

# Fluoride poisoning effects in pregnant women, infants and children:

## Simple and Easy to practise interventions for the community

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# Indian Scenario

- **Anemia in Pregnancy**  
(Ranges from 30 – 98%) in different states.
- **Low birth weight (< 2.5 kg) babies**  
(Ranges from 40 – 80% )
- **Major Public Health problem facing India**
- **India unable to achieve Millennium Development Goals 5 & 4 by 2015.**

## Maternal Mortality rate

**Presently**      **139 per 100,000 births**



**By 2015**      **109 per 100,000 births**

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## Infant Mortality rate

**Presently**      **43 per 1000 live births**



**By 2015**      **27 per 1000 live births**

**India shall not achieve the  
Millennium Development Goals by 2015**

**A National Programme for  
Iron (100 mg) & Folic acid (500 µg)  
supplementation to pregnant women in India**

**“ON”**

**Since 1980 with little success**

*The failure is attributed to Pregnant women for non-compliance by Policy makers / Government*

## Innovative Approach

**Fluorosis Foundation of India launched a programme (2005 – 2009) with the objectives**

1. To withdraw  $F^-$  from ingestion followed by promotion of Nutritive diet
2. To continue Iron & Folic acid supplementation
3. To monitor Hemoglobin &  $F^-$  in urine until delivery
4. To assess the impact on Pregnant women & Pregnancy outcome

