Tackling Pavagada Fluorosis

Report 14th May 2016

Fluoride & Health

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Professor Chitta Chowdhury and Team

In association with
Integrated Rural Health Centre Shri Ramakrishna Mission Pavagada
Tumkuru, Karnataka, India

Cover Image: One of the Spectacular Hills at Pavagada Captured by Team Fluoride 5 May 2016
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Mission Statement

- We wouldn’t want to see anymore fluorosis teeth among children at Pavagada. Dental fluorosis seems to be an indicator of systemic fluorosis.

- It is not difficult to fix the cause of fluorosis, provided the policy makers come forward and implement the policy into actions through appropriate stakeholders and partners.

Strategic Plan and Actions

- We want to help contribute effectively running all the de-fluoridation plans by 2017.

- We need to ensure long-term solution by protecting environment of Pavagada by planned plantation aiming a rain forest.

- We expect the reticulated water contains fluoride 0.8-1.5 ppm all-over Pavagada and supplied by pipe lines

- Inaccessible rural population needs deep-tube well (bore well) fixed with monitored de-fluoridating cartridges.

- Rivers needs easy flow of water and its adequate capacity throughout the year.
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Editor’s note
I am extremely grateful to Mr N V Hegde, Chancellor of Nitte University, without his support such piloting would not have been possible.

We need to know the cause of high fluoride in Pavagada. We do not know who is doing what and who is responsible to fix the fluorosis menace at Pavagada.

With my team I have done spatial mapping of Fluoride in all the districts of Karnataka and Published in UK based Journal. Apart from Pavagada of Tumkur, two more districts, such as - Koppal and Kolar have higher concentration of fluoride. We need to know the situation over there too. But we wouldn’t like to proceed without creating a model at Pavagada, and that would help us to intervene elsewhere. The fluorosis is a part of national problem, simply because many states of the country have several fluorosis endemic areas, and the people in those areas are suffering severely from dental and musculo-skeletal fluorosis.

We made a plan for cost-effective treatment procedures of dental fluorosis. It is possible to treat all the teeth with fluorosis in Pavagada provided an implementable plan with resources is available and engaged sincerely.

Clinical and Translational researches, both in community and laboratory are urgently needed. In this context, we prioritise to educate people especially in rural remote areas to secure safe drinking water. I find many of them are still ignorant about the ill effect of excessive fluoride in drinking water, and they are helpless. We also are progressing to check a gene whether that particular gene has a role on development of Fluorosis. In collaboration with Mangalore University Centre for Advanced Research in Environmental Radioactivity (CARER) we assessed background radiation in drinking water, soil and rocks of Pavagada, it seems the level remain within the normal range. Thanks to Professor Karunakara, head of the Centre for the help. I am thankful to Swami Japananda for his supports, and intents to take this project forward through MoU. I am very much thankful to my principal Professor US Krishna Nayak for his warm supports. Thanks to Professor Ramananda Shetty Vice Chancellor and Professor M. S. Moodithaya Registrar of Nitte University for their concern, encouragement and administrative support. My special thanks for Mr N Vishal Hegde Pro-Chancellor for his dynamic entrepreneurship, supporting sustainable progress of Nitte University Services at home and beyond. Finally I thank Professor Raman Bedi, formerly Chief Dental Officer of England and current Chairman of Global Child Dental Health at King’s College London for his strategic and advisory support. It is essential to stop new cases of fluorosis in the country. Let us work together to protect health and environment of the country. Thanks.

Chitta Chowdhury, Prof

Editor | Lead Team Fluoride and Health, 2 June 2016
Foreword
HELP US STOP PAVAGADA FLUOROSIS SOON

Mr. N. V. Hegde, Chancellor, Nitte University

Message

I am glad to know that our A B Shetty Memorial Institute of Dental Sciences, which has always been in the forefront of community dental health service, has embarked upon a novel project at Pavagada, a taluka in distant Tumkur district of Karnataka. The initiative and the effort of the team led by Professor Chitta Chowdhury, Head of the Department of Oral Biology, is indeed commendable.

The work done by Dr. Chowdhury, shockingly reveals that more than 90% children are suffering from dental fluorosis and in the rural areas of the taluka many aged people are suffering from joint pain and bone deformity. This issue needs to be addressed and a cost-effective way on maintaining low level of fluorides has to be found out.

I understand that the Swami Vivekananda Integrated Rural Health Centre of Sri Ramakrishna Sevashrama of Pavagada, Tumkur, Karnataka has extended their support to the College to tackle the problem.

I am sure that this team will be successful in its mission and thus provide quality health service to the people of Pavagada.

Best Wishes

N.V. Hegde
Chancellor Nitte University and
President, Nitte Education Trust
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Message
Swami Japananda, Chairman, Swami Vivekananda Integrated Rural Health Centre, Sri Ramakrishna Sevashrama, Pavagada 561 202, Tumkur, Karnataka

We are extremely gratified that the A. B. Shetty Memorial Institute of Dental Sciences, Deralakatte, Mangalore-575 018, has come forward to render their specialist service to the population of Pavagada Taluk in the field of oral health. This community, faced with a variety of health related problems, is also a victim of high fluoride content in ground water, which causes various diseases including fluorosis, resulting in early ageing, and bad and grey teeth full of cavities. The Government departments, on their part, have utterly failed to address the primary issue of ensuring safe drinking water. Recently it was found that even the mothers’ milk has fluoride content, and babies are being poisoned even since infancy. The local medical practitioners report that there are hundreds of cases of kidney stones, uterus related problems, and even more appalling, erosion of bones rendering the entire skeletal frames brittle. We come across scores of people suffering from orthopedic complications including severe rheumatism.

In this background, we feel beholden to Prof. Chitta Chowdhury and his team members from the department of Oral Biology, ABSM Institute of Dental Sciences, for having volunteered to take up the cause of the local children, more than 50% of whom are affected by dental fluorosis. The team would strive to finding medical and genetic solutions to countering this debilitating disease, especially its oral symptoms. This is a very noble and commendable initiative that deserves all praise, and I am sure that would make a lasting positive impact on the community. We are extremely happy to be partnering in this humanitarian initiative to alleviate one of the dire problems of the people of this most backward area of our state.

We wish all the best to the team that has taken up this challenging task.

With warm regards,

Swami Japananda
Chairman
Swami Vivekananda Integrated Rural Health Centre

Dr. Swami Japananda
Chairman
Swami Vivekananda Integrated Rural Health Centre
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Message

Justice Mr N. Santosh Hegde, Formerly Lokayukta of Karnataka
EXECUTIVE SUMMARY

Project title
Facts and Fallacies of Pavagada Fluorosis
Assessment of Skeletal and Dental Fluorosis among Rural Community of Pavagada Taluk, Tumkur Karnataka India

4th & 5th May 2016

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Community & Environment
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Managing Editor
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Background

Pavagada is a panchayat town in Tumkur district in the Indian state of Karnataka. The main source of drinking water is bore-well water. Nearly, there are 15-20 bore-wells according to information provided by Bharatiya Agro-Industries Foundation (BAIF) Institute of Rural Development- Karnataka (BIRD-K) Sanketana drinking water project. Most of the bore-wells contain high amount of fluoride in drinking water including in rural and remote areas of Pavagada. According to a report in 2005, nearly 156 villages have been affected with this problem i.e. high fluoride content in drinking water (1). This has led to the severe occurrence of dental fluorosis, osteoporosis, osteoarthritis and musculoskeletal diseases, gastro-intestinal problems, headache etc.

Sociological perspective of Pavagada Fluorosis

The Pavagada taluk contains higher amount of fluoride in drinking water. It has resulted in the occurrence of dental fluorosis in younger and older age group. It has also affected the sociological aspects of daily life namely aesthetic appearance, deformity of skeleton, informed quotient, marital situations etc. Recently it was observed that, the parents of bride from outside the Pavagada are not happy to get associated with the grooms from the Pavagada city and vice versa. The parents of the students are finding it difficult to send for rural postings due to present situations prevailing in Pavagada. Some of the families have relocated to another city for better prospectus and healthy life.
Appendix 1: Previous report Sep 2014

Appendix 2: Published Research: Spatial Fluoride mapping in all the districts of Karnataka. Chitta CR, et al. Month 2016 Vol XX No X l Perspectives in Public Health

Abstract

Objectives: (1) To estimate the concentrations of fluoride in drinking water throughout different zones and districts of the state of Karnataka. (2) To investigate the variation of fluoride concentration in drinking water from different sources, and its relationships to daily temperature and rainfall status in the regional districts. (3) To develop an updated fluoride concentration intensity map of the state of Karnataka, and to evaluate these data in the context of fluoriderelated health effects such as fluorosis and their prevalence.

Materials and Methods: Aqueous standard solutions of 10, 100 and 1,000 ppm fluoride (F\textsuperscript{−}) were prepared with analytical grade Na+/F\textsuperscript{−} and a buffer; TISAB II was incorporated in both calibration standard and analysis solutions in order to remove the potentially interfering effects of trace metal ions. This analysis was performed using an ion-selective electrode (ISE), and mean determination readings for n = 5 samples collected at each Karnataka water source were recorded.

Results: The F\textsuperscript{−} concentration in drinking water in Karnataka state was found to vary substantially, with the highest mean values recorded being in the north-eastern zone (1.61 ppm), and the lowest in the south-western one (only 0.41 ppm). Analysis of variance (ANOVA) demonstrated that there were very highly significant ‘between-zone’ and ‘between districts- within-zones’ sources of variation (p < 10\textsuperscript{−5}–10\textsuperscript{−9}), results consistent with a substantial spatial variance of water source F\textsuperscript{−} levels within this state.

Conclusions: The southern part of Karnataka has low levels of F\textsuperscript{−} in its drinking water, and may require fluoridation treatment in order to mitigate for dental caries and further ailments.
related to fluoride deficiency. However, districts within the north-eastern region have contrastingly high levels of fluoride, an observation which has been linked to dental and skeletal fluorosis. This highlights a major requirement for interventional actions in order to ensure maintenance of the recommended range of fluoride concentrations (0.8–1.5 ppm) in Karnataka’s drinking water sources.

