



Assessing Water Fluoride Levels in Rural Rajasthan, India

Kajal Mehta, Pranavi Sreeramoju, MD MPH
UT Southwestern Medical Center¹, Jal Bhagirathi Foundation²

¹5323 Harry Hines Blvd, Dallas Tx 75390, ²Water Resource Center, Bijolai, Near Kaylana Lake, Jodhpur, Rajasthan, India, 342 003

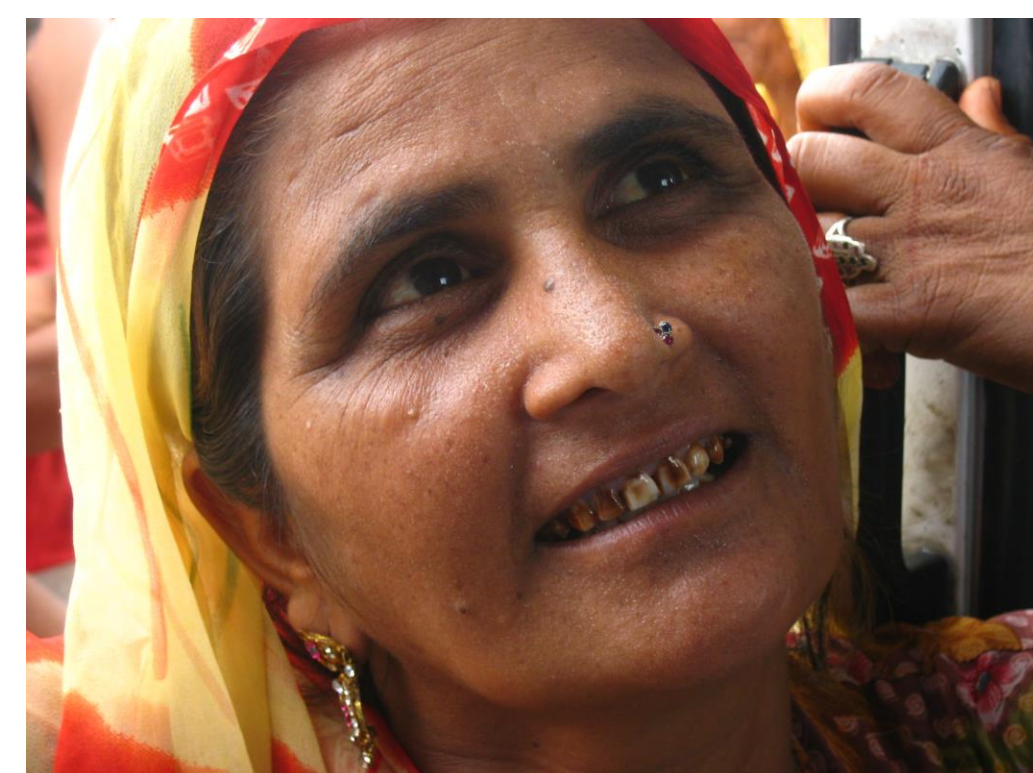


INTRODUCTION

Skeletal and dental fluorosis are crippling diseases associated with consumption of water with excess fluoride.¹ Dental fluorosis manifests with symptoms such as severe staining, pitting, enamel damage and cracking of teeth. Skeletal fluorosis manifests with stiffness, joint pain, crippling, kyphosis, invalidism,² secondary and GI complications.³ Fluorosis occurs when fluoride interacts with mineralizing tissues, causing changes in the mineralization process, however the precise mechanism of fluorosis is incompletely understood. In dental fluorosis, the fluoride is thought to cause sub-enamel porosity.⁴

Fluorosis is an endemic public health issue in many developing regions around the world. An epidemiological study in Ethiopia found radiological evidence of skeletal fluorosis in 65.7% of adults in the surveyed population.⁵ A study conducted in Rajasthan, India shows the prevalence of dental fluorosis to be 70.6-100% in village children and 68-100% in village adults. Prevalence of skeletal fluorosis was 5.2% among children and ranged from 7.4% to 37.7% in adults.⁶

The region of interest in this study is the rural area around Jodhpur, Rajasthan, located in the Thar Desert. The inhabitants of the region rely on water supply from rainfall and underground resources. The underground resources are known to be saline with high levels of minerals, like fluoride.⁷



Villagers with staining, and degeneration of their dental enamel, characteristic of dental fluorosis.
Photos by Kajal Mehta, June 2013

RESEARCH QUESTION

The present study hopes to address the underlying problem of fluorosis in the area surrounding Jodhpur, Rajasthan, India by analyzing water quality in the region for prevalence of high fluoride levels, among other factors.