# Protocol

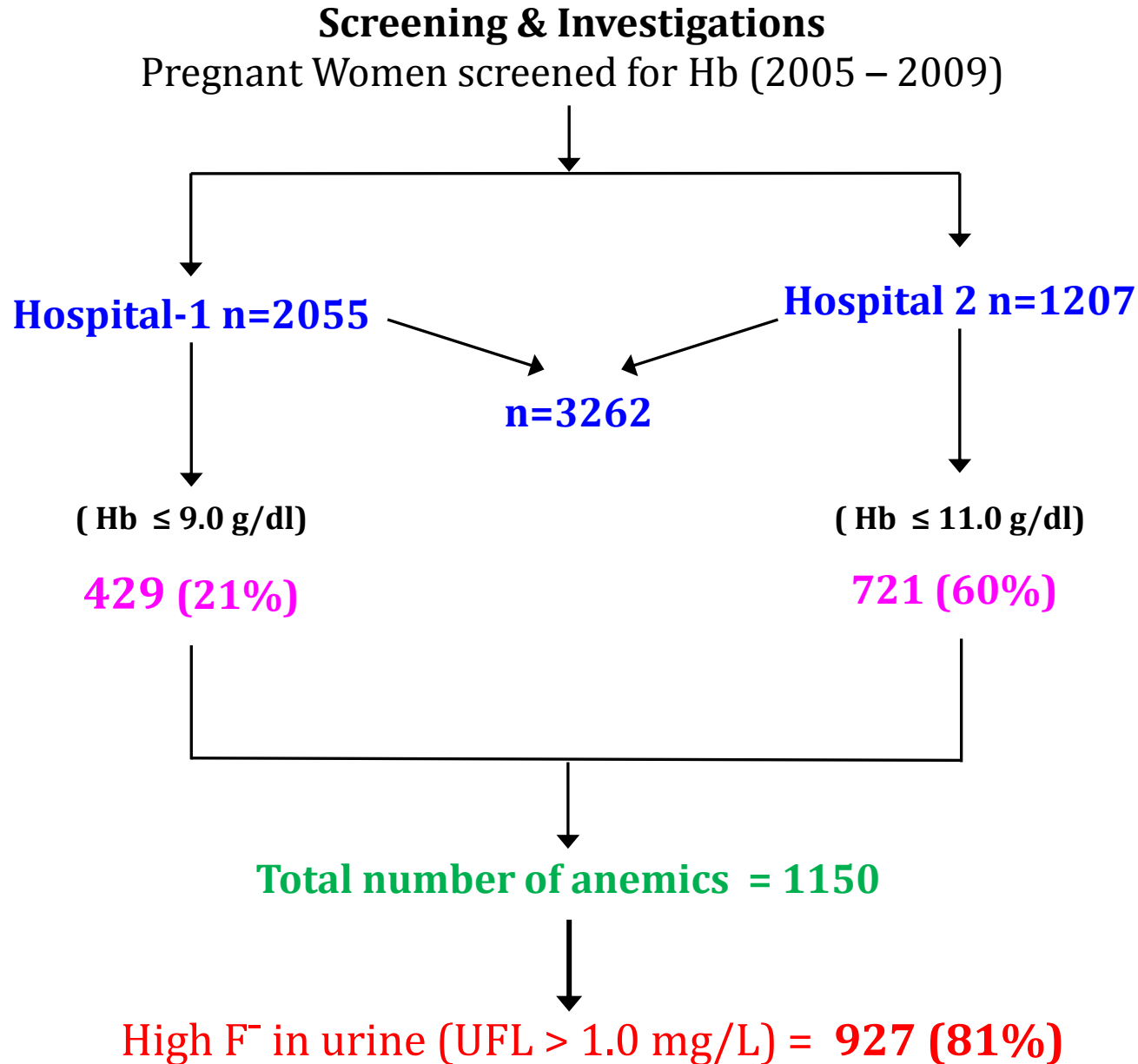
## Antenatal Clinic Approach

### Pregnant Women :

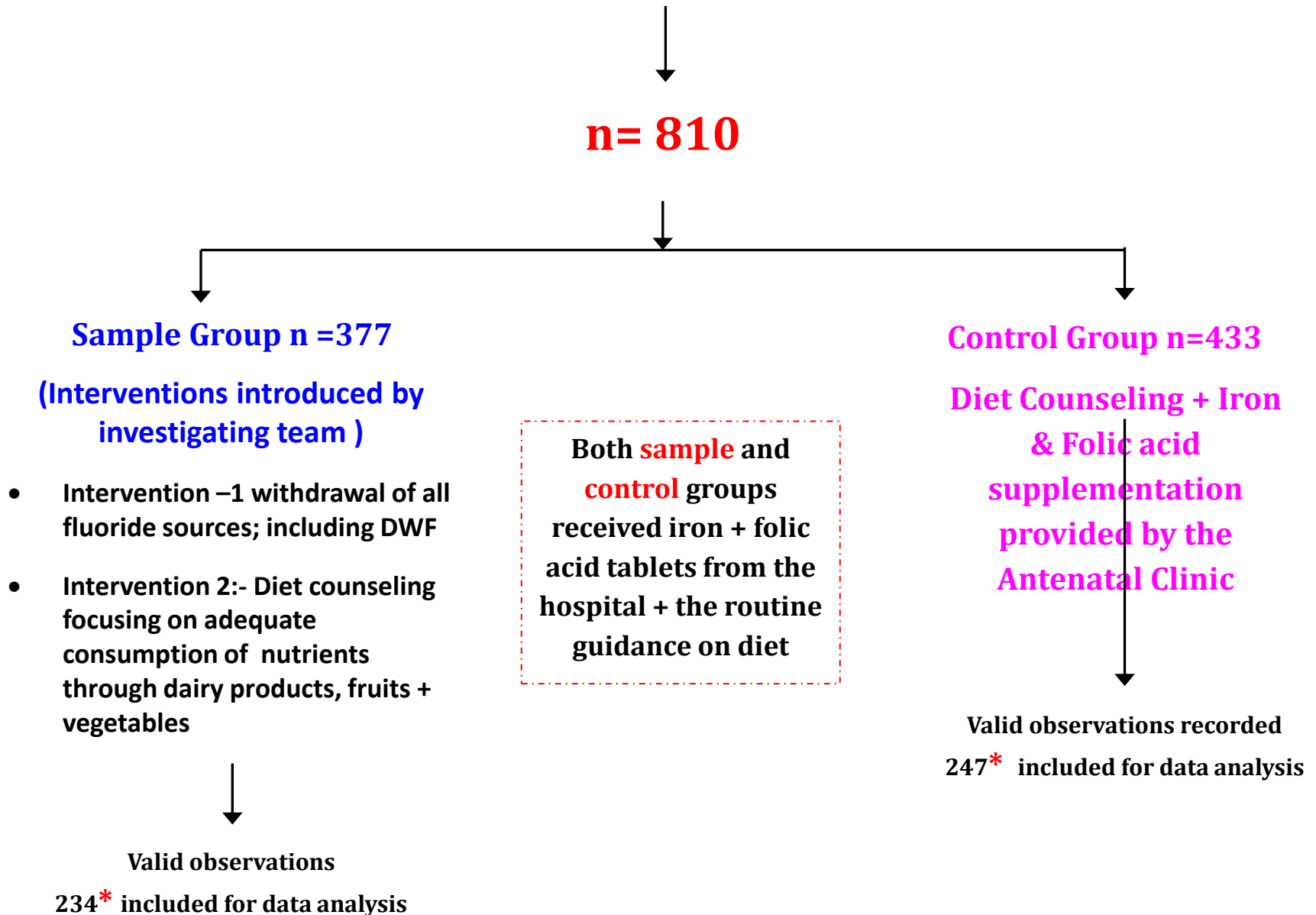
- **Exclusion criteria =** With HIV AIDs, Diabetes, Tuberculosis, Malaria, High B.P, other ailments if any
- **Inclusion Criteria =** First & Second trimester upto 20 wk pregnancy chosen
- Pregnant women screened for **Hemoglobin**
- Pregnant women tested for **urine fluoride**
- **Anemic Pregnant women with high UFL introduced to:**
  - **Interventions**
  - **Monitored until delivery → pregnancy outcome**