**Highlights from First experts’ work-group meeting**

An expert work-group meeting was held on 26th August 2014 at A.B. Shetty Memorial Institute of Dental Sciences (ABSMIDS) Deralakate-575018 Mangalore Karnataka India. The meeting was convened by organizing chairman and lead of Fluoride team Professor Chitta Chowdhury, Head, Department of Oral Biology and Genomic studies, ABSMIDS Nitte University. The meeting was inaugurated with the consent from Professor Ramananda Shetty Vice chancellor of Nitte University. The experts of the group were introduced by U.S.Krishna Nayak Dean of Academics of ABSMIDS. A message from Chief Minister of Karnataka and Health Minister of Karnataka was also addressed. The research outcome of the fluoride team was presented by Professor Chitta Chowdhury and his team member Dr Shahnawaz Khijmatgar and Divya kumara P and discussed extensively among the participants. The principal of JSS Dental College Mysore Professor B.Nandalal spoke with a brief note and represented Mysore as one of the multi-centres proposed. Environmental engineers from Mangalore City Corporation (MCC) and scientific officer from Karnataka state pollution control board (KSPCB) were also present as expert advisors and stakeholders.

The objective of the meeting was to-

1. Survey and surveillance of drinking water and main sources to be continue. The climatic and temperature changes will be considered as one of the determinants for estimation of variable concentration.
2. Fluorosis affected area will be intervened systematically to eradicate fluorosis both for dental and musculoskeletal system. The target of zero-tolerance of fluorosis is agreed.

3. A cost-effective de-fluoridation will be requested for supplementation of supply water with proper monitoring

4. Mangalore City Corporation will be requested for supplementation of supply water with proper monitoring.

5. Extensive clinical research for osteoporosis, fibro-osseous diseases and dental caries, fluorosis, will be carried out. A frontier research group combining clinicians and scientists will be formed.

6. Stakeholders will be communicated and the governmental, private organisations, funding agencies will be communicated.

7. A user friendly website will be developed where community participation for protection of fluorosis is added. Also educational stuff for mothers and young adults will be provided with ill effect of fluoride if excess and deficit.

8. A recommended daily allowance of fluoride (RDA) for Karnataka will be developed

9. Several task forces for research, action-programmes will be formed and number of multi-centres will be identified.

10. International experts and learned organisations will be consulted and incorporated where needed.

11. Operational and basic research on hard tissue and fluoride and fluoride related elements will be studies in frontier research approach. The multidisciplinary sub-group will be formed soon.

12. Researches will be published in the journals of high impact factor.

13. Fortification of fluoride in diets, marketed food, drinks etc. will be monitored and supplementation of fluoride in toothpaste and dentifrices, mouth washes will be
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quantified in order to ensure the quality control (QC) and the recommendations will be given to drug control board and relevant statutory bodies of the country.

14. Guideline and series of information booklet will be published for clinicians, researches and the team members of the public

15. All the members of the experts work group and stakeholders will be communicated regularly to interact for further progress

16. The press and the media will be requested to high light the public health concern of fluoride related diseases and condition
Global situation of Fluorosis
The increased Fluoride levels in drinking water above the normal limit (Normal limit recommended by World Health Organisation (WHO) is ≤1.5ppm) has been widely reported in the literature (2). The increased content of Fluoride in drinking water has resulted in increased prevalence of dental fluorosis and skeletal fluorosis (3). An estimation of Global disease burden due to fluorosis has been tried by international agencies, such as- WHO, in order to assess the performance of a country in terms of intervention to improve health, mapping, population-specific difference, identifying, quantifying, monitoring and ranking the health priorities and hence facilitating the policy decision making.

Recently, a study by Fewtrell L et al (2006) tried to determine the global burden of disease due to fluoride. The authors concluded that, although the skeletal fluorosis is a major burden in some countries, it is difficult to quantify the burden of illness globally. The author recommended, more data is needed on drinking water fluoride concentrations, the number of people exposed to such levels and also sensible and validated exposure-response relationships accounting for major confounding factors such as differences in nutritional status, dose and other fluoride sources. However, the author was able to gather information from the previous published reports and found that China is the most widely affected followed by Pakistan, India, Saudi Arabia and Etiopia. The dental fluorosis estimate of 24 million and Skeletal fluorosis estimate of 10 million shown in Figure 1. (4)

Remarks
1. The age of onset of Dental Fluorosis is 8 years
2. The age of onset of Skeletal Fluorosis is 40 years
3. The severity of Dental Fluorosis is low. The severity for skeletal fluorosis is high and increases with age.
### Table 6: Estimated population affected by dental and skeletal fluorosis in selected countries (mid point estimate)

<table>
<thead>
<tr>
<th>WHO CRA region</th>
<th>Country</th>
<th>Dental fluorosis</th>
<th>Skeletal fluorosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afr D</td>
<td>Niger</td>
<td>159</td>
<td>41</td>
</tr>
<tr>
<td>Afr D</td>
<td>Senegal</td>
<td>119</td>
<td>18</td>
</tr>
<tr>
<td>Afr E</td>
<td>Eritrea</td>
<td>57</td>
<td>15</td>
</tr>
<tr>
<td>Afr E</td>
<td>Ethiopia</td>
<td>868</td>
<td>184</td>
</tr>
<tr>
<td>Amr A</td>
<td>USA</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amr B</td>
<td>Brazil</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amr D</td>
<td>Peru</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Emr B</td>
<td>Saudi Arabia</td>
<td>263</td>
<td>35</td>
</tr>
<tr>
<td>Emr D</td>
<td>Pakistan</td>
<td>2,234</td>
<td>517</td>
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<tr>
<td>Emr D</td>
<td>Egypt</td>
<td>928</td>
<td>182</td>
</tr>
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<td>UK</td>
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<td>0</td>
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<td>Eur B</td>
<td>Kyrgyzstan</td>
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<td>16</td>
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<tr>
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<td>219</td>
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<tr>
<td>Scar B</td>
<td>Thailand</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Scar D</td>
<td>India</td>
<td>18,197</td>
<td>7,889</td>
</tr>
<tr>
<td>Wpr A</td>
<td>New Zealand</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Wpr B</td>
<td>China</td>
<td>23,523</td>
<td>10,887</td>
</tr>
</tbody>
</table>

Figure 1: Reproduced from a published report Fewtrell L et al (2006) (4)
Fluorosis in India (National Problem)

The data suggests that 15 states in India are fluoride endemic areas which contain increased levels of fluoride in drinking water about more than 1.5ppm. Around 62 million people in India are suffering from dental fluorosis, skeletal fluorosis and non-skeletal fluorosis. Out of 62 million, 16 million children below the age of 14 years have been severely affected (7). Groundwater is considered as the major source of drinking water in most of the part of India (8). The health effects such as dental fluorosis and skeletal fluorosis on the population is extensively reported in Figure 3 and 4.
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<table>
<thead>
<tr>
<th>State/Area</th>
<th>Age-group (Years)</th>
<th>Prevalence (%)</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Rajasthan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Madhya Pradesh</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raigad, Maharashtra</td>
<td>0-23</td>
<td>91.7</td>
<td>Bavastark and Bavastark. Trop Doc. 2006; 36: 221.</td>
</tr>
</tbody>
</table>

Figure 3: Prevalence (%) of dental fluorosis in different parts of India by age groups (6)
<table>
<thead>
<tr>
<th>State/Area</th>
<th>Age group</th>
<th>Prevalence (%)</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Palanpur, Jharkhand</td>
<td>Adults</td>
<td>47.4</td>
<td>Sirkant et al. Research report Fluoride. 2008; 41(3)206–211.</td>
</tr>
</tbody>
</table>

Figure 4: Prevalence (%) of skeletal fluorosis in different parts of India by age groups (6)
Why Pavagada is affected with fluorosis

Pavagada is a rocky area surrounded by high rocky hills and mountains. The main source of fluoride in Pavagada is groundwater surrounded by rocks which are rich in fluoride. Most of the people who are affected with fluorosis consume water containing high levels of fluoride in ground water. Most of the people affected by high fluoride concentration in groundwater live in rural Pavagada where the per capita consumption of water is more because of hot climate (9). The rocks in southern India are rich in fluoride which forms the major reason for fluoride contamination in groundwater (9), and the granites in the district of Nalgonda, Andhra Pradesh contain much higher fluoride than the world average fluoride concentration of 810 mg/kg (12). Moreover geology, hydrogeology, geochemistry and climate of the area apart from saturating water properties were found to be the associated factors.

Geo-chemistry, environment, weather and Fluorosis at Pavagada: Any live river. Any regional conflict of water

Ground water is the main source of drinking water for 80% of rural population, 50% urban water requirements and more than 50% for irrigation requirements in the nation. The major public health determinants are strongly interdependent of supply of quality of ground water and its availability. However, water in Pavagada is not sufficient, and it contains higher concentration of fluoride, arsenic and iron (14). This scenario in Pavagada region of Tumkuru district under Karnataka State of India is really uncomfortable. A study for understanding with hydrogeochemical found that, majority portion of the ground water in Pavagada is not properly distributed, neither it meets the demand of the portable water (by mobile water track) supply. Anyway, water at Pavagada has higher levels of fluoride (>1.5ppm), dissolved salts (>500mg/L) and a total hardness (75-924mg/L) (15).
Hydrochemical characteristics of the ground water samples suggests that rock weathering and evaporation-crystallization control the ground water composition in the study area with 50-67% of samples belonging to the Ca-HCO3 type and the remaining falling into the mixed Ca-Na-HCO3 or Ca-Ma-Cl type. The saturation index values indicated that the ground water in the study area is oversaturated with respect to calcite and under-saturated with respect to fluorite. The deficiency of calcium ion concentration in the groundwater from calcite precipitation favours fluorite dissolution leading to excess fluoride concentration (15).

South Pinakini River and water dispute
It is seen that Uttara (South) Pinakini River flows from this taluk. The Penna basin water apportionment is governed by colonial time water sharing agreement in the year 1892 and the Interstate River Water Disputes Act 1956 (16). However the future development of Penna basin depends on Interstate water sharing agreements of Krishna River. Tungabhadra Dam which is located in Karnataka and a joint project of Andhra Pradesh and Karnataka is the only gate way to transfer water from Krishna River to the uplands of Penna basin up to 600 m MSL. The low lands of Penna basin can be supplied with Krishna River from the Srisailam dam up to 250 m MSL. The outcome of ongoing Krishna Water Disputes Tribunal (17) is very crucial for the future of Penna river basin. The morphometric analysis of the sub-watersheds around Pavagada taluk has been shown in the Figure 5.
Figure 5: 9 Sub-watersheds around 49 to 75 km² forming part of Pennar river basin around Pavagada (18) (Dalavayihalli, Maddalenahalli, Talamadahalli, Puluvalli tank, Nagalamadike, Gawdatimmanahalli, Naliganahalli, Devadabetta, Byadunnur)
Back-ground radiation affecting fluorosis
There are no-reports justifying that. There is an association with the background radiation and in occurrence of fluorosis. The highest known level of background radiation affecting a substantial population is in Kerala and Madras States in India where some 140,000 people receive doses which average over 15 millisievert per year (maximum permissible dose –MPD is 27,000 mSv annually) from gamma radiation in addition to a similar dose from radon (19). Nethertheless, we collected the rocks, sands and water to examine the level of background radiation in those specific areas where Pavagada population is badly affected. The study is under progress will be reported soon.

