



# Outcome of Systemic Fluoride Effects on Developmental Neurocognitions and Psychopathology in Adolescent Children

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**To the Editor:** The Centers for Disease Control recognized community water fluoridation as one of the 10 great public health achievements of the twentieth century for improving oral health, especially in children [1]. Unfortunately, long-term exposure to higher endemic water fluoride caused dental fluorosis, skeletal fractures, cancers, and affected reproduction, thyroid functions, and intelligence quotient (IQ) [2, 3]. The present study analyzed the outcome of spectral severity of water fluoride levels in growing adolescents aged 11 to 15 y on their neurocognitions, psychopathologies, and neuropsychiatric disorders by using naturalistic case–control study design from Nalgonda district of Telangana state in India.

We evaluated 150 adolescents, 50 each from three different areas with water fluoride ranging from <2.5 ppm to ~10 ppm (Scott–Sanchis method). We observed that in ~10 ppm group, clinically none had normal Dean fluorosis index and only 4% had above average intelligence scores on Bhatia Battery, as compared to 48% in ~5 ppm group. There were significant differences on one-way ANOVA for attention/concentration ( $F = 13.879$ ;  $p = 0.000$ ), verbal memory ( $F = 36.197$ ;

$p = 0.000$ ), working memory ( $F = 3.078$ ;  $p = 0.014$ ) apart from IQ ( $F = 12.938$ ;  $p = 0.000$ ) suggesting the inverse relationship. Further, significant ( $p < 0.001$ ) spectral progression of psychopathology was evident in domains of ADHD, childhood disruptive mood disorder, persistent defiant disorders, and specific arithmetic scholastic skills disorders. We found no association with epilepsy or other neuropsychiatric presentations.

Meta-analysis of 26 studies comprising 7258 children for effect of fluoride on IQ levels found robust associations [4], but data on neurocognitions and childhood psychopathology are scarce and the current study bridges this gap in medical literature. However, one of the potential limitations was our inability to measure blood levels of fluoride or other concomitant toxins like lead. We conclude that exposure to water fluoride should be controlled in these areas by coordinating public policies to protect brain development during crucial life stages.

## Declarations

**Conflict of Interest** None.

## References

1. From the Centers for Disease Control and Prevention. Achievements in public health, 1900–1999: fluoridation of drinking water to prevent dental caries. *JAMA*. 2000;283:1283–6.
2. Guth S, Hüser S, Roth A, et al. Toxicity of fluoride: critical evaluation of evidence for human developmental neurotoxicity in epidemiological studies, animal experiments and in vitro analyses. *Arch Toxicol*. 2020;94:1375–415.
3. Malin AJ, Till C. Exposure to fluoridated water and attention deficit hyperactivity disorder prevalence among children and adolescents in the United States: an ecological association. *Environ Health*. 2015;14:17. <https://doi.org/10.1186/s12940-015-0003-1>.
4. Duan Q, Jiao J, Chen X, Wang X. Association between water fluoride and the level of children's intelligence: a dose-response meta-analysis. *Public Health*. 2018;154:87–97.

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