# Flow Chart

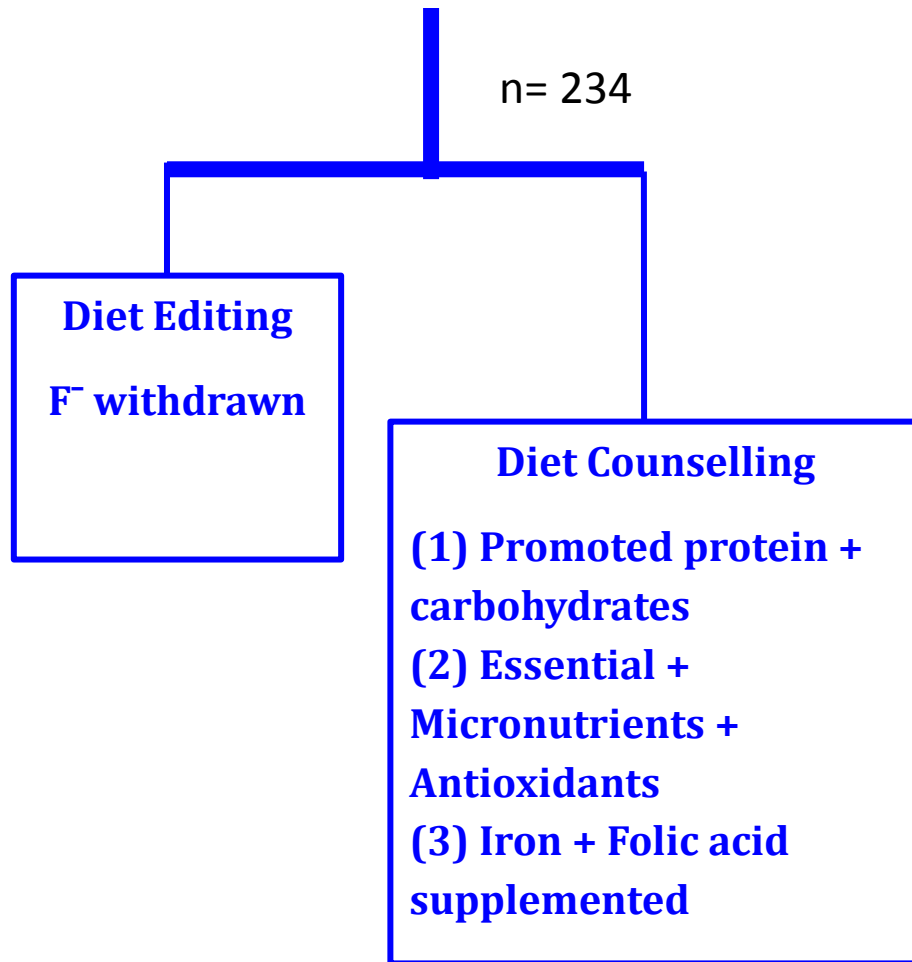
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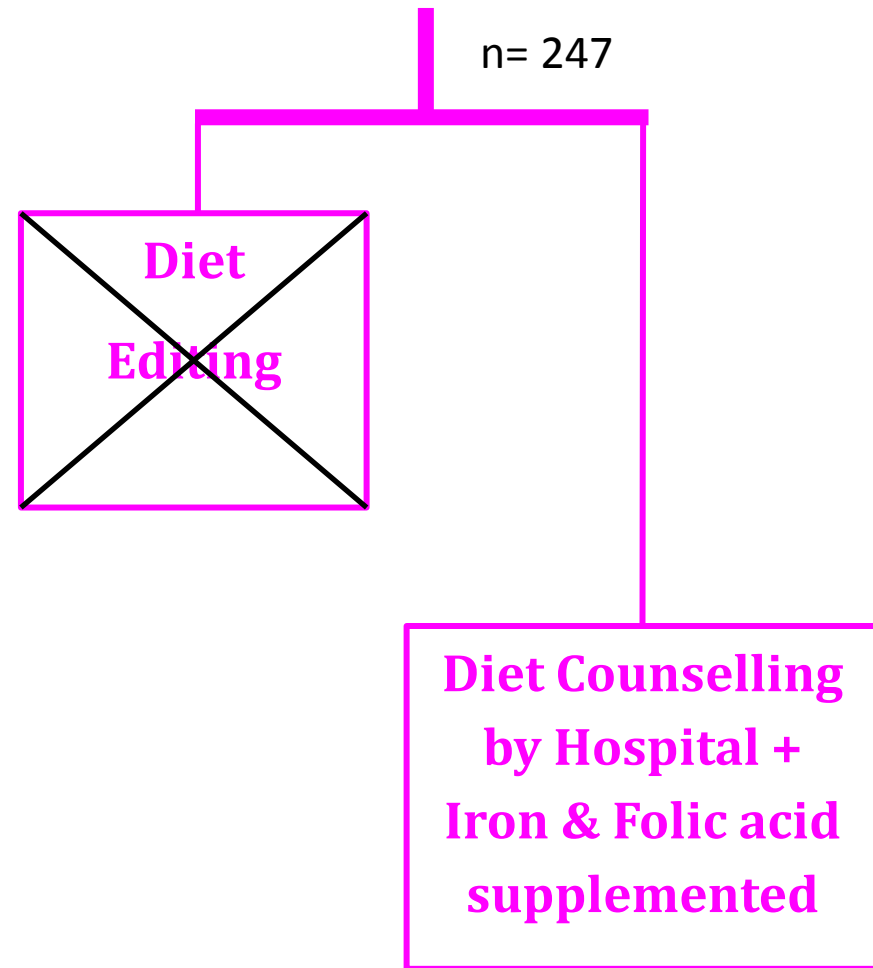
# Flow Chart Contd.