Involvement of gene COL1A2 for Fluorosis
COL1A1 and COL1A2 are responsible for the formation of collagen for bone, tendon, skill and cartilage etc. Specifically, the COL1A1gene produces a component of type I collagen, called the pro-alpha1 (I) chain; whereas the COL1A2 gene produces the pro-alpha2 (I) chain. Since they play an important role in bone formation and bone architecture, polymorphisms in COL1A1and COL1A2 may influence the occurrence of dental fluorosis (20-21).
We are in progress to investigate any influence of Gene for development of fluorosis in Pavagada-- is in a sampled population of the Panchayet.
About COL1A2 SNP Gene

COL1A2 collagen type I alpha 2 [Homo sapiens (human)] Gene ID: 1278
>gi|568815591:94394561-94431232 Homo sapiens chromosome 7, GRCh38.p2 Primary Assembly

Target SNP Region Sequence
>gi|568815591:94412000-94413200 Homo sapiens chromosome 7, GRCh38.p2 Primary Assembly
CAGTTAATCTAAGGCTTGAGTATGTAAGTTAAGTGGCAATATAAAAACATCCTCATTATTATTTTATAG
GGTCTTTCTGTGCCCTTGGGAAATATCGGGCCTGGAGAAA(ForwardPrimer)AGGTCCTGTCG
TAAGTATTGCTCATTATTCCATTATTTCCAAGGACACTTTATGACCCCTATCAAGTTCTATTGCGCTG
TTATTTTACATGAAACACTTTGAAAAATAATCATGACACATACATCATCTCTGGGAAATGCAAGTAAT
AGATTGTAATTATGGAGTCCAAATGAATAACGGACTGAAAGCAGACAGGGAGAGGAAGAAACATAG
GCAGGGAAAAATGAAGCAGGTGAAGGGAGATGCAAAGGAGGAATGAGGAGAAATTGTGCTACACA
TACGAGATTGAAATGGCTATGTTGATGACTACATCTCAAGTTAGAAAAAGGAATGATTCTCAATTAT
ATTACCGCTTTATACAGAGAGCTCTAGCATCAAAGAACTATATTCGTTATCTTCGTCGGCAAGATCAT
AAGCTTTGAGTTGTGAATAGTTGACACTGAGATACTGAAACTGCAAAATACGTCTGCTCCAAGGCCCTC
CTGGCAGTGCAGGCAGGCTGCGCAATGGCCAGCCAGCTGGAGCAAGGAGAGAGGCTGGCAACATT
GGATTTCTGGGAAAGAGGGCACTGTGAAGATCATGATACACAAAGGACTTTCTTTCTACACAGCAGATTCG
AGCCAAATTTTACAAATCTCTAGATTTATCTCTCGGAAATCAGTCAGGTCCAGGGAGGTTTCTTTCGA
ACACAGGAAACTGAGGAGC CCTT(Reverseprimer)ATACACATTAAAAAGTTTACCTCTAGTGATATCCT
TATATCTTCTGCTAAATCTCTCTCTTGAGCCAGACACAGGAGCATCTTATGTAC
ATGGAGGTCGATGGTGAATGATCATCTCTAGATAAAGAAACACAGACTAGGGATCTCAAAGAA
HELP US STOP PAVAGADA FLUOROSIS SOON

CACAAAAACAAGCAGGATTCAACATTGGAAAAATCACCGTGTTAATTGGACATCAAATGTGCAAAGC
TGTCTTTTGTGGGGTTTTCTCTTTACTCTAGGGTGATCTGCGGAAAACCGGTGATAAAAGGTACATGCT
GGTCTGTGTGCTGCTCGGGTGGTAGGTGCTAAGTTGCTGACAGATCTATTACATAGCATTACATGTAAGA
ACCACACCTTTTTTT

1.  A = rs412777,  A/C , position:94,412,625
2.  C = rs414408,  A/C/T,  position: 94,412,627

Primer Sequence
Forward Primer:AGGTCCTGATCCTAGTTGCT
Reverse Primer:AGGAAACTGCAGGCACCTT
PCR Product Size: 706bp

Note: Report will be published soon after confirming the outcome, will be annexed.
Understanding of a situation in a rural community at Pavagada

Demography of Pavagada
Pavagada has a population of approximately 50,000. Males constitute 51% of the population and females 49%. Pavagada has an average literacy rate of 67%: male literacy is 74%, and female literacy is 59%. In Pavagada, 12% of the population is under 6 years of age.

Name of the area
Pavagada, Tumkuru (District) Karnataka State India

Geographic location in directional map (Curtsey: Google map)
Pavagada, Tumkuru, Karnataka India
An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkuru, Karnataka, India
HELP US STOP PAVAGADA FLUOROSIS SOON

**Population density**
2,00,000 (Urban-50,000; Rural-1,50,000)

**Access to school**
8 Urban, 2 colleges in Pavagada Taluk Tumkur District Karnataka India

**Access to health centre**
4 hospitals
HELP US STOP PAVAGADA FLUOROSIS SOON

Fluorosis

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India
Identified determinants of Fluorosis in Pavagada

Source of Water
The ground water in pavagada, Tumkur district contains high amount of fluoride in groundwater. It accounts to 4.6% geographical area of Karnataka covering areas of eastern and south-eastern belt of the state namely; Gulbarga, Raichur, Bellary, Chitradurga, Tumkur and Kolar. In Tumkur, a recent hydrogeo-chemical investigation was carried out to determine the compatibility of ground water for portable use. It was found that, greater part of the water samples did not meet the portable water criteria as they contained excess (>1.5ppm) fluoride, dissolved salts and hardness. BAIF Institute of Rural Development-Karnataka (BIRD-K) has taken up initiatives for recharge of ground water and harvesting of rain water as a sustainable intervention for tackling fluorosis at village level.

![WHO Fluoride Guidelines Value in Drinking water and Air](image)

Figure 2: WHO Fluoride Guidelines Value in Drinking water and Air (5)
People’s Perceptions In Pavagada

Pavagada taluk comprises of 33 gram panchayats with 2,46,255 population according to 2001 census? report. Several villages in Pavagada taluk in Tumkur district have fluoride concentration 3 times more than the permissible level (22).

The community addresses several different aspects to the problem like:

- Financial aspect: Lack of fund.
- Technical aspect: Unavailability and Accessibility of de-fluoridation kits and plants.
- Social aspect: Lack of maintenance of the technical solutions of the de-fluoridation plants is implemented.

Medical conditions and Fluorosis

Medical practitioners say that the foetus and the new-born, who consume breast milk, are prone to Fluorosis. Dr Mahesh (author met in Sept 2014), who is the Taluk Health inspector, says “They are suffering from DUB dysfunctional uterine bleeding. Due to weakness they are suffering from severe gynaecological problems. We see a lot of foetal abnormalities children in Pavagada, like clubfoot, mentally retarded children. Lot of postpartum haemorrhage (PPH) cases that are excessive bleeding after delivery more and more cases due to weakness of our body organ.”

Residents complain that neither the political parties nor government have done nothing to defluoridate especially Rural Pavagada where 90% population lives. The State Government had launched the Sachetana scheme to help the people in Pavagada, Sira and Bagapalli, where drinking water is causing health hazards. Several tests and experiments have been conducted but all of them have failed to yield any positive results.
A say from Manjula from Rural Pavagada

Manjula, a resident of Pavagada says “We don’t have any government people coming here it’s just you journalists, researchers who come here asking about us and do nothing on the issue there are no schemes to purify water. Not only children but also health of elderly people is not good. We don’t know what to do for children we spend around 150-200 rupees on health. We are all suffering from cold, cough, headache, joint pains and other diseases. We are fed up with the government.”(23)

Knowledge Attitude and Practice (KAP) on Pavagada Fluorosis
A KAP intervention was carried out by Professor Chitta Chowdhury and his team revealed that nearly 70-80% population do not have precise knowledge about the ill effect of highly concentrated drinking water related fluorosis and their complications. Attitude is hopelessness and apathetic regarding fluorosis menace. Practice-wise they are not comfortable to raise their voices to fix the problem. They do not have favourable KAP score for dental fluorosis as well (24).

Administrative support
Institute of Public health, Bangalore (IPH) conducted a survey in 2010 on request from the District administration and the District Health Officer; IPH collaborated with BAIFInstitute of Rural Development, Tumkur to prepare a report on fluorosis situation in Pavagada taluka, Tumkur. The report was submitted to the District Commissioner and Chief Executive Officer, Tumkur Zilla Panchayat along with recommendations (25). Similar kinds of surveys (22) have been carried out by various local, national and international organisations but nothing progressed in terms of public health policy implementation.
**Watchdog**

There are some local health officers for schools, general district hospitals and other associations who are assigned specific role to monitor dental and skeletal fluorosis, in a way that never meets the demand of the supply. The maintenance of private de-fluoridation plant is poor due to lack of personnel and support from the company. The government de-fluoridation plants are maintained by the government personnel. But our survey and surveillance find there is inconsistent monitoring of fluoride checks in water.