METHODS

This study is a retrospective observational study based on water data collected over a ten month period by the Jal Bhagirathi Foundation (JBF) NGO in Jodhpur, India for a European Union funded water monitoring project. The water data are from the nearby Jalore, Barmer and Jaisalmer Districts. The water samples are from all drinking water sources including handpumps, deep bore wells, tube wells, government run pipelines, ponds, lakes, and reverse osmosis water purification systems. The water samples were collected by trained JBF staff in sterile 1L containers, and the water quality testing was carried out by the on-site chemistry lab manager. Fluoride levels were tested within 24 hours of water sampling using a benchtop multiparameter meter and a fluoride electrode in 100 mL water. Additional tests for color, odor, turbidity, pH, alkalinity, total dissolved solutes, and presence of fecal bacteria were performed on each sample.



Water samples for fluoride level testing were taken from all sources of drinking water utilized by local villagers, including sources like this hand pump well within a village.
Photo by Kajal Mehta, June 2013

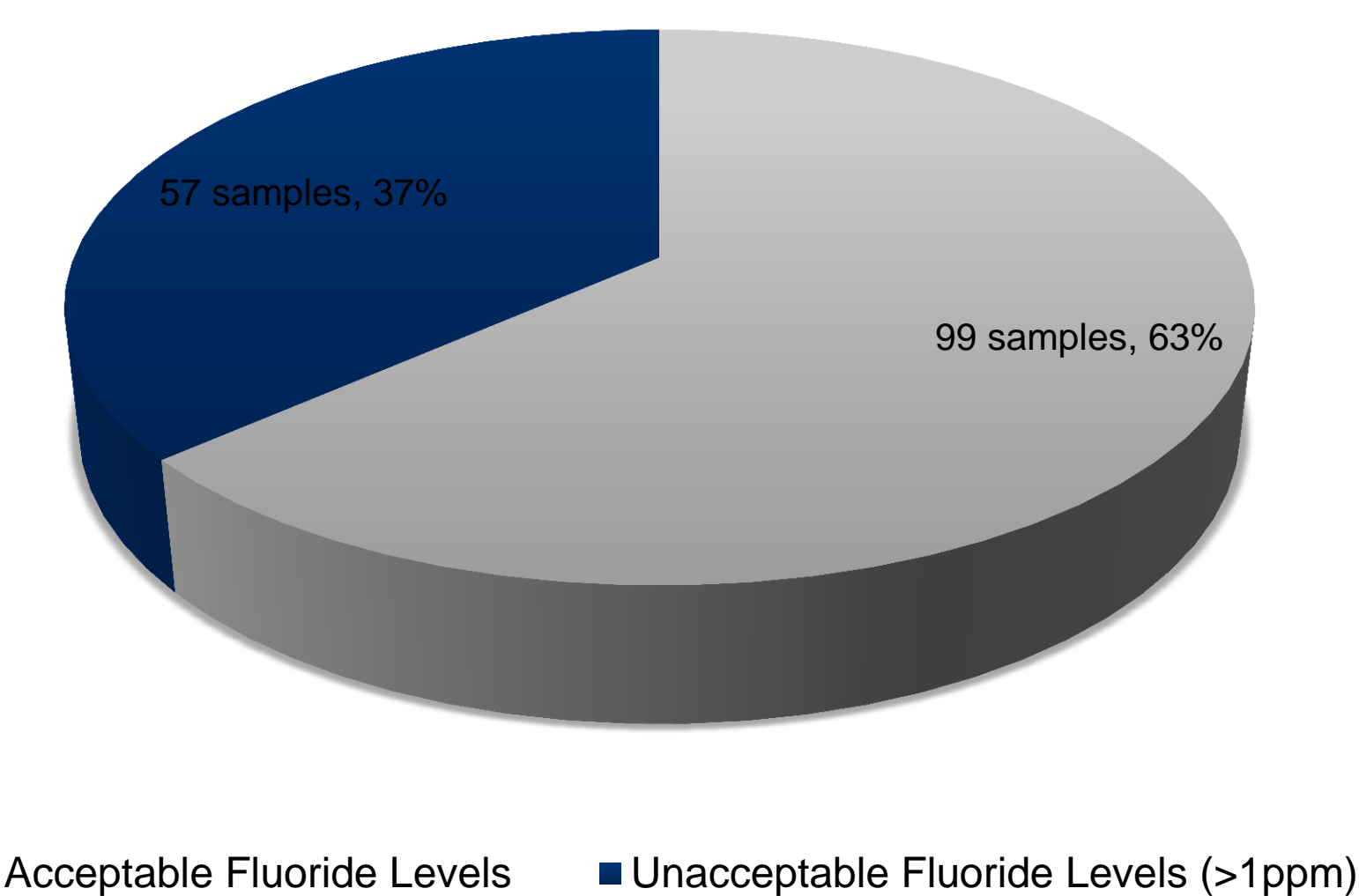


Water sample testing apparatus at the JBF chemistry lab. In the picture, there are 4 water samples prepared for fluoride testing with the fluoride electrode and benchtop meter.
Photo by Kajal Mehta, June 2013

RESULTS

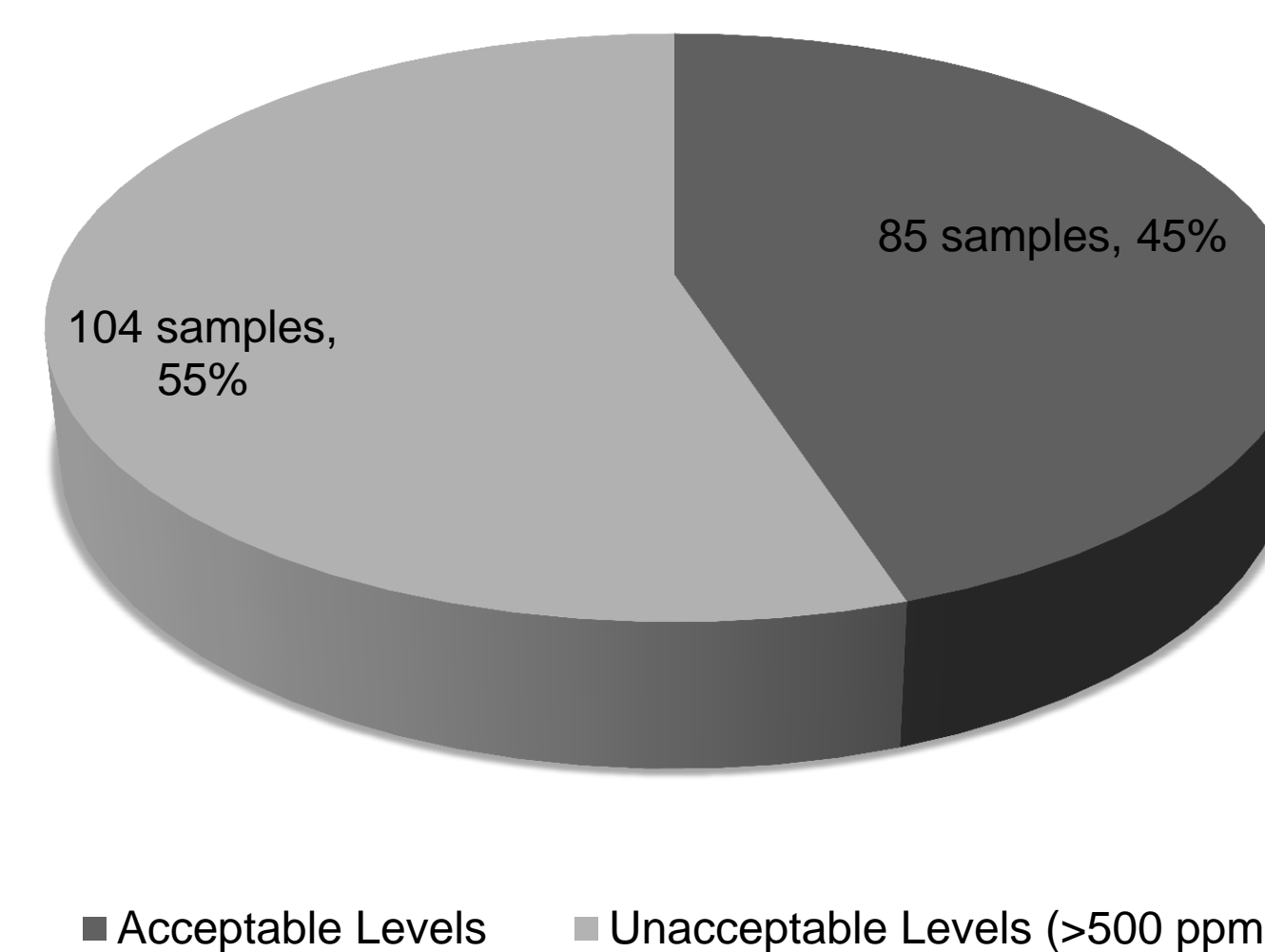
The data were analyzed for frequency of fluoride levels above the recommended level of 1 parts per million (ppm). Of the water samples tested for fluoride concentration, 57 of 156 samples (36.5%) showed concentrations above 1ppm. The mean fluoride concentration of all tested water samples was .81ppm, with a standard deviation of .73ppm.