## SAMPLE GROUP



## CONTROL GROUP



# When high $F^-$ water consumed; safe water provision through:

|    | (1) Existing Safe Sources<br>(mg/l) |             |
|----|-------------------------------------|-------------|
|    | Contaminated<br>with $F^-$          | Safe Source |
| 1. | 7.586                               | 0.594       |
| 2. | 3.650                               | 0.331       |
| 3. | 10.900                              | 0.451       |
| 4. | 4.190                               | 0.551       |
| 5. | 1.687                               | 0.464       |
| 6. | 0.925                               | 0.061       |

| (2) De-fluoridated<br>Water / RO |
|----------------------------------|
|                                  |
|                                  |
|                                  |
|                                  |
|                                  |
|                                  |

# **Pregnant women monitored during visits to AN Clinic for :**

- 1. Hemoglobin**
- 2. Urine Fluoride**
- 3. Diet Editing & Diet Counselling re-enforced for sample group**

## Three sets of results with high and normal fluoride levels in drinking water

|           |                                      | Drinking Water F <sup>-</sup><br>(mg/l) | Urine F <sup>-</sup><br>(mg/l) |
|-----------|--------------------------------------|---|--------------------------------|
| Patient 1 | 7 Years, Male *<br>(U.P)             | <b>4.41</b>                             | <b>5.54</b>                    |
| Patient 2 | 5 Years, Male *<br>(Rajasthan)       | <b>0.89</b>                             | <b>4.31</b>                    |
| Patient 3 | 7 Years, Male **<br>(Madhya Pradesh) | <b>0.61</b>                             | <b>13.8</b>                    |

BIS Standard Drinking Water: 1.0 mg upper limit; less the better as F<sup>-</sup> is injurious to health  
 Urine F<sup>-</sup> Normal range= 0.1 – 1.0 mg/L

\* Samples received through Dr. Suma Ganesh, Paediatric Ophthalmologist,  
 Dr. Shroff's Charity Eye Hospital, Darya Ganj.

\*\* From Jhabua District through an NGO

# Have a peep into the children living in Fluoride endemic villages in India

Jharkhand \*  $F^- = 7.0 - 14.0 \text{ mg/L}$



Assam \*  $F^- = 2.5 - 12.00 \text{ mg/L}$



Madhya Pradesh \*  $F^- = 2.0 - 10.3 \text{ mg/L}$



- Short stature (cretinism)
- Deaf mutism
- Low IQ (mental retardation)
- Knock-knee
- Bow-legs

Uttar Pradesh (Agra)



# Monitoring Details

| Date                               | Duration<br>between visits | Hb<br>(g/dl) | Urinary F <sup>-</sup><br>(mg/l) | Overall Change |  |
|------------------------------------|----------------------------|--------------|----------------------------------|----------------|--|
|                                    |                            |              |                                  | Hb (g/dl)      | Urinary F <sup>-</sup><br>level (mg/l) |
| (21/4/05)<br>1st Visit             |                            | 7.7          | 1.082                            | <b>+ 4.1</b>   | <b>- 0.828</b>                         |
| (27/6/05) 2nd<br>Visit             | 67 Days                    | 6.7          | 1.738                            |                |  |
| (25/7/05) 3rd<br>Visit             | 28 Days                    | 8.1          | 0.467                            |                |  |
| (22/8/05)<br>4 <sup>th</sup> Visit | 28 Days                    | 10.2         | 0.903                            |                |  |
| (12/9/05)<br>5 <sup>th</sup> visit | 28 Days                    | 12.1         | 0.303                            |                |  |
| (26/9/05)<br>6 <sup>th</sup> Visit | 17 Days                    | 11.8         | 0.254                            |                |  |

**Mother's age:** 23, Literate (Monthly income US \$ 250/Month)

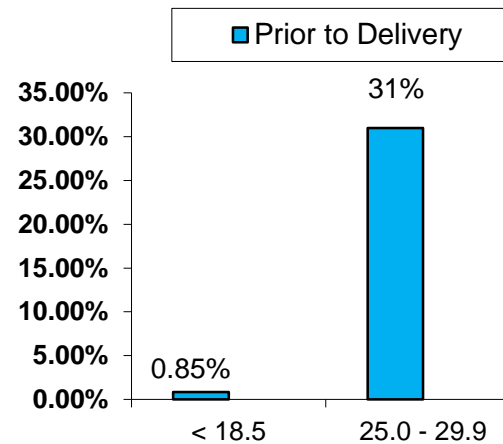
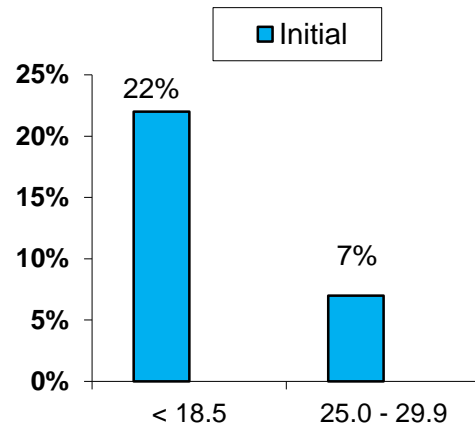
**Date of Delivery:** 18/10/05 (Delivered at 39 weeks 2 days)