**Table 1: Population Covered by Rain harvesting**

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Name of the Village</th>
<th>No. of rooftop rain water harvesting structures constructed</th>
<th>Households in the Village</th>
<th>Population</th>
<th>Population Covered</th>
<th>% Coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CK Pura</td>
<td>107</td>
<td>524</td>
<td>2825</td>
<td>896</td>
<td>31.72</td>
</tr>
<tr>
<td>2</td>
<td>Kottur</td>
<td>50</td>
<td>459</td>
<td>2180</td>
<td>254</td>
<td>11.65</td>
</tr>
<tr>
<td>3</td>
<td>Hariharapura</td>
<td>105</td>
<td>222</td>
<td>1125</td>
<td>499</td>
<td>44.36</td>
</tr>
<tr>
<td>4</td>
<td>Gujjanadu</td>
<td>57</td>
<td>488</td>
<td>2478</td>
<td>406</td>
<td>16.38</td>
</tr>
<tr>
<td>5</td>
<td>TN Betta</td>
<td>57</td>
<td>590</td>
<td>3187</td>
<td>781</td>
<td>44.51</td>
</tr>
<tr>
<td>6</td>
<td>Devarabetta</td>
<td>91</td>
<td>344</td>
<td>1666</td>
<td>543</td>
<td>32.59</td>
</tr>
<tr>
<td>7</td>
<td>Jangamanahalli</td>
<td>41</td>
<td>306</td>
<td>1540</td>
<td>251</td>
<td>16.3</td>
</tr>
<tr>
<td>8</td>
<td>KT halli</td>
<td>20</td>
<td>714</td>
<td>3679</td>
<td>553</td>
<td>15.03</td>
</tr>
<tr>
<td>9</td>
<td>Mugadalbetta</td>
<td>27</td>
<td>382</td>
<td>1918</td>
<td>184</td>
<td>9.54</td>
</tr>
<tr>
<td>10</td>
<td>Magalwada</td>
<td>36</td>
<td>714</td>
<td>3679</td>
<td>553</td>
<td>15.03</td>
</tr>
<tr>
<td>11</td>
<td>Karekyathanahalli</td>
<td>89</td>
<td>266</td>
<td>1335</td>
<td>430</td>
<td>32.31</td>
</tr>
<tr>
<td>12</td>
<td>Kannamedi</td>
<td>65</td>
<td>757</td>
<td>3728</td>
<td>588</td>
<td>15.77</td>
</tr>
</tbody>
</table>

*Based on the BIRD-K document provided by District Hospital, Pavagada Tumkur.
De-fluoridation Plants
**De-fluoridation Plants**

Around 19 de-fluoridation plants have been installed. Each plant cost 10.50 lakhs as provided by the district health hospital.
Current Situation of De-fluoridation Plants in various parts of Pavagada Villages

The de-fluoridation plant project is financed by the NABARD under UPNRM. The plant is installed by the Smaat-RO manufactured by Smaat-RO Aqua Technologies Private Limited. Maintenance is a question. (Sampling performed by Prof Chitta Chowdhury and Team)
Report from Bharatiya Agro-Industries Foundation (BAIF) Institute of Rural Development-Karnataka (BIRD-K)
**Program**

### APPROXIMATE COST

<table>
<thead>
<tr>
<th>S. No</th>
<th>Activity</th>
<th>Unit cost</th>
<th>Proposed units</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>RWH through Surface structure</td>
<td>25000</td>
<td>5000</td>
<td>12.50 cr</td>
</tr>
<tr>
<td>02</td>
<td>RWH through Underground structure</td>
<td>20200</td>
<td>15000</td>
<td>30.30 cr</td>
</tr>
<tr>
<td>03</td>
<td>Borewell recharge</td>
<td>30000</td>
<td>156</td>
<td>0.47 Cr</td>
</tr>
<tr>
<td>04</td>
<td>Aquifier recharge</td>
<td>300000</td>
<td>20</td>
<td>0.60 Cr</td>
</tr>
<tr>
<td>05</td>
<td>Nutritional support and awareness</td>
<td>25000 per village</td>
<td>143</td>
<td>0.36 Cr</td>
</tr>
<tr>
<td>06</td>
<td>Repair and Maintainence of D-flouride units</td>
<td>200000</td>
<td>19</td>
<td>0.38 Cr</td>
</tr>
</tbody>
</table>
Places Visited
**Places Visited**

1. Kadamalakunte
2. Kodmadgu
3. Sumkalkunta
4. Khrishnapura
5. Jagaranahalli
6. Venkatapura- Neralakante
7. Chickkanayaknahalli

The villagers were interviewed randomly near the water delivery sources and quick spot assessment and evaluation was carried out in a sampled population of each areas of the list.

Knowledge Attitude and Practice (KAP) was used to understand their knowledge and attitude regarding ill effective of excess fluoride and its management. Proper positive reflection was not evidenced.

Oral Health status was very poor among the adults age group and few cases seems developed associated disorder of fluorosis including a case of oral –submucous fibrosis.
Results
Our Findings

Current Situation
The government and private companies have taken the initiative to install the de-fluoridation plants in urban and rural areas of the Pavagada. But, due to poor maintenance and monitoring of de-fluoridation plants, most of them remain non-functional. Only few de-fluoridation plants are monitored after every 3 days and maintained. Most of the de-fluoridation plants lack of maintenance for more than 6 months and some of them exceeds 2 years. The current existing situation was reported to the concerned private company by the local people and Vice president of Zila Parisad (ZP), but there is no response from any of the authorities and private companies. As a result, people have no option, and only to consume the high fluoride water. In Pavagada urban area, majority people consume fluoridated water, but the reverse in rural areas. Interrupted electricity supply is one of the reasons for non-functional status of many of the de-fluoridation plants, mentioned by a proportion of population. Deterrent id accessibility to De-fluoridation plant, it takes time and time to reach to a de-fluoridated plant. Again by reaching there you find the plant is under lock. Majority of these de-fluoridation plants are maintained by private company. A Similar situation in Rangatumuaba panchayat Keralangatti – filter was non-functional since 2 years and no response from any one since then. There is also an issue with the payment of salary to a person who is looking after the de-fluoridation plant. Recently, a person working for private de-fluoridation plant is not paid for 2 years and neither have they visited to the plant since its installation.
Quarrelling and queuing while collecting water
The timings of availability of de-fluoridated water are between 6-10 in the morning and 4-8 in the evening. There are no de-fluoridation plants in Kodmadgu and Venkatapura-Neralakante. The availability of de-fluoridation plants and filtered water to population is not proportional. Hence, it makes high demand and also leading to a conflict, and they start quarrelling among themselves while collecting water.

Joint-Pain and Systemic Involvement of Fluorosis
Nearly, 2000 people live in Chickkanayaknalli (total population= )? out of which majority of the people are suffering from joint pain, musculoskeletal diseases, dental fluorosis, headache, gastric problems etc. Seven people are affected since birth from crippling fluorosis.

Taluk* wise information

Fluorosis affects population at Pavagada quite severely, nearly 57132 people are suffering from dental fluorosis; skeletal changes in 4997, 2167 suffer from nausea, 607diarrhoea, 572 constipation, 3053 have headache (REF).

Dental Fluorosis:

Table 1: Dental Fluorosis Scores (WHO) among Children’s

<table>
<thead>
<tr>
<th>Scores</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 (Normal)</td>
<td>11 (22)</td>
</tr>
<tr>
<td>0.5 (Questionable)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>1 (Very Mild)</td>
<td>10 (20)</td>
</tr>
<tr>
<td>2 (Mild)</td>
<td>13 (26)</td>
</tr>
<tr>
<td>3 (Moderate)</td>
<td>13 (26)</td>
</tr>
<tr>
<td>4 (Severe)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>
Graph 1: Frequency of Dental Fluorosis among adults

Graph 2: Frequency of dental fluorosis among occupation. Majority of the population were farmers.

Results 1: The children’s in Pavagada has been affected with dental fluorosis ranging from very mild to moderate dental fluorosis. 20% of the children are affected with very mild, 26% mild and 26% with moderate dental fluorosis.
HELP US STOP PAVAGADA FLUOROSIS SOON

Table 2: Age, Fluorosis and DMFT

<table>
<thead>
<tr>
<th>Gender</th>
<th>N (%)</th>
<th>Age Mean (Range)</th>
<th>Dental Fluorosis</th>
<th>DMFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>30</td>
<td>7.76 (3-14)</td>
<td>2 (0-3)</td>
<td>0.36 (0-4)</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>8.73 (3-14)</td>
<td>2 (0-3)</td>
<td>0.31 (0-2)</td>
</tr>
</tbody>
</table>

Results 2: The average mean age is 7.76 (3-14) for males and 8.73 for females. The males and females are affected with grade-2 and grade-3 dental fluorosis. The DMFT for males is 0.36 and females 0.31 indicative of lesser number of decayed teeth.

Table 3: Demographics and Occurrence of Dental Fluorosis

<table>
<thead>
<tr>
<th>Variables</th>
<th>N (%)</th>
<th>Average mean (Range)</th>
<th>WHO Grade of Dental Fluorosis</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N (%)</td>
<td></td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-------------</td>
<td>----------------------</td>
<td>-----------------------------</td>
<td>-------</td>
</tr>
<tr>
<td>Age</td>
<td>59 (93.6)</td>
<td>50.8 (15-76)</td>
<td>24 (60.0)</td>
<td>40</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>38 (100)</td>
<td>50.8</td>
</tr>
<tr>
<td>Male</td>
<td>40 (63.5)</td>
<td>0.0</td>
<td>16 (40.0)</td>
<td>40.0</td>
</tr>
<tr>
<td>Female</td>
<td>23 (36.5)</td>
<td>0.0</td>
<td>9 (39.1)</td>
<td>39.1</td>
</tr>
<tr>
<td>Total</td>
<td>63 (100)</td>
<td>0.0</td>
<td>25 (39.6)</td>
<td>39.6</td>
</tr>
<tr>
<td>Socio-economic Status</td>
<td></td>
<td></td>
<td>38 (100)</td>
<td>50.8</td>
</tr>
<tr>
<td>Below Poverty Line (BPL)</td>
<td>63 (100)</td>
<td>0.0</td>
<td>25 (100)</td>
<td>100</td>
</tr>
<tr>
<td>Above Poverty Line (ABL)</td>
<td>0 (0.0)</td>
<td>0.0</td>
<td>0 (0.0)</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>63 (100)</td>
<td>0.0</td>
<td>25 (100)</td>
<td>100</td>
</tr>
<tr>
<td>Literacy</td>
<td></td>
<td></td>
<td>31 (67.39)</td>
<td>67.39</td>
</tr>
<tr>
<td>Illiterate</td>
<td>46 (73.0)</td>
<td>0.0</td>
<td>15 (32.6)</td>
<td>32.6</td>
</tr>
<tr>
<td>Primary</td>
<td>9 (14.3)</td>
<td>0.0</td>
<td>6 (66.6)</td>
<td>66.6</td>
</tr>
<tr>
<td>High School</td>
<td>5 (7.9)</td>
<td>0.0</td>
<td>2 (40.0)</td>
<td>40.0</td>
</tr>
<tr>
<td>PUC</td>
<td>2 (3.2)</td>
<td>0.0</td>
<td>1 (50.0)</td>
<td>50.0</td>
</tr>
<tr>
<td>University</td>
<td>1 (1.6)</td>
<td>0.0</td>
<td>1 (100)</td>
<td>100</td>
</tr>
</tbody>
</table>
HELP US STOP PAVAGADA FLUOROSIS SOON

