rate sand confining layers above the aquifer.	
14	Different Serbian municipalities: Valjevo, Veliko Gradiste, Kacarevo and Vranjska Banja	Well water, tap water, hair	Average fluoride levels were 0.10, 0.15, 0.79 and 11 ppm in well water, 0.07, 0.10, 0.17 and 0.15 ppm in tap water, 19.3, 21.5, 25.4, and 32.5 ppm in hair samples	Dental fluorosis in Vranjska Banja	NA	Mandinic et al., 2010	<ul style="list-style-type: none"> <li>fluoride content in hair is highly correlated with fluoride content in drinking water and dental fluorosis level.</li> <li>Hair may be regarded as biomaterial of high informative potential in evaluating prolonged exposure to fluorides and to individuate children at risk of fluorosis regardless of the phase of teeth eruption.</li> </ul>	NA



**Figure S1:** Average Fluoride trend in Andhra Pradesh (AP) (2014-2018)