**Time of Delivery:** 12:50 A.M

**Birth weight of the Male Baby:** 3.28 kg

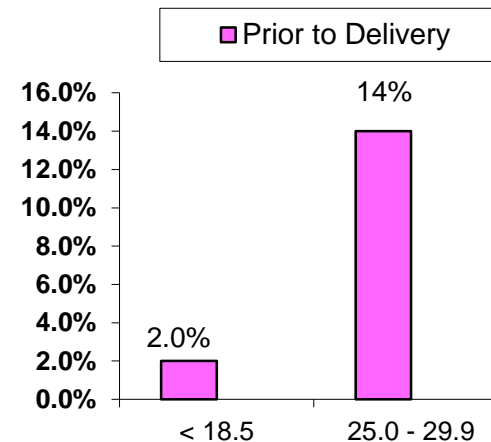
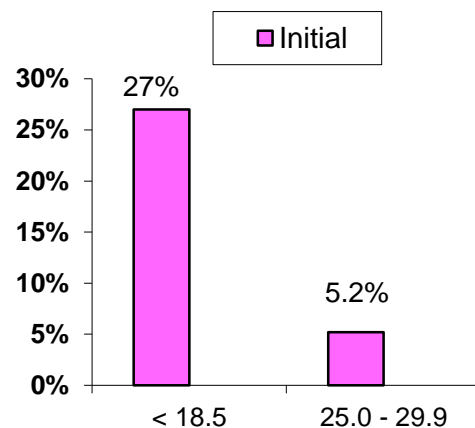
# Body Mass Index (BMI)

**Sample Group** n = 234



**BMI  $\geq 30$  = 1 (Obese)**

**Control Group** n = 247



**BMI  $\geq 30$  = 7**

# Results

| <u>Parameters</u>                      | <u>SAMPLE GROUP</u> | <u>CONTROL GROUP</u> |
|--|---------------------|----------------------|
| UFL ↓ decreased<br>(Prior to delivery) | 64 – 68 %           | 47 – 50 %            |
| Hemoglobin ↑<br>(Prior to delivery)    | 77%                 | 57 %                 |
| <u>Pregnancy Outcome</u>               |                     |                      |
| Birth weight > 2.5 – 3.89 kg           | 83%                 | 57 – 60 %            |
| Birth weight < 2.5 – 1.35 kg           | 17%                 | 43 – 40 %            |

**RAW DATA:** Results of the Investigations of **Control Population (Hospital Protocol)**

| S.No | Id. No. | Hb Level (g/dl) | Hb Level (g/dl)   | Urinary Fluoride Level (mg/l) | Urinary Fluoride Level (mg/l) | Birth weight (kg) |
|------|---------|-----------------|-------------------|-------------------------------|-------------------------------|-------------------|
|      |         | Initial         | Prior to delivery | Initial                       | Prior to delivery             |                   |
| 1.   | 004     | 5.9             | 8.2               | 3.520                         | 3.002                         | 1.70              |
| 2.   | 006     | 7.0             | 6.4               | 3.380                         | ✓ 6.430                       | 1.75              |
| 3.   | 007     | 8.9             | 9.5               | 4.850                         | 4.778                         | 2.00              |
| 4.   | 032     | 8.7             | 9.8               | 1.553                         | 1.759                         | 1.75              |
| 5.   | 1658    | 8.9             | ✓ 10.4            | 1.163                         | 2.561                         | IUD               |
| 6.   | 570     | 8.0             | 7.6               | 1.316                         | 1.936                         | 2.30              |
| 7.   | 508     | 7.0             | 10.2              | 1.761                         | 1.230                         | 1.35/1.40 ✓       |
| 8.   | 610     | ✓ 5.5           | ✓ 5.9             | 1.811                         | 2.285                         | 2.10              |
| 9.   | 869     | ✓ 9.0           | 9.3               | 2.101                         | 2.251                         | 2.20              |
| 10.  | 1203    | 8.7             | 8.1               | 1.507                         | ✓ 1.030                       | 2.19              |
| 11.  | 559     | 8.2             | 8.3               | ✓ 0.472                       | 1.911                         | 2.10              |
| 12.  | 1638    | 6.0             | 6.8               | 0.862                         | 2.781                         | IUD               |
| 13.  | 1043    | 8.4             | 8.9               | 0.671                         | 1.340                         | 2.23              |
| 14.  | 1048    | 7.5             | 6.3               | 0.976                         | 2.203                         | 2.25 ✓            |
| 15   | 1001    | 8.0             | 7.7               | 0.669                         | 1.187                         | 2.10              |