<table>
<thead>
<tr>
<th>Total</th>
<th>63 (100)</th>
<th>-</th>
<th>0.0</th>
<th>0.0</th>
<th>0.0</th>
<th>0.0</th>
<th>25 (39.6)</th>
<th>38 (60.3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drink De-fluoridated water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>9 (14.3)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>5 (55.5)</td>
<td>4 (80.0)</td>
</tr>
<tr>
<td>No</td>
<td>54 (85.7)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>20 (37.0)</td>
<td>34 (62.9)</td>
</tr>
<tr>
<td><strong>Source of Drinking water</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BORE WELL</td>
<td>5 (7.9)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2 (40.0)</td>
<td>3 (60.0)</td>
</tr>
<tr>
<td>FILTER</td>
<td>6 (9.5)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>2 (33.3)</td>
<td>4 (66.6)</td>
</tr>
<tr>
<td>De-fluoridated</td>
<td>0 (0.0)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Nothing specific</td>
<td>52 (82.5)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
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<td>0.0</td>
<td>21 (40.3)</td>
<td>31 (59.6)</td>
</tr>
<tr>
<td><strong>Medical Problems</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goitre</td>
<td>0 (0.0)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
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<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Sickle cell anaemia</td>
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<td>-</td>
<td>0.0</td>
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</tr>
<tr>
<td>Anaemia</td>
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<td>-</td>
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<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Skeletal deformity</td>
<td>2 (0.3)</td>
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<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Headache</td>
<td>48 (76.1)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>18 (37.5)</td>
<td>30 (62.5)</td>
</tr>
<tr>
<td>Kidney disease</td>
<td>0 (0.0)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Joint Pain</td>
<td>48 (76.1)</td>
<td>-</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>18 (37.5)</td>
<td>30 (62.5)</td>
</tr>
</tbody>
</table>

The average mean age of the rural population of Pavagada is 50.8 (15-76). Among the examined population, there are 63.5% males and 36.5% females. The dental fluorosis score 4 is most commonly noted followed by score 3.

Majority rural population lives in below poverty line (BPL) by 100% and illiterate 73.0%. Dental fluorosis (WHO criteria) is 3 and 4 are commonly observed. The population who used de-fluoridated water have less number of dental fluorosis compared to the individuals who consumed fluoridated water. The source of water had also an influence on occurrence of dental fluorosis. Most of the people had no specific source of drinking water. Since the majority population had no access to de-fluoridated water and has no specific source of water either, the majority of the population were suffering from 76.1% Joint pain, 76.1% Headache, Vomiting, Hypertensive, Diabetic, Varicose veins, Epilepsy, TB, Eye pain, Gastro-intestinal problem, etc. The dental fluorosis scores (WHO criteria) in such cases were 3 and 4.
Table 4: Dental fluorosis by age and gender and the status of drinking water (Fluoridated or de-fluoridated)

<table>
<thead>
<tr>
<th>Status of water</th>
<th>Consumed by age group</th>
<th>Gender</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-18 N (%)</td>
<td>19-76 N (%)</td>
<td>Male N (%)</td>
</tr>
<tr>
<td>De-Fluoridated water</td>
<td>Yes</td>
<td>0 (0.0)</td>
<td>9 (1)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1 (1.0)</td>
<td>49 (98.0)</td>
</tr>
<tr>
<td>Source of water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bore-well Water</td>
<td>0 (0.0)</td>
<td>5 (1.0)</td>
</tr>
<tr>
<td></td>
<td>Filter Water</td>
<td>0 (0.0)</td>
<td>6 (1.0)</td>
</tr>
<tr>
<td></td>
<td>Nothing Specific</td>
<td>1 (1.0)</td>
<td>47 (97.9)</td>
</tr>
</tbody>
</table>

The population consuming de-fluoridated water were from older age group and most commonly affected are males compared to females. Dental fluorosis is more common in the older age group, but there is no significant difference by gender.
Table 5: Fluoridation Status of drinking water and occurrence of pre-skeletal including crippling fluorosis

<table>
<thead>
<tr>
<th>Status of Drinking Water</th>
<th>Joint Pain and Stiffness (A)</th>
<th>Repeated fracture (B)</th>
<th>Skeletal Deformity (C)</th>
<th>Duration of Skeletal Deformity (D) Years Mean (Range)</th>
<th>Crippling Fluorosis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes N (%)</td>
<td>No N (%)</td>
<td>Yes N (%)</td>
<td>No N (%)</td>
<td>Yes N (%)</td>
</tr>
<tr>
<td>De-Fluoridated water</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td>2 (1.3)</td>
</tr>
<tr>
<td></td>
<td>7(1.2)</td>
<td>2 (3.3)</td>
<td>1(1.0)</td>
<td>8 (1.3)</td>
<td>7 (1.1)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>50 (87.7)</td>
<td>4 (6.6)</td>
<td>52 (86.6)</td>
<td>13 (15.0)</td>
</tr>
<tr>
<td></td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>12 (19.0)</td>
<td>42 (66.6)</td>
<td>41 (85.4)</td>
</tr>
<tr>
<td></td>
<td>2.36 (0-50)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source of Drinking Water</td>
<td>Bore-well water</td>
<td></td>
<td>4(0.7)</td>
<td>0(0.0)</td>
<td>2 (1.3)</td>
</tr>
<tr>
<td></td>
<td>1(1.6)</td>
<td>0 (0.0)</td>
<td>5(0.8)</td>
<td>2 (1.4)</td>
<td>3 (0.6)</td>
</tr>
<tr>
<td></td>
<td>3(0.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Filter Water</td>
<td></td>
<td>5(0.8)</td>
<td>0(0.0)</td>
<td>3 (0.2)</td>
</tr>
<tr>
<td></td>
<td>1(1.6)</td>
<td>0 (0.0)</td>
<td>6(0.1)</td>
<td>3(0.6)</td>
<td>3 (0.6)</td>
</tr>
<tr>
<td></td>
<td>3(0.6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nothing Specific</td>
<td></td>
<td>48 (84.2)</td>
<td>1(1.0)</td>
<td>10 (6.6)</td>
</tr>
<tr>
<td></td>
<td>4(6.6)</td>
<td>49 (81.6)</td>
<td>9(6.4)</td>
<td>43 (87.7)</td>
<td>42 (8.7)</td>
</tr>
<tr>
<td></td>
<td>87.7%</td>
<td>6.6%</td>
<td>1%</td>
<td>19.0%</td>
<td>66.6%</td>
</tr>
</tbody>
</table>

The population who were not having de-fluoridated water and had no specific water for drinking, among them, 87.7% population are suffering from joint pain and stiffness. The history of skeletal deformity is of 2.36 years duration. Only 20% of the population were suffering from crippling fluorosis.
Table 6: Another condition Mimic Fluorosis

<table>
<thead>
<tr>
<th>Status</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familial deformity</td>
<td>7 (11.1)</td>
<td>56 (88.9)</td>
</tr>
<tr>
<td>Tetracycline stain</td>
<td>0 (0.0)</td>
<td>63 (100)</td>
</tr>
<tr>
<td>Questionable Fluorosis</td>
<td>9 (14.3)</td>
<td>54 (85.7)</td>
</tr>
</tbody>
</table>

Only 7% of the population had familial history of occurrence of dental fluorosis and skeletal fluorosis. There was no association of tetracycline stains. 9% of the people were affected with questionable fluorosis.
Estimation of Fluoride in Drinking Water at Swami Vivekananda Ashram Laboratory

A PhD Scholar from the Department of Oral Biology and Genomic Studies performing Fluoride analysis (fetching the Fluoride Ion selective electrode and necessary supplies from the Department of Oral Biology). The study was carried out within the laboratory space at Swami Vivekananda Shevashram Pavagada Taluk Tumkuru District. It would be an extended monitoring unit at Sri Ramakrishna Shevasma Laboratory upon accomplishment of MoU between the sides.
Fluoride concentration in water of in bore-well source

<table>
<thead>
<tr>
<th>Name of the place</th>
<th>Source</th>
<th>Defluoridation Before</th>
<th>Defluoridation After</th>
<th>pH Before</th>
<th>pH After</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F⁻ in ppm</td>
<td>pH</td>
<td>F⁻ in ppm</td>
<td>pH</td>
<td></td>
</tr>
<tr>
<td>SVIRHC*, Bore well water</td>
<td>1.57</td>
<td>6</td>
<td>0.33</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>SVIRHC* Bore well water</td>
<td>1.71</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Chikanayak halli Bore well water</td>
<td>3.62</td>
<td>7</td>
<td>0.32</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Rajavanthi Bore well water</td>
<td>--</td>
<td>--</td>
<td>0.16</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Ashram Pathanjali Nagar</td>
<td>2.12</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Ashram Bore well water</td>
<td>2.18</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>School Pathanjali Nagar</td>
<td>2.235</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Venkatapura Bore well water</td>
<td>1.49</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Venkatapura Bore well water</td>
<td>1.48</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Hotel Gayathri Comforts, Tumkur Road, Pavagada Bore well water</td>
<td>1.85</td>
<td>7</td>
<td>0.177</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Sunkarlakunta Bore well water</td>
<td>1.467</td>
<td>7</td>
<td>0.223</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Neralakunte Bore well water</td>
<td>1.247</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>Jajurayanahalli Bore well water</td>
<td>2.35</td>
<td>7</td>
<td>1.343</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Kadmanakunte Bore well water</td>
<td>2.04</td>
<td>7</td>
<td>1.48</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Krishnapur Bore well water</td>
<td>2.573</td>
<td>7-8</td>
<td>0.203</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Kerampura Bore well water</td>
<td>--</td>
<td>--</td>
<td>0.133</td>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
Observation:

1. Bore well water sample

Summary of fluoride concentration (in ppm) was found in Bore well water samples collected in different parts of Pavagada.

<table>
<thead>
<tr>
<th>Minimum Concentration</th>
<th>Before defluoridation</th>
<th>After Defluoridation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Venkatapura)</td>
<td>1.48</td>
<td>0.133 (Kerampura)</td>
</tr>
<tr>
<td>Maximum Concentration</td>
<td>3.62</td>
<td>0.16 (Rajavanthi)</td>
</tr>
<tr>
<td>(Chikanayakhalli)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Fluoride Concentration of tender coconut water collected from near SVIRHC*, Pavagada was 0.127 ppm

3. pH of water samples was decreased after de-fluoridation process. Before de-fluoridation, pH of water samples was 7 and that of after de-fluoridation was 6 or less than 6.
**HELP US STOP PAVAGADA FLUOROSIS SOON**

**Gamma Spectrometry** : Soil/Rock, and water collected from Pavagada fluorosis endemic areas to detect the background radiation which might have an interrelation of fluorosis *

[Curtsey collaboration between Department of Oral Biology of Nitte University AB Shetty Dental College and ACRER of Mangalore University. The work was carried-out by Sudeep Kumara K, under the guidance of Professor Karunakara Naregundi, Co-ordinator, Centre for Advanced Research in Environmental Radioactivity (CARER), Mangalore University, Mangalore].

