

Intelligence quotient in children exposed to fluoride in groundwater, Colombia

F.D. González¹, M. Beltrán², P. Bermúdez³, P. Castro⁴, M.D. Cerezo⁵, R.A. Gómez³, C.A. Martínez⁶, A. Salas³, L.R. Tirado⁷, O.B. Salcedo², A. Saldarriaga⁸, M. Sánchez⁹, L.A. Vila¹⁰

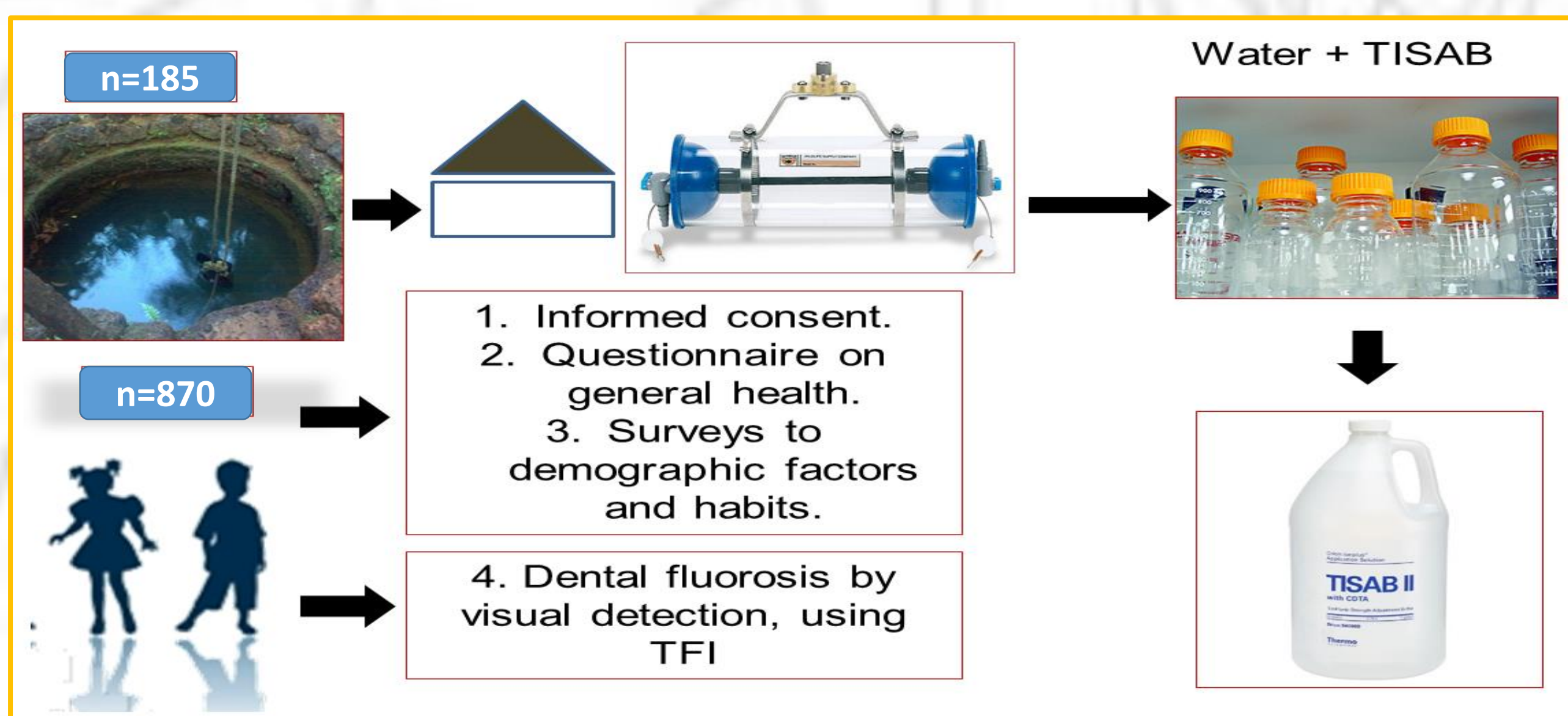
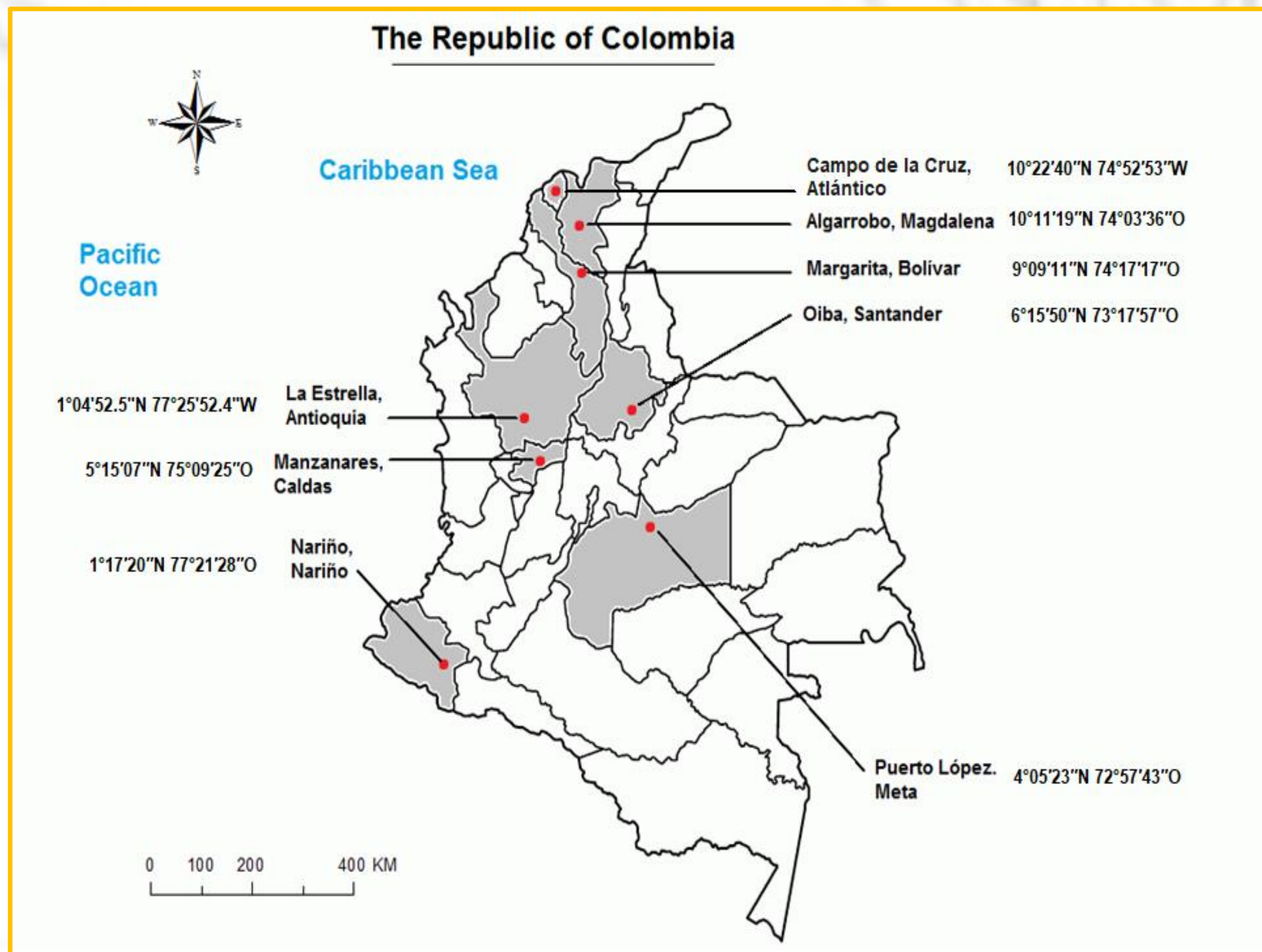
¹Universidad de Cartagena; ²Universidad de Antioquia; ³Universidad Cooperativa de Colombia; ⁴Universidad Rafael Núñez; ⁵Universidad Autónoma de Manizales; ⁶Universidad Santo Tomas-Bucaramanga; ⁷Universidad del Sinú-Cartagena; ⁸Universidad CES- Medellín; ⁹Universidad Metropolitana; ¹⁰Universidad del Magdalena.