**IUD — Intrauterine Death**

Normal range of fluoride level in urine is 0.1—1.0 mg/l

**(15 Nos from 43%)**

**RAW DATA:** Results of the Investigations of **Sample Population**  
(Interventions I & II Introduced)

| S. No | Id. No. | Hb Level (g/dl) | Hb Level (g/dl)   | Urinary F <sup>-</sup> Level (mg/l) | Urinary F <sup>-</sup> Level (mg/l) | Birth weight (>2.5 kg) |
|-------|---------|-----------------|-------------------|-------------------------------------|-------------------------------------|------------------------|
|       |         | Initial         | Prior to delivery | Initial                             | Prior to delivery                   |                        |
| 1.    | 016     | 7.7             | → 11.8            | 1.082                               | → 0.254 ✓                           | 3.28                   |
| 2.    | 247     | 8.9             | → 12.9 ✓          | 1.983                               | → 0.557                             | 3.40                   |
| 3.    | 287     | 8.4             | → 11.2            | 1.262                               | → 0.639                             | 3.35                   |
| 4.    | 641     | 8.7             | → 11.9            | 1.824                               | → 0.616                             | 3.05                   |
| 5.    | 162     | 9.0             | → 11.7            | 2.930                               | → 0.840                             | 3.40                   |
| 6.    | 516     | 9.0             | → 12.2            | 1.174                               | → 0.386                             | 2.85 ✓                 |
| 7.    | 216     | 7.2             | → 10.5            | ✓ 1.060                             | → 0.961                             | 3.20                   |
| 8.    | 111     | 7.8             | → 10.4            | 5.464                               | → 1.957 ✓                           | 3.30                   |
| 9.    | 480     | 8.5             | → 10.2            | 1.166                               | → 0.834                             | 2.85                   |
| 10.   | 1265    | 8.8             | → 11.3            | 1.837                               | → 0.674                             | 3.50                   |
| 11.   | 602     | 6.5             | → 11.9            | 1.204                               | → 0.638                             | 2.95                   |
| 12.   | 426     | 8.5             | → 10.9            | ✓ 6.256                             | → 0.946                             | 2.87                   |
| 13.   | 083     | ✓ 6.2           | → 10.7            | 1.943                               | → 0.684                             | 3.08                   |
| 14.   | 713     | 9.0             | → 12.8            | 1.166                               | → 0.834                             | 3.45 ✓                 |
| 15.   | 1893    | 9.0             | → 11.9            | 2.183                               | → 0.801                             | 3.08                   |

Normal range of fluoride level in urine is 0.1—1.0 mg/l

(15 Nos from 83%)

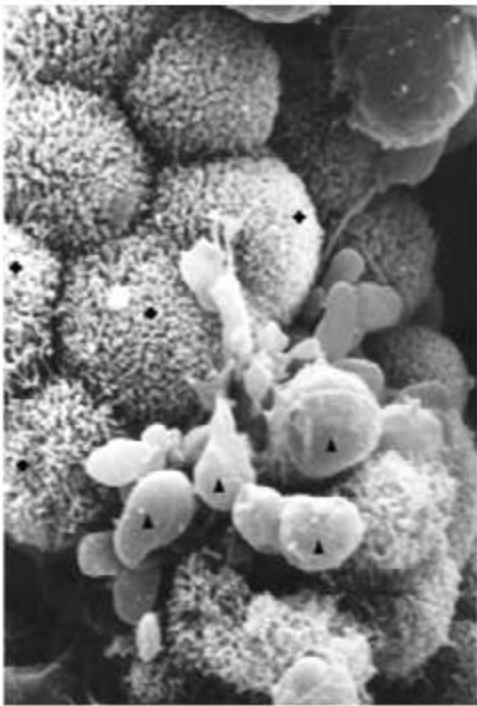
*Showing Scanning Electronmicrographs of the Intestinal lining  
(Duodenal region) of a normal volunteer and those consuming  
fluoride contaminated ground water*