**Soil /Rock**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Location</th>
<th>Activity concentration in Bq kg(^{-1})</th>
<th>(^{40})K</th>
<th>(^{232})Th</th>
<th>(^{226})Ra</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Kumudu soil</td>
<td></td>
<td>566.9±15.0</td>
<td>54.4±1.8</td>
<td>14.9±0.8</td>
</tr>
<tr>
<td>2.</td>
<td>Simkala Kunda soil</td>
<td></td>
<td>416.6±9.3</td>
<td>13.6±0.6</td>
<td>6.4±0.4</td>
</tr>
<tr>
<td>3.</td>
<td>Kanavanghalli granite</td>
<td></td>
<td>1608.5±26.9</td>
<td>57.6±1.3</td>
<td>21.6±0.7</td>
</tr>
<tr>
<td>4.</td>
<td>Venkatapura soil</td>
<td></td>
<td>769.1±15.0</td>
<td>53.5±1.4</td>
<td>13.6±0.7</td>
</tr>
<tr>
<td>5.</td>
<td>Simkarla Kunda granite</td>
<td>BDL**</td>
<td>BDL</td>
<td>BDL</td>
<td>BDL</td>
</tr>
<tr>
<td>6.</td>
<td>Kodamagadu soil (Pavagada)</td>
<td></td>
<td>652.5±17.0</td>
<td>33.7±1.9</td>
<td>14.4±1.1</td>
</tr>
<tr>
<td>7.</td>
<td>Kodamagadu granite(Pavagada)</td>
<td></td>
<td>259.8±6.9</td>
<td>26.4±0.8</td>
<td>6.6±0.3</td>
</tr>
</tbody>
</table>

**Water**  

**BDL** – Below Detection Limit

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Location</th>
<th>Activity concentration in Bq L(^{-1})</th>
<th>(^{40})K</th>
<th>(^{232})Th</th>
<th>(^{226})Ra</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Simkarlakunda water</td>
<td>BDL</td>
<td>BDL</td>
<td>BDL</td>
<td>BDL</td>
</tr>
<tr>
<td>2.</td>
<td>Venkatapura bore well water</td>
<td></td>
<td>BDL</td>
<td>BDL</td>
<td>BDL</td>
</tr>
</tbody>
</table>
Discussion

Environmentally Pavagada taluk is a draught–prone and has hotter temperature because of its geographical locations and has less green and more rocks. The rocky areas are mostly granite. The fluoride from granites leaches into the drinking water located in the ground. In order to determine the amount of radiation released from the water, A Gamma Spectrometry technique was employed. The gamma spectrometry helps in identifying the intensity of gamma radiation versus the energy of each photon. A National environmental radiation monitoring facility, which is located at Mangalore University, Mangalore Karnataka India was collaborated for detections.

The samples of water and soil were collected from the different parts of the Pavagada taluk and appropriately processed for detection of radionuclide using Gamma Spectrometry. The results of the radiation activity are mentioned above tables. The radiation released from water was found to be below the level of detection. The soil/socks showed variations in their radiation activity. The soil and rock collected from all sampled areas showed relatively high radiation except, Simkarla Kunda granite, which was below the detection limit.

Results: Activity concentration of different radionuclides is similar to those observed for normal background radiation of the regions. Grain size of the prepared sample ranged between 80-120 micron. Remark: The values are almost within the permissible limit.
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Photographs
HELP US STOP PAVAGADA FLUOROSIS SOON

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India

Prof. Chitta Chowdhury and his team with Swami Japananda, Chairman of Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (while Swamiji was facilitating cattle fodders at his Centre)

Queing and Querraling for Pavada water: Local Population at Chickkanayanahalli waiting for their turn to collect water from the de-fluoridation plant in scorching summer. (Curtsey: Professor Chitta Chowdhury & Team. Consent of Photograph was taken)
Local Population at Chickkanayanahalli waiting for their turn to collect water from the de-fluoridation plant in scorching summer. (Curtsey: Professor Chitta Chowdhury & Team. Consent of Photograph was taken)
Skeletal Fluorosis case representing a case of excess intake of fluoride from drinking water. (Curtsey: Professor Chitta Chowdhury & Team. Consent of Photograph was taken)
Figure A and B representing case of Skeletal and Dental Fluorosis due to excess intake of fluoride from drinking water. Generalized attrition and erosion is a common feature among elderly population group. (Curtsey: Professor Chitta Chowdhury & Team. Consent of Photograph was taken)
Dental Fluorosis due to excess intake of fluoride from drinking water. Erosion and Attrition is a common feature among elderly group of population. (Curtsey: Professor Chitta Chowdhury & Team. Consent of photograph was taken)

Professor Chitta Chowdhury and Dr Akash from Bangalore Medical College (BMC) an intern training at Pavagada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama is addressing the public about the objective of the programme and taking a valid consent for Blood Collection for a genetic study. Dr Akash translated the instructions from Dr Chowdhury into local language. (Curtsey: Professor Chitta Chowdhury & Team. Consent of photograph was taken)
Collection of samples for Genetic study

Dental intern Collin Robert: A team member estimating Blood Pressure.

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekananda Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India
Collection of sample for genetic study. (Curtsey: Professor Chitta Chowdhury & Team. Informed consent of taking blood samples and photograph was taken)
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Skeletal Fluorosis case in Chickkanayaknahalli. Pavagada Tumkuru Karnataka India. (Curtsey: Professor Chitta Chowdhury & Team. Consent of photograph was taken)
Swami Japananda at Ramakrishna Ashrama is addressing while starting for Oral Health Assessment by Professor Chowdhury and his team at early morning before a routine breakfast provided at free of cost by the Ashrama. (Curtsey: Professor Chitta Chowdhury & Team. Informed consent of oral health examination and assessment and taking photograph was confirmed)
Classification of Dental Fluorosis
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Grade 0: Normal
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Grade 0.5: Questionable
Grade 1: Very Mild
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Grade 2: Mild

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Grade 3: Moderate
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Grade 4: Severe

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### Classification of Dental Fluorosis

<table>
<thead>
<tr>
<th>Code</th>
<th>Classification</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
<td>The enamel represents the usual translucent semivitriform-type of structure. The surface is smooth, glossy and usually of pale, creamy white colour.</td>
</tr>
<tr>
<td>0.5</td>
<td>Questionable</td>
<td>The enamel disclosed slight aberrations from the translucency of normal enamel, ranging from a few flecks to occasional white spots</td>
</tr>
<tr>
<td>1</td>
<td>Very Mild</td>
<td>Small, opaque, paper white areas scattered irregularly over the tooth but not involving as much as approximately 25% of tooth surface</td>
</tr>
<tr>
<td>2</td>
<td>Mild</td>
<td>The white opaque areas in the enamel of the teeth are more extensive, but not involve 50% of the tooth</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>All surfaces of the tooth are affected and surface subject to attrition show wear. Brown stain is a disfiguring feature</td>
</tr>
<tr>
<td>4</td>
<td>Severe</td>
<td>All surfaces of the tooth are affected and hypoplasia is so marked that the general form of the tooth is affected. This is discrete and pitting form of the tooth. Brown stains are widespread and tooth often present a corroded appearance</td>
</tr>
</tbody>
</table>
Discussion

According our results, there were n=63 subjects available for the survey (Table 3). The average mean age of the survey population is about 50.8 (15-76). There were 63.5% (N=40) males and 36.5 (N=23) females. Majority of the population were belonged to below poverty line (BPL) i.e. 100% (N= 63) and 73.0% (N=46) were illiterate. Most of the population i.e. 85.7% (N=54) did not use de-fluoridated water for drinking and 82.5% (N=52) used all available sources for drinking water. The subjects had common medical problem such as headache (76%), joint pain (76.1), skeletal deformity (2.0%) and crippling fluorosis in (15%).

Dental Fluorosis among Children

The average mean age of the children was 7.76 (3-14). There were 30 males and 19 females. Majority of children in Pavagada Taluk has been affected with Dental Fluorosis. Out of N=60, 20% (n=10) very mild, 26% (n=13) mild and 26% (n=13) moderately affected with dental fluorosis. The decayed, missing, filled tooth due to decay score was low for the children (0.36) (Table 1 and 2). This is most probably due to the anti-cariogenic effect of fluoride on tooth surface (29).

Dental Fluorosis among Adults

The dental fluorosis score 3 and 4 was most common score among the adults (Table 3). (30-31)

Inter-relation between De-fluoridation water, source of water, age and gender

Majority of the population didn’t have access to de-fluoridated water. The older age group between ages 19-76 were the most common people having fluoridated water and had nothing specific source of water to drink. The males 62.9% (n=34) and 37.0% (n=20) were more common to have fluoridated water and 97.9% (n=47) between age group 19-76 had nothing specific source of water (Table 4). (4)

Inter-relationship between de-fluoridated water, source of drinking water and skeletal problems

The population who were not having de-fluoridated water and had no specific water for drinking, among them, 87.7% population are suffering from joint pain and stiffness. The duration of skeletal deformity was since 2.36 years. Only 15.0% of the population were suffering from crippling fluorosis (Table 5). These finding have confirmed by previous report as well (26-28)
HELP US STOP PAVAGADA FLUOROSIS SOON

Suggested plan of action: Zero tolerance of Fluorosis

Treatment of Dental Fluorosis
Suggested plan of action: Zero tolerance of Fluorosis
Treatment of Dental Fluorosis

Aim: Zero Tolerance of Fluorosis (ZTF) for prevention and treatment of affected teeth with fluorosis

Objective: In five years all discoloured teeth from fluorosis will be whitened (bleaching)

Target population: Students at School and colleges, Non-school going children at rural areas.