Objective

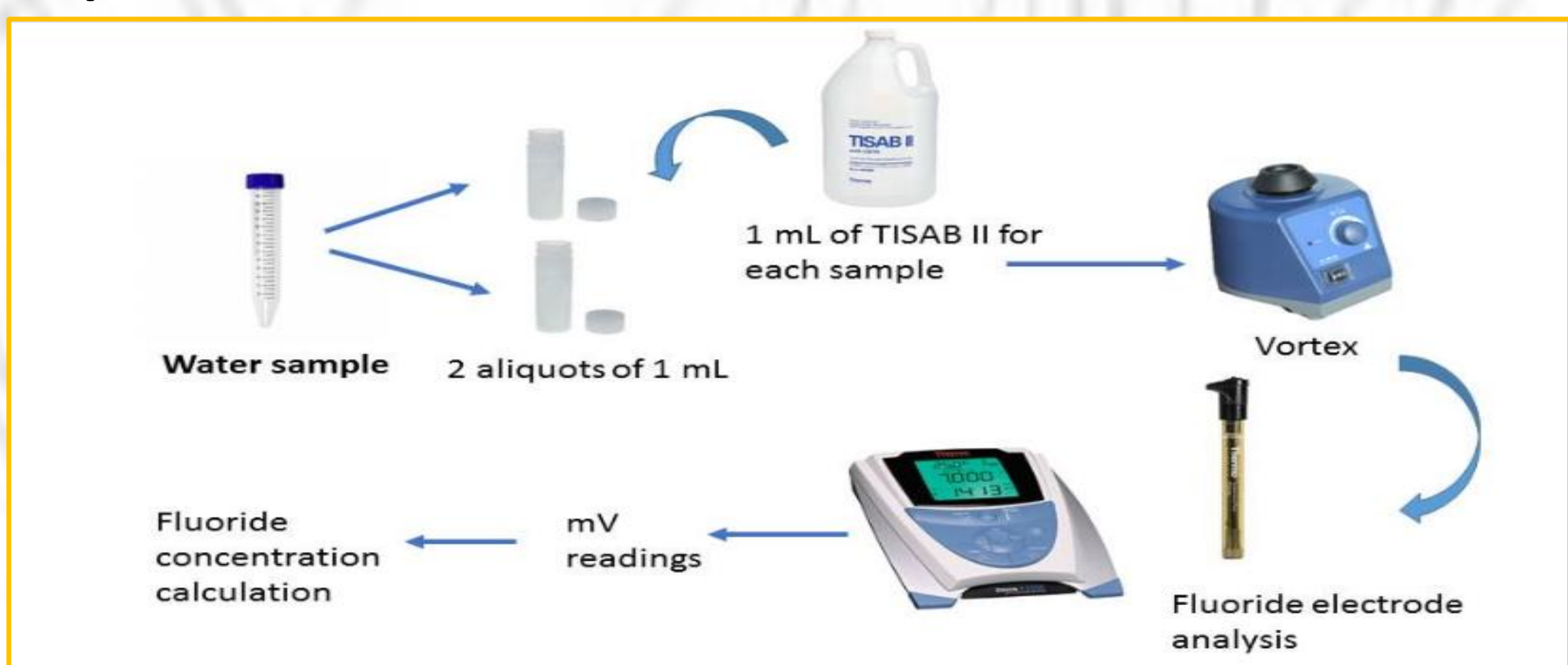
To explore the association between exposure doses to fluoride by water intake and the intelligence quotient (IQ) of children.

Methods

This is a cross-sectional exploratory study conducted during the months 2017 and 2018. 870 children aged 7-11 years selected from seven populations in Colombia.