Prevalence of High Fluoride Levels in Local Water Samples

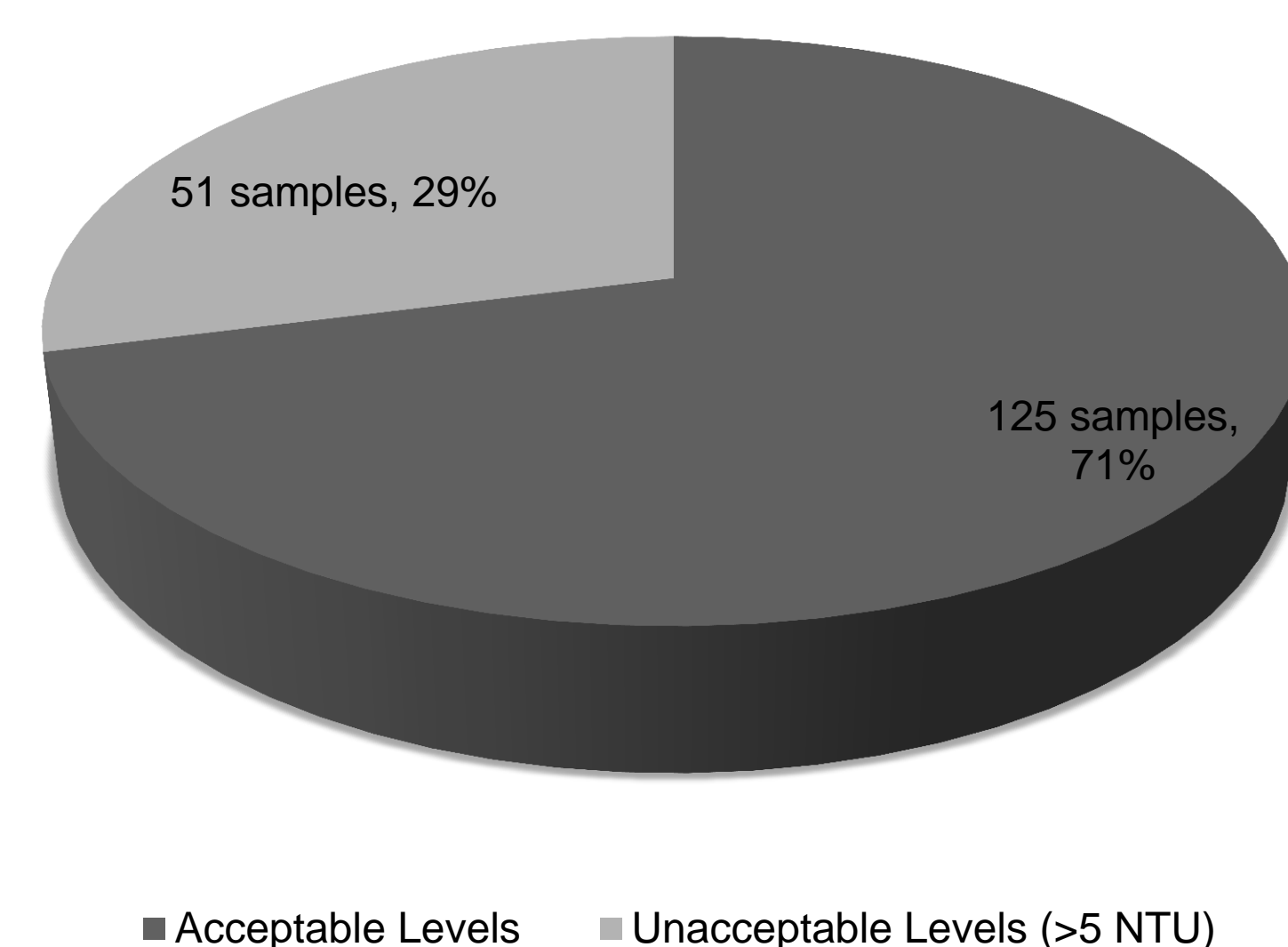


Initial prevalence analyses were also conducted for the factors of Total Dissolved Solutes and Turbidity. The results are shown below.

Prevalence of High Total Dissolved Solutes in Local Water Samples



Prevalence of High Turbidity Levels in Local Water Samples



CONCLUSIONS

The results demonstrate over one-third of the sampled drinking water is potentially toxic to the health of its consumers. This incidence is particularly alarming in the arid conditions of Rajasthan where rural inhabitants have limited water resources, leading them to rely heavily on these harmful supplies. These results provide an impetus to approach the problem by increasing community education of unsafe drinking water sources and methods of purification, including home systems and community-wide solutions like reserve osmosis plants.

In our further analysis of the data, we would like to focus on conducting more stratified data analyses of the water quality across different districts, villages, and water sources. If significant results arise, then there would ideally be a focused effort from local NGOs like JBF on notifying and educating locals in the area about managing the quality of their water resources.

ACKNOWLEDGEMENTS

Thanks to the Jal Bhagirathi Foundation for their partnership and enthusiasm in analyzing their collected water data. Special thanks to Ms. Kanupriya Harish and Dr. Parikshit Singh for their guidance. Additional thanks to Dr. Pranavi Sreeramoju for her assistance in data analysis as well as her mentorship and guidance throughout the project.