Policy declaration: Zero Tolerance of Fluorosis. No more discoloured teeth after treating discoloured teeth

Title
Minimally Invasive treatment protocol for patients of very mild to severe dental fluorosis

Objective
- To determine the most minimally invasive procedure for patients of very mild to severe dental fluorosis
- To determine the most minimally invasive treatment outcome

Age Group:
12-25 years age group

Procedures
1. Micro/Macro Abrasion Technique
2. Home and In office Bleaching
3. Composite Restorations
4. Veneers
Bleaching (Whitening of teeth)
**Bleaching**

<table>
<thead>
<tr>
<th>Vital Bleaching</th>
<th>Home Bleaching</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Informed consent and case history</td>
<td>1. Whitening agent (10–20% carbamide peroxide, which equals 3.5–6.5% hydrogen peroxide).</td>
</tr>
<tr>
<td>2. Rubber dam</td>
<td>2. It is recommended that the 10% carbamide peroxide be used 8 h per day, and the 15–20% carbamide peroxide 3–4 h per day.</td>
</tr>
<tr>
<td>3. First, in-office bleaching utilizes a high concentration of tooth-whitening agents (25–40% hydrogen peroxide).</td>
<td>3. The bleaching gel is applied to the teeth through a custom-fabricated mouth guard worn at night for at least 2 weeks.</td>
</tr>
<tr>
<td>4. Light for around one hour in the dental office</td>
<td></td>
</tr>
</tbody>
</table>

**A.** Informed Consent  
**B.** Case History  
**C.** Classify the type of Fluorosis  
**D.** Choose treatment protocol
**HELP US STOP PAVAGADA FLUOROSIS SOON**

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Treatment Protocol</th>
<th>Method and Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I</td>
<td>Oral Prophalaxis&lt;br&gt;Office tooth Bleaching followed by home bleaching, 35% Hydrogen Peroxide, Light Cure Machine</td>
</tr>
<tr>
<td>2</td>
<td>II</td>
<td>Oral Prophalaxis&lt;br&gt;Micro-abrasion (0.2mm) removal of Enamel – 10sec on each tooth Opalustre Slurry (Ultradent, 6.6% HCL &amp; Silicon carbide particles) 1mm thickness in increments Opalcup – 60 Secs on each tooth After micro-abrasion, APF gel for 4 mins. Advised not to drink or eat for 30mins (Post-operative instructions APF gel Applications) Next 3 weeks = The patients will be placed on MI paste in her custom tray bleaching trays and slept with trays in place Two Weeks of Home Bleaching</td>
</tr>
<tr>
<td>3</td>
<td>III</td>
<td>Oral Prophalaxis&lt;br&gt;McInne’s Solution&lt;br&gt;Home Bleaching</td>
</tr>
<tr>
<td>4</td>
<td>IV</td>
<td>Oral Prophalaxis&lt;br&gt;Tooth Mousse</td>
</tr>
<tr>
<td>5</td>
<td>V</td>
<td>Direct Veneers</td>
</tr>
</tbody>
</table>

**Treatment Plan and Time-Table**

Five years’ Treatment plan [Let Pavagada Smiles]
Job 1:
Objective: Free from Dental Fluorosis by treatment

<table>
<thead>
<tr>
<th>Year</th>
<th>Duration</th>
<th>Target Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jan 2017–Dec 2017</td>
<td>Five schools, 5 villages</td>
</tr>
<tr>
<td>2</td>
<td>Jan 2018–Dec 2018</td>
<td>Five schools, 5 villages</td>
</tr>
<tr>
<td>3</td>
<td>Jan 2019–Dec 2019</td>
<td>Five schools, 5 villages</td>
</tr>
<tr>
<td>4</td>
<td>Jan 2020–Dec 2020</td>
<td>Five schools, 5 villages</td>
</tr>
<tr>
<td>5</td>
<td>Jan 2021–Dec 2021</td>
<td>Five schools, 5 villages</td>
</tr>
</tbody>
</table>
Planned hierarchical approach of implementation

- Formation of experts’ team for treatment
- Organizing a dental setting where in-office bleaching will be carried out
- Setting a criteria for selection of vital-tooth bleaching and follow-up
- Follow-up 6 months, 1 year, 3 years, 5 years.
HELP US STOP PAVAGADA FLUOROSIS SOON

Costing* (treatment based on the severity/complication of the case)

<table>
<thead>
<tr>
<th>Dental Fluorosis Code</th>
<th>Classification</th>
<th>Treatment Protocol</th>
<th>Approximate cost for one patient (Rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Normal</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>0.5</td>
<td>Questionable</td>
<td>IV</td>
<td>2000</td>
</tr>
<tr>
<td>1</td>
<td>Very Mild</td>
<td>IV</td>
<td>2000</td>
</tr>
<tr>
<td>2</td>
<td>Mild</td>
<td>II</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IV</td>
<td>2000</td>
</tr>
<tr>
<td>3</td>
<td>Moderate</td>
<td>I</td>
<td>500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>1500</td>
</tr>
<tr>
<td></td>
<td></td>
<td>III</td>
<td>700</td>
</tr>
<tr>
<td>4</td>
<td>Severe</td>
<td>V</td>
<td>700/ tooth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Procedure</th>
<th>Cost of Material (Rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Vital tooth bleaching</td>
<td>600 (Office)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1000 (Home)</td>
</tr>
<tr>
<td>2</td>
<td>GC Tooth Mouse</td>
<td>1500 (Tooth Paste)</td>
</tr>
<tr>
<td>3</td>
<td>EverSrick Net Veneer</td>
<td>9000 (Fibre reinforced)</td>
</tr>
<tr>
<td>4</td>
<td>G-Aenial Composite Resin</td>
<td>3500 (Composite (A2))</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3500 (A3)</td>
</tr>
</tbody>
</table>

Job 2: Treatment of Systemic Fluorosis: TBC
Job 3: Ensure the de-fluoridated water in entire (5 years plan) Pavagada Urban area:
Through piped water supply

i. In rural Area: Deep Tube-well(bore-well) fitted with de-
ii. Fluorinating cartridge. Piped water from big water Tank
HELP US STOP PAVAGADA FLUOROSIS SOON


Budgetary description

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>Activity</th>
<th>Unit Cost</th>
<th>Proposed Unit</th>
<th>Total Cost (Rupees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>De-fluoridation plant repair and maintenance</td>
<td>200000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source of fund and resource allocation

- National and International Funding Organisation
- Charity
- Government Bodies, Organisation and Institutions
- Grants-in-aids
- Joint venture. Public- private – NGO partnership

Detailed budgetary description will be provided with yearly break-down
Recommendation

1. Training of the clinicians and health workers for periodic assessment of the services to the population-in-need is required.

2. Monitoring of dental and skeletal fluorosis among children through survey and surveillance must be implemented.

3. Establishment of surveillance system for fluoride levels in drinking water is needed.

4. Management of dental fluorosis, skeletal fluorosis including surgical rehabilitation upon consultation with involved doctors is needed.

These Include

- Early Intervention
- Referral system
Year wise coverage of villages of Pavagada Taluk for intervention - planned

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Villages</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016-17</td>
<td>10</td>
</tr>
<tr>
<td>2017-18</td>
<td>20</td>
</tr>
<tr>
<td>2018-19</td>
<td>40</td>
</tr>
<tr>
<td>2019-20</td>
<td>40</td>
</tr>
<tr>
<td>2020-21</td>
<td>20</td>
</tr>
</tbody>
</table>
Conclusion

It is concluded that the Pavagada taluk is severely affected with dental fluorosis and skeletal fluorosis. This fact has also been known previously observed, but the issues of fluorosis menace has not been properly addressed and intervened. According to the report, a framework has been designed to tackle dental fluorosis and skeletal fluorosis among young and older age groups. This will help to come up with evidence based protocol in managing dental fluorosis and also coming up with public health policy to improve the health status of the population. The proposed plan will be a consideration for implementation through a MoU between Swami Vivekananda Ramakrishna Mission and Nitte University. The supports from governmental and non-governmental agencies will be a need.
Appendices I

Press Coverage 1

Concern over fluoride content

Chitto Grassbury, head of the Department of Oral Biology and Genetics, Shetty Memorial Institute of Dental Sciences, Deralakatte, and leader, Team Fluoride and Health, said some well-known manufacturers of “up-to-date toothpastes” have not been mentioning the fluoride content in their toothpastes. The first meeting of Team Fluoride and Health, a private initiative by the university, discussed various aspects of fluoride, which is both beneficial and harmful to health. The meeting felt that there should be an instant method of monitoring the fluoride content in drinking water supplied by the civic body. It decided to form sub-committees with experts for specific studies.
HELP US STOP PAVAGADA FLUOROSIS SOON

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekananda Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India

MANGALORE: A study under the leadership of Dr. Chetan Ranjith Chowdhury, the lead investigator, Department of Oral Biology & Genomic Studies at AB Shetty Memorial Institute of Dental Sciences (AMSIS), Nitte University, has found that the drinking water in Lakshmangad, Pavagada, and Rooppur have excess fluoride content in drinking water.

The fluoride content in drinking water was analysed by the team using a method called capillary electrophoresis (CE). The team conducted a study over a period of six months, during which time water samples were collected from different locations in the area.

The results of the study showed that the fluoride content in the drinking water exceeded the recommended level by the World Health Organization (WHO). The team also found that the fluoride content in the drinking water was higher in the areas closer to the fluoride sources, such as mining operations and industrial areas.

The team recommended that the local authorities take necessary action to reduce the fluoride content in the drinking water to safe levels. They also recommended that the residents take precautions to ensure their health is not affected by the high fluoride content.

The study was conducted as part of an initiative to help reduce the prevalence of fluorosis in the region. The team is working with local authorities to implement the recommendations and ensure the health of the residents is protected.