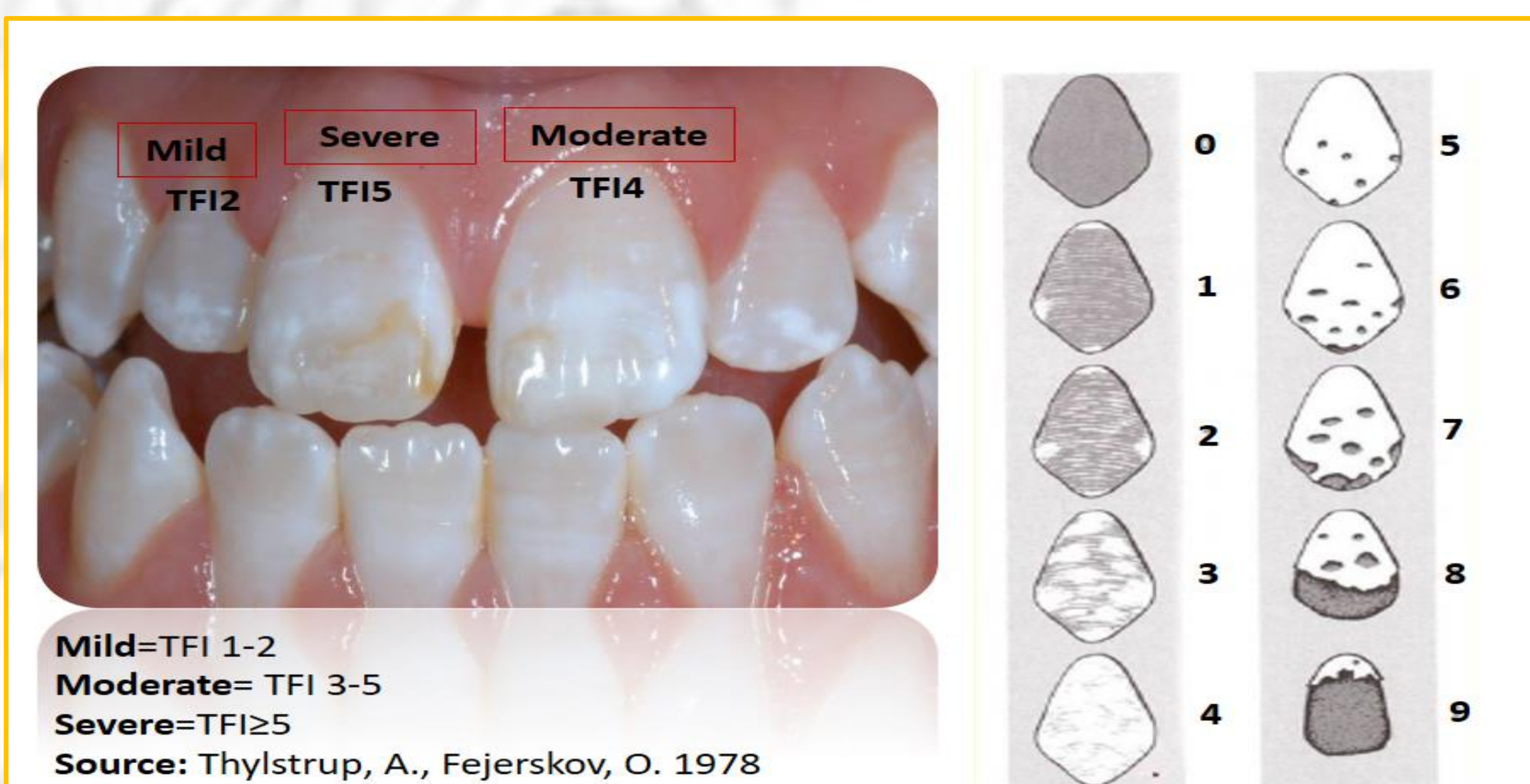
Exposure assessment



Water ingestion exposure doses (IDag) (ATSDR, 2005).

$$IDag = \frac{C \times IR \times EF}{BW}$$
 Fluoride optimal daily dose (<0.05 mg/kg/day).

Dental examination



IQ Test Raven's Color Progressive Matrices-RCPM

IQ ≥ 120 = superior intelligence
 IQ = 90-109 = normal or average intelligence
 IQ = 110-119 = above-average intelligence
 IQ = 70-89 = dullness and lower IQ

Results

Table 1. Characteristics of study

Sample characteristics	%	Sample characteristics	median
Gender		Physical factors	
Male	50.7	Age (years)	10
Female	49.3	Weight (kg)	30
Child's school grade		Psychosocial factors	
2	14.1	Evolutionary development	0.81
3	27.4	Educational aspects	0.70
4	29.9	Autonomy and self-care	0.85
5	28.6	Social relations	0.83
Mother's educational level			
Elementary school	63.3		
High school	30.7		
Bachelor's degree or higher	6.0		

Table 2. Fluoride concentration in water and IDag

Municipality	Fluoride (mg/L) Median	IDag (mg/kg/day) Median
Algarrobo	24.0	0.89
Campo de la cruz	0.06	0.002
La estrella	0.04	0.001
Manzanares	0.03	0.0008
Margarita	6.3	0.22
Oiba	0.05	0.002
Puerto López	0.45	0.01
Total	4.45	0.16