REFERENCES

- 1) "Water-related Diseases." WHO. World Health Organization, n.d. Web. 13 Jan. 2014.
- 2) Choubisa, S. L., L. Choubisa, and D. K. Choubisa. "Endemic Fluorosis in Rajasthan." *Indian Journal of Environmental Health* 43.4 (2001): 177-89. Web.
- 3) Susheela, A. K., Arbind Kumar, Madhu Bhatnagar, and Rashi Bahadur. "Prevalence of Endemic Fluorosis with Gastrointestinal Manifestations in People Living in Some North-Indian Villages." *Fluoride* 26.2 (1993): 97-104. Web.
- 4) DenBesten, P. K. "Biological Mechanisms of Dental Fluorosis Relevant to the Use of Fluoride Supplements." *Community Dentistry and Oral Epidemiology* 27.1 (1999): 41-47. Web.
- 5) Susheela, A. K., Arbind Kumar, Madhu Bhatnagar, and Rashi Bahadur. "Prevalence of Endemic Fluorosis with Gastrointestinal Manifestations in People Living in Some North-Indian Villages." *Fluoride* 26.2 (1993): 97-104. Web.
- 6) Melaku, Z., G. Assefa, F. Enqusilassie, K. Bjorvatn, and R. Taekle-Haimanot. "Epidemiology of Skeletal Fluorosis in Wonji Shoa Sugar Estate, Wonji, Ethiopia: A Community Based Survey." *Ethiopian Medical Journal* 4th ser. Oct.50 (2012): 307-13. Web.
- 7) "Jal Bhagirathi Foundation: The Land and Its People." *Jal Bhagirathi*. N.p., n.d. Web. 13 Jan. 2014.

CONTACT INFORMATION

Kajal Mehta
Phone: 979.824.5064
Email: kajal.mehta@utsouthwestern.edu

Jal Bhagirathi Foundation
Website: www.jalbhagirathi.org
Email: jbf@jalbhagirathi.org