Press Coverage 2

DK district has less fluoride in drinking water: Study

'Koppal, Bellary, Kolar have excess fluoride content in drinking water'

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HELP US STOP PAVAGADA FLUOROSIS SOON

Expert’s Working Group Meeting on Fluoride and Health

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India
HELP US STOP PAVAGADA FLUOROSIS SOON

Expert’s Working Group Meeting on Fluoride and Health

List of Experts/Stakeholders (open to co-opt)

Advisors-supporters on Policy and Strategy

Mr. Siddaramaiah, Chief Minister, Karnataka State (Patron)
Dr. U.T. Khader, Minister, Health and Family welfare, State Govt. of Karnataka (Chief advisor)
Mr.N.V Hegde, Chancellor, Nitte University, Mangalore
Professor Ramanada Shetty, Vice Chancellor, Nitte University, Mangalore

1. Professor Bharath Shetty, Vice-President, Dental Council of India, Mangalore
2. Professor Tilak Raj, President, Karnataka State Dental Council, Bangalore
3. Dr. Darshak R Trivedi, Department of Chemistry, NITK, Surathkal
4. Professor Ganesh Senoy, Head, Public Health Dentistry, Yenepoya Dental College, Deralakatte
5. Professor Shivakumar, Vice Principal, Rajaraeswari Dental College, Bangalore
6. Professor Arunachalam Kumar, Research Director, Nitte University
7. Professor N Udayakiran, Head, Department of Community Medicine, KS Hegde Medical Academy
8. Professor Sridhar Shetty, Director CAODS, ABMSIDS, Mangalore
9. Professor Shipathi Rao, Principal, Yenepoya Dental College, Deralakatte
10. Professor Dillip Naik, Principal, College of Dentistry, Mangalore
11. Professor C.S Shastri, Principal, Pharmacy College, Nitte University, Deralakatte
12. Professor B. Nandala, Principal, JSS Dental College, Mysore
13. Professor Balakrishna Kalluraya, Department of Chemistry, Mangalore University
15. Dr. Ravi S Shiraathzali, Head, Public Health Dentistry, ABMSIDS, Deralakatte
16. Professor Anand Bangera, Head, Dept of Anesthesiology, KSHEMA
17. Professor Rajeev TP, Head, Department of Urology
18. Professor Nazar Attar, Internal Medicine
19. Professor H.R.Rai, Head, Department of Orthopedics
20. Mayor, Mangalore Municipal Corporation(MCC), Mangalore
21. Mr Madhusudan and Mr. Manu, Environmental Engineer, MCC, Mangalore
22. Stanley Pinto, Chief Correspondent, Times of India, Mangalore
23. Mr. Rajeshkumar Poranik, Chief Environmental Officer, Karnataka State Pollution Control Board, Mangalore
24. Interested Faculties/Clinicians from ABMSIDS, Mangalore
25. Representative, National Institute of Nutrition (NIN), Hyderabad, AP

International Advisors

1. Professor Takuo Kubuki, Dean, Okayama University Dental School, Japan
2. Professor Maki M, Department Community Dentistry, Tokyo Dental College, Japan
3. Professor Akio Tanaka, Department of Pathology, Osaka Dental University, Japan
4. Professor Edward Lynch, Head Warwick Distilly, Coventry, UK
5. Professor Raman Bedi, Head, Global Child Dental Health, Kings College London, UK

Chitta Chowdhury, Prof
Organising Chair and Lead

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty
Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami
Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman)
Pavagada, Tumkur, Karnataka, India
Expert’s Working Group Meeting on Fluoride and Health

Venue: ABSSMIDS Board Room (2nd Floor) | Date & Day: 26th August, Tuesday 2014 | Time: 10:30 AM - 12:30 PM

Re: Road-map for Fluoride Study in Karnataka for India: A Consultation Paper

Agenda 1.

1.1. Scouring of sources for Fluoride from drinking water
   1.1.1. In the intake of Fluoride from drinking water is constant? How to calculate the daily water requirement which is equal to 1 ml per calorie of energy in daily diet by age group
   1.1.2. Determination of Estimated Fluoride intake from drinking water versus level of fluoride in drinking water in Karnataka

1.2. Fluoride in dietary sources (towards RDA)
   1.2.1. Animal tissue: cow’s liver, kidney, heart, chicken liver, dried fish with bone of Salmon, Sardines,
   1.2.2. Fluoride in environment leaching to water, fodders and diet (eg. rock, soil) [de-flouridation if needed]

1.3. Fluoride in marketed dentifrices (tooth paste and tooth powder- QC and standardization)

1.4. Fluoride in home-made (Indigenous) dentifrices- QC and accreditation

1.5. How to make Society involved for Fluoride awareness

1.6. Is the Fluoride map in Karnataka District is accurate?

1.7. RDA – directive

1.8. Reducing Environmental pollution of Fluoride

1.9. Does it need reticulated water supply of Fluoride?

1.10. Monitoring and control of Fluoride: throg survey and surveillance

1.11. Controlling Fluorosis

1.12. Alliance action for Community involvement for Health Protection from Fluoride deficiency/overdosing

2. Stakeholders group
3. Experts’ alliance group
5. Researchers and Clinicians frontier groups for translational research of Fluoride.
6. Declaration and Press release

Team Fluoride, Aug. 2014
Chitta Chowdhury & Members

An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashrama (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India
HELP US STOP PAVAGADA FLUOROSIS SOON

- Recommended Daily allowance (RDA) for Fluoride for Karnataka
- Fluoride & Fluorosis: Facts and Fallacies in India
- Fluoride and Systemic Ailments - goal for interventions
- Reticulated water and another cost-effective supplementation: pros and cons
- Fluoride: Exposure and Relative Source Contribution (RSC) Analysis: Where we stand for Fluoride
  Research and actions in India
HELP US STOP PAVAGADA FLUOROSIS SOON

Message from Chief Minister, Mr Siddaramaiah Government of Karnataka India

I am glad to learn that an Expert Working Group Meeting on Fluoride and Health is slated for August 26 in Mangalore.

Urbanites showcase their denture! But, Dental Health is most neglected in rural areas. The fluoride content in drinking water is the root cause of fluorosis.

I hope experts deliberate not merely on the reasons for fluorosis, but also evolve solutions for its care and cure.

I wish the Expert Working Group Meeting come out with concrete solutions to improve the Oral Health, especially of the rural folk.

(SIDDARAMAIAH)

The Professor, Chitta Chowdhury
Lead Fluoride and Health Research,
Department of Oral Biology and Genomic Studies,
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Documents on Declaration of Action- Based Programme
HELP US STOP PAVAGADA FLUOROSIS SOON

26th August 2014

Dear Learned Colleagues of
The Experts' Work-Group on Fluoride, Health and Environment

OVER-VIEWING OF THE ISSUE: Towards a Declaration For Action-Based Programme [Honest and accountable]

Perhaps, you are aware of the fact that some of the districts are affected with fluorosis in bone, ligaments and teeth—if it is true, then certainly a public health concern to all of us. We received a message from Chief Minister of Karnataka (enclosed) and his office is now aware of this problem—will be communicated with the outcome of our meeting. I also spoke to Health Minister Dr. U.T. Khader, he is also informed about it. I also spoke to Mayor of Mangalore City Corporation. He kindly refers to the department concern. All the major dailies are also informed about this. However,

Considering the facts and fallacies on the issue the Fluoride Research team of my department formed by frontier researchers of different specialties completed a substantial amount of work and continuing to do so. We have a dedicated dust-free air-conditioned lab for Fluoride research. We use most sophisticated equipment e., Fluoride ion selective electrode which we standardize and calibrate for a group of 5 samples regularly. We have developed simple but sensitive method of detection of fluoride from biological samples i.e., blood serum, saliva, urine, mother’s milk, bone, and environmental samples such as soil, rock, water including various diets and drinks such as wines and beers, Fizzy/soft drinks, marketed bottled mineral water. We also estimate the concentration in tooth paste, mouth wash, indigenous dentifrices, dairy products, cow’s milk, formula milk.

We are on progress to determine recommended daily allowance (RDA) of fluoride from regular food items (e.g., Dosa, idly-veda, Chutney, Gajji) consumed by common people in Karnataka. This will help understand the amount of fluoride from different dietary sources—providing fluoride for protection of health.

We are working on cost-effective de-fluoridation as well as fluoride supplementation methods suitable for Indian population including people living in remote rural areas. With the aim we have already surveyed all the districts of Karnataka to determine fluoride concentration in drinking water (main source of fluoride), and we developed an updated Fluoride map for Karnataka.

We are also pursuing number of applied and clinical research on this area. We have seen most of the districts have lower concentration of fluoride against normal values (of optimal concentration: 0.8-1 ppm) except few northern districts. And we are reported that a significant number of population is suffering from skeletal, ligaments and teeth fluorosis—a motting and disabling diseases of hard structures and tendons (of muscle) of human system. It may effecting cattle as well. However, we are on progress to investigate the fluoride endemic area to explore the real situation, and if it is so—way out will be need.

Action: We shall discuss over a consultation paper (enclosed) and draw a road-map on how to tackle fluoride problem starting at Karnataka. We also plan to develop our own guideline for Fluoride, health and Environment in the line of WHO directive.

To inform you that if we are sure that the concentration of Fluoride is less, then how the Mangalore City Corporation can help reticulate the central supply (this will be first of its kind in the country—if it’s accepted) with fluoride supplementation in order to optimize the concentration. Alternatively another cost-effective method will be suggested.

At the same time we need to find out a cost-efficient method of de-fluoridation in Fluoride endemic areas of the state (if it’s really so), supposed to be located in the AP-border-districts, such as, Bidar, Gulbarga, Yadga, Raichur etc.

Fortunately we have got a number of international experts of the field, will help validate our work globally comparable.

I am sure your support will help highlight several translational research of the area.

Thank you very much for your time.

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An Initiative of Team Fluoride and Health of Department of Oral Biology & Genomic Studies of AB Shetty Dental College of Nitte University, Deralakatte, Mangalore 575018, Karnataka, India in Association with Swami Vivekanada Integrated Rural Health Centre of Sri Ramakrishna Sevashram (Swami Japananda, Chairman) Pavagada, Tumkur, Karnataka, India
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Experts Working Group meeting – A Consultation paper

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List of abbreviation

ABSMIDS – A.B. Shetty Memorial Institute of Dental Sciences

BIRD-K- Bharatiya Agro-Industries Foundation (BAIF) Institute of Rural Development-Karnataka (BIRD-K)

ZToF: Zero Tolerance of Fluorosis

IRHC of SVRKS: Integrated Rural Health Centre of Swami Vivekananda Ramakrishna Shevashrama
Acknowledgement

We do acknowledge for the support from Sri Ramakrishna Ashram and Nitte University. We are sincerely thankful to Swami Japananda Chairman of Integrated Rural Health Centre of Swami Vivekananda Ramakrishna Shevashrama of Pavagada (IRHC of SVRKS) for his support for providing us with a medical doctor, a guide and some of the supplies. The organisation also provided with a laboratory area for fluoride analysis, where the estimation of fluoride in local water samples was carried out by using the instruments and supplies were fetched by the team of Nitte University. The organisation arranged to get an access to the villages and the school children. The team fluoride duly acknowledge for their local hospitality as well. The team wish to convey their sincere thanks to the population for their cooperation during survey and assessment.

Nitte University provided with a full-time transport (Mangalore-Pavagada-Mangalore) and vehicle for two days survey work. Nitte University also supported us the accommodation and incidental expenses for the personnel involved in the study. We are gratefully thankful to Nitte University.
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Reference


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