**Normal Mucosa**

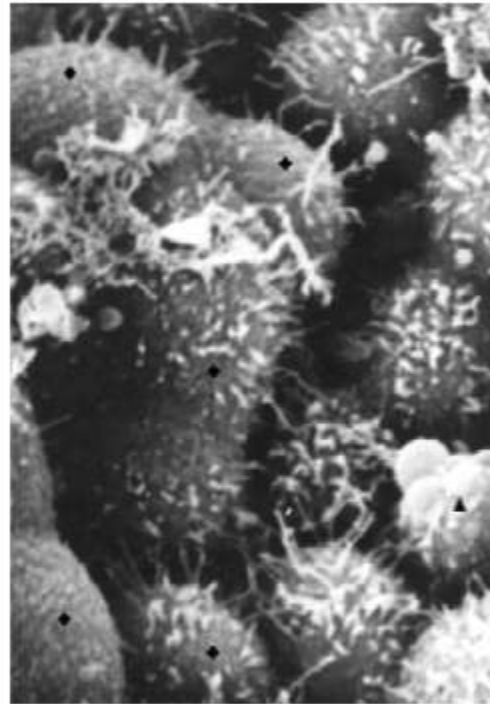
**F<sup>-</sup> 1.2 mg/l**

**F<sup>-</sup> 3.2 mg/l**

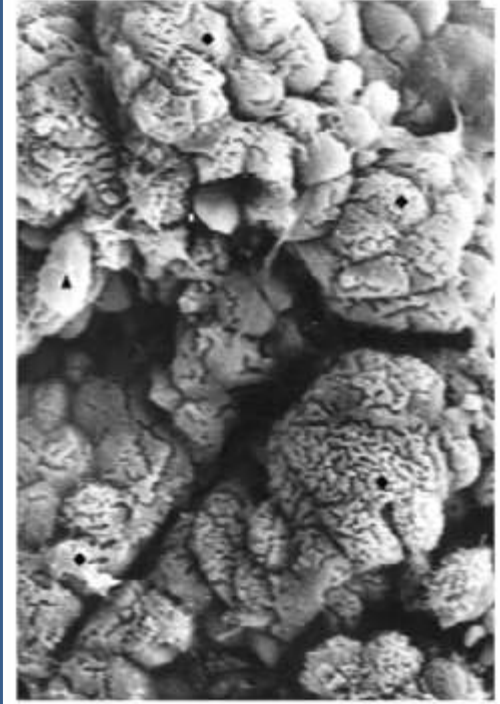
Absorption 100 %



20 %



3 %



**Regeneration**

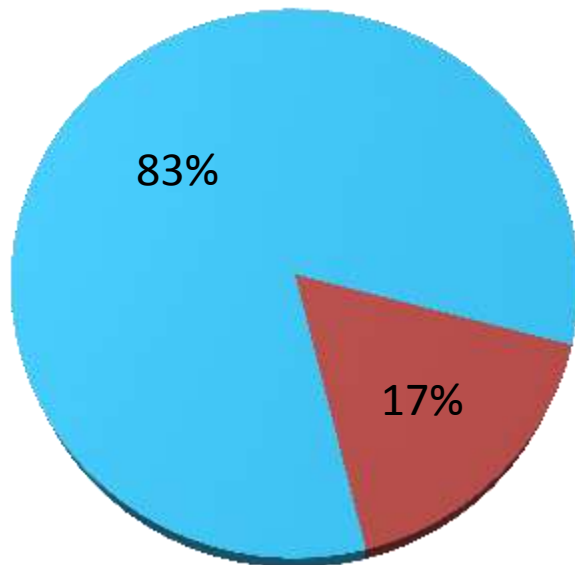
**Occurs upon withdrawal of F<sup>-</sup>  
100% Absorption of nutrients**

**Hemoglobin enhanced**

# Pregnancy outcome

*[ Iron + Folic acid supplementation unsuccessful;  
due to non-absorption of nutrients ;  
in our protocol  $F^-$  is eliminated & therefore malnutrition /  
undernutrition corrected ]*

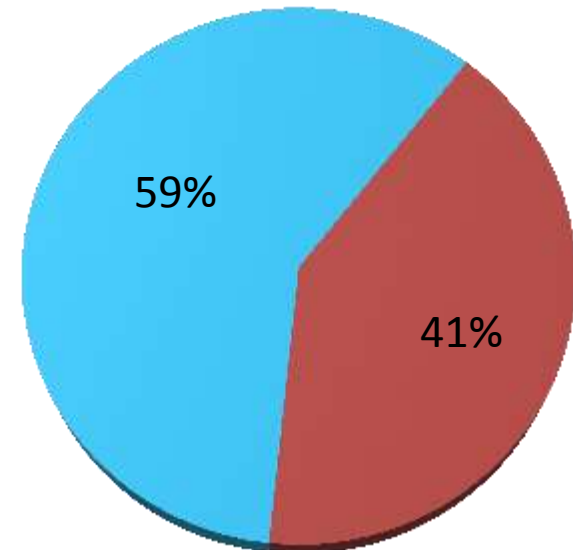
**Sample**



**Diet Editing +**  
**Diet Counseling** + Iron & Folic  
acid supplementation

■ NBW  
■ LBW

**Control**



**Diet Counseling +**  
**Iron & Folic acid**  
**supplementation**

# Gestation period at delivery

| Gestation period | < 34 weeks<br>(Preterm) | 34 – 37 weeks<br>(Term) | > 37 weeks<br>(Full term) |
|------------------|-------------------------|-------------------------|---------------------------|
| Sample<br>(234)  | n= 3                    | n= 63                   | n= 168                    |
|                  | 3/234 = 1 %             | 33/234 = 27 %           | 168/234 = 72 %            |