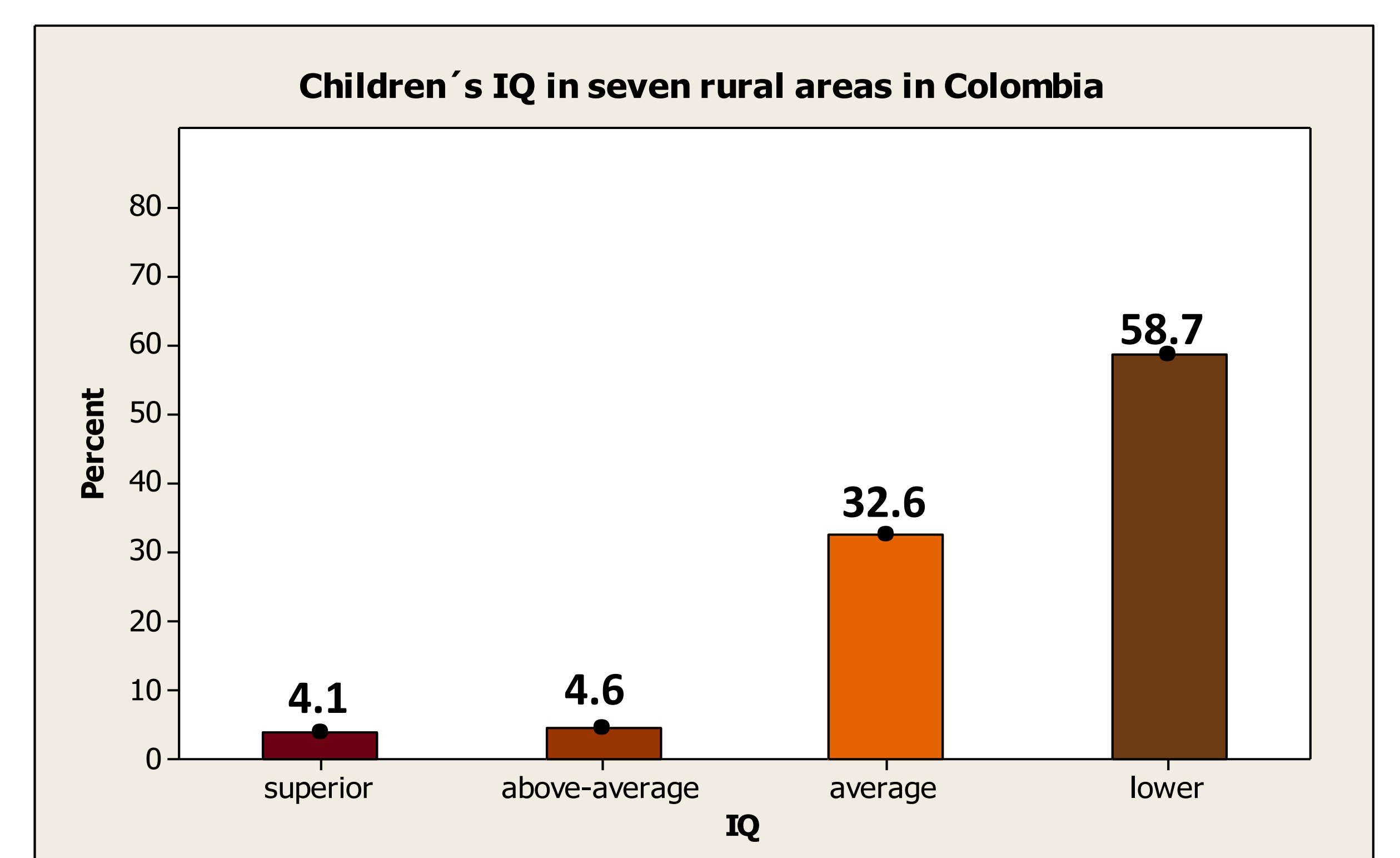
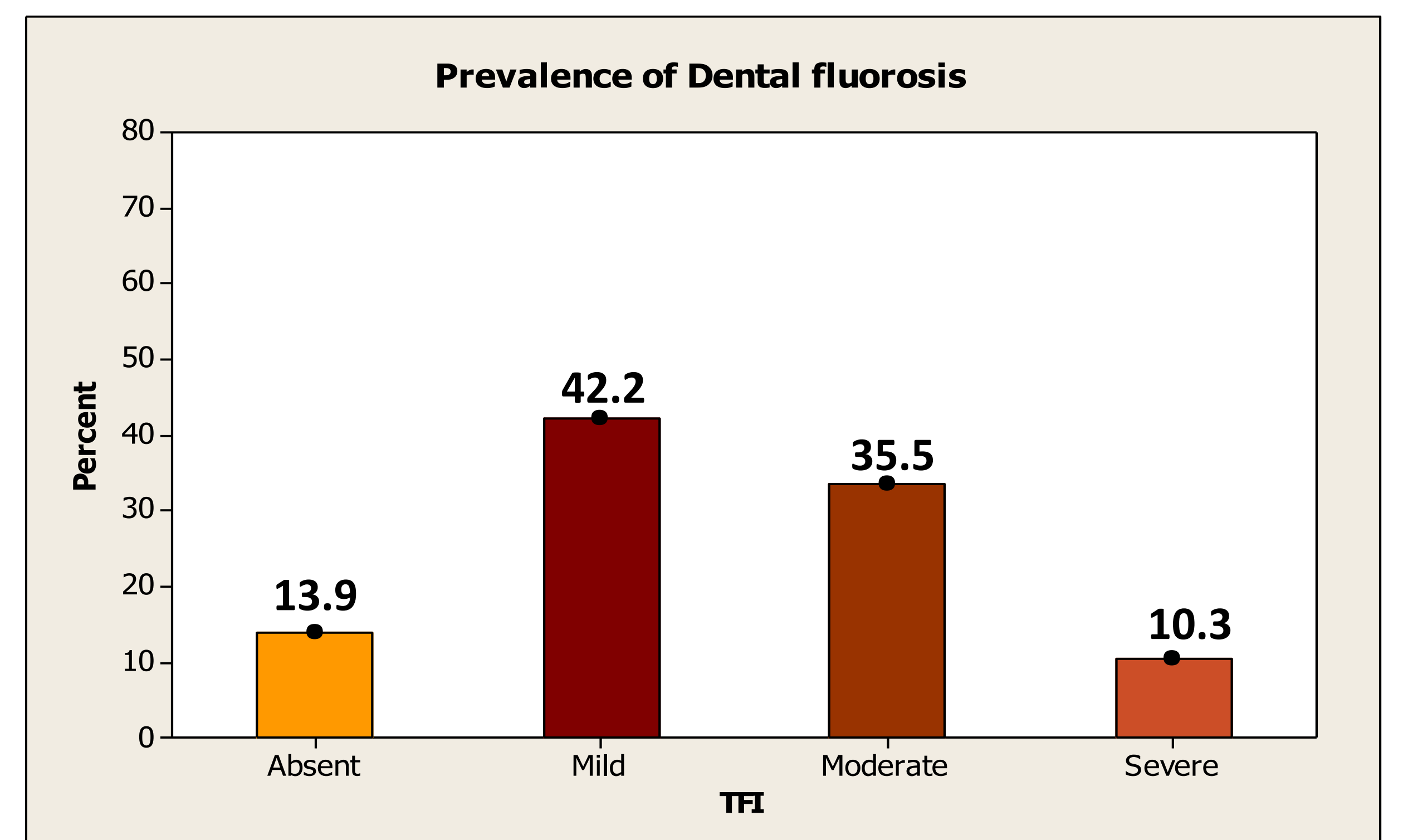


Table 3. Logistic regression with factor influencing IQ scores

Exposure variable	Coef. β	SE Coef.	p-value	Lower	Upper
Child's school grade	0.15	0.07	0.03	1.01	1.33
Mother's educational level	-0.34	0.13	0.009	0.55	0.92
Social relations	0.30	0.08	0.000	1.15	1.6
Water ingestion exposure doses	-0.36	0.17	0.03	0.50	0.96
Fluorosis severity	0.06	0.09	0.53	0.89	1.26
Chi-Square=702.1; p-Value = 0.000					

Conclusions

The IQ scores in children residents in rural areas of Colombia are associated with the exposure dose to fluoride, child's and mother's educational level, and the social relations. These interactions could be influencing high or low IQ scores.