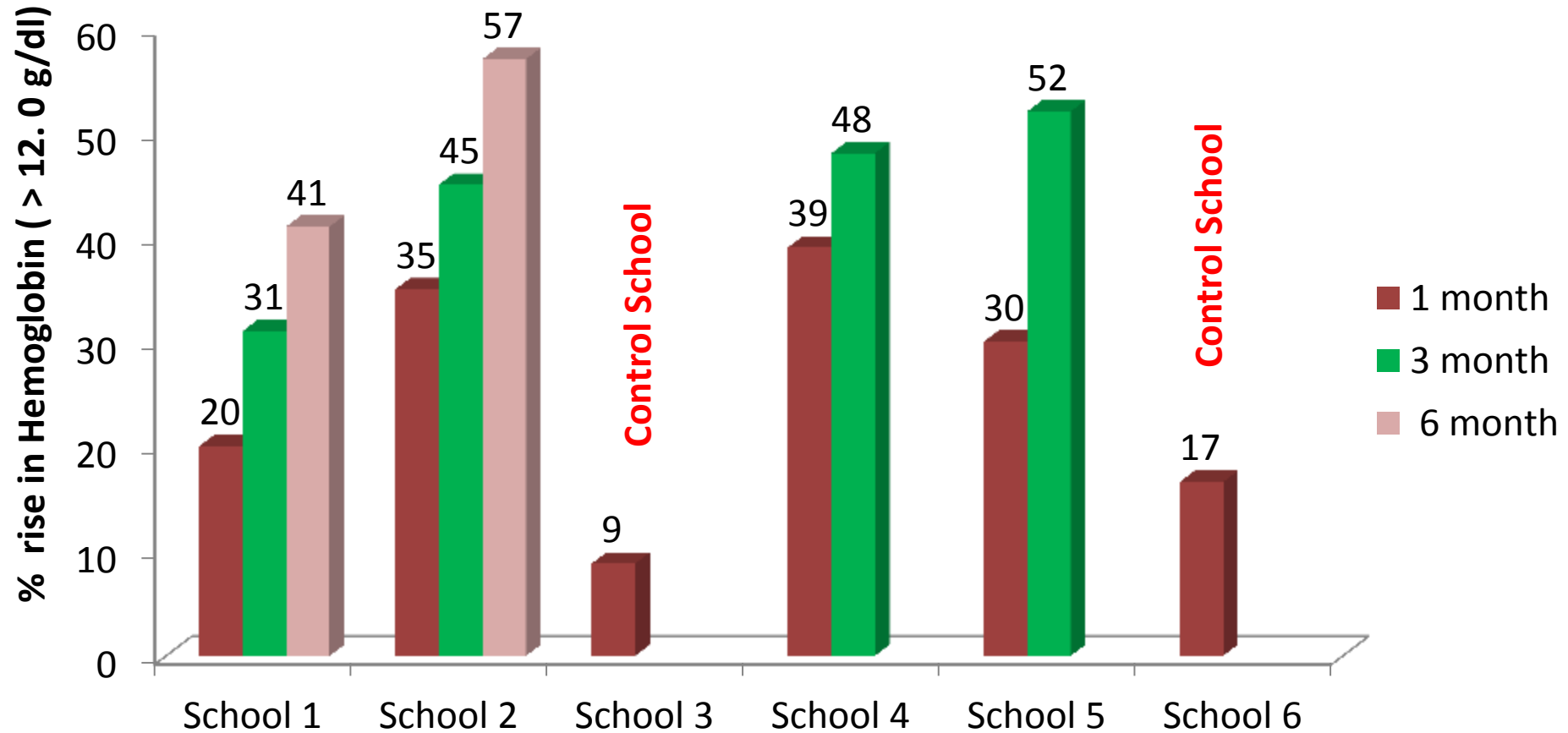
One = Intra uterine death = 0.42 %

|                   |   |  |   |
|-------------------|---|--|---|
| Control<br>(247 ) | n= 12   | n= 80  | n= 168  |
|                   | 12/247 = 5 %  | 80/247 = 32 %  | 155/247 = 63 %  |
|                   | 1 abortion (19 <sup>th</sup> wk)<br>1 preterm still born<br>(30 <sup>th</sup> wk) | 2 still births<br>(34 <sup>th</sup> & 35 <sup>th</sup> wk) | 2 Intra uterine death<br>(38 <sup>th</sup> & 40 <sup>th</sup> wk) |

6 deaths = 2.4 % deaths

# Hypothesis tested in Adolescent girls

Percentage Rise in Hemoglobin  
(from 4 sample and 2 control school children)



# Role of $F^-$ in causing Anemia

| Cause   | Effect   |
|---|--|
| (1) Gastro Intestinal mucosa deranged                             | <ul style="list-style-type: none"> <li>Non-absorption of Nutrients and orally administered supplements. Hb ↓</li> </ul>                                      |
| (2) Destroys Probiotics (Good Bacteria in the Gut )               | <ul style="list-style-type: none"> <li>Vitamin B<sub>12</sub> production ↓ Hb ↓</li> </ul>   |
| (3) Destroys Red Blood Cells. Erythrocyte membrane looses calcium | <ul style="list-style-type: none"> <li>Abnormal RBC i.e. Echinocyte formed. Short-lived</li> <li>Low RBC → Low Hb → Anemia</li> </ul>                        |
| (4) Thyroid hormone production reduced                            | <ul style="list-style-type: none"> <li>Adequate normal stimuli for bone marrow + other Erythropoetic tissues lacking → RBC production less ↓ Hb ↓</li> </ul> |

1 -4 causes low hemoglobin biosynthesis → Anemia

Withdrawal of Fluoride → 1-4 reversed → Hemoglobin ↑ → Anemia Rectified

# Prescription for a Healthy Baby

Prior to Conception, test for:

|    |  |                  |
|----|--|------------------|
| 1. | Thyroid hormone level                  | Should be normal |
| 2. | Vitamin B <sub>12</sub> level in serum | ”                |
| 3. | RBC Count                              | ”                |
| 4. | Urine F <sup>-</sup>                   | (< 1.0 mg/l)     |

# Take Home Messages

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Anemia and low birth weight babies easily rectifiable

## Way Forward

1. Safe water / Defluoridated water essential for improving maternal and child health : A wakeup call – endemic nations for Fluorosis around the Globe
2. Monitoring Hb & UFL until delivery most essential
3. Consumption of Fruits, Vegetables and Dairy products besides *(iron & folic acid supplementation essential during pregnancy)*
4. Outcome Healthy Mother & Healthy Baby
5. Protocol: simple, easy to practise for the community
6. Enormous benefits for Pregnant women, Adolescent girls for controlling trans-generational deformities in the community.

to continue.....

# Our Babies

| ID No. 067       |   |
|------------------|---|
| Birth weight     | <b>3.5 Kg</b>                               |
| Date of Delivery | 26/2/2008 (Delivered at 40 weeks and 2 day) |
| Mother's Hb      | <b>12.0 g/dl</b>                            |



| ID No. 174       |  |
|------------------|--|
| Birth weight     | <b>3.5 Kg</b>                              |
| Date of Delivery | 8/8/2008 (Delivered at 37 weeks and 5 day) |
| Mother's Hb      | <b>11.6 g/dl</b>                           |



| ID No. 372       |  |
|------------------|--|
| Birth weight     | <b>3.7 Kg</b>                              |
| Date of Delivery | 8/9/2008 (Delivered at 39 weeks and 3 day) |
| Mother's Hb      | <b>12.2 g/dl</b>                           |





**Thank You**

