

Domains Tested, Norms, and Standardizing

1.1 Children

Attention

- Reason for interest in domain: Moderate and severe fluorosis have been indicated to cause significant deficits in digit span scores suggesting that children's auditory span or working memory may be particularly affected by chronic fluoride exposure.¹
- Chosen test: Digit Span Test (forward & backward) which tests sustained attention and auditory working
- Validity evidence: Malin;² Kurani and colleagues;³ Arun and colleagues⁴

Executive Function

- Reason for interest in domain: Animal studies have indicated that the prefrontal cortex may be one of the main target areas for fluoride, causing excitotoxicity, oxidative stress and possible neuronal death.^{5,6} The prefrontal cortex is known to be key in performing executive functions, sending signals and mediating neuronal activity.^{7,8}
- Mazes: This subtest is taken from the Malin's Intelligence Scale for Indian Children. It measures planning ability, perceptual organization, visual-motor coordination, and self-control. English
- Validity evidence (methodology used with Indian population): Kishore and colleagues;⁹ Kotnala and Halder¹⁰

Processing Speed

- Reason for interest in domain: Offspring of fluoride exposed mice have been indicated to have significantly decreased locomotor ability and significant dysfunction with sensorimotor development.¹¹
- Chosen test: Coding which tests attention, visual and motor integration, and visual discrimination (visual-motor dexterity, associative nonverbal learning, nonverbal short-term memory)
- Validity evidence: Malin and colleagues;² Kurani and colleagues;³ Arun and colleagues⁴

Psychopathology

- Reason for interest in domain: Mice open-field studies have indicated that exposure to fluoride may cause for increased anxiety-related behavior. This is also shown by noradrenaline increases with fluoride exposure. In addition, negative psychopathology symptoms were indicated to be more negatively correlated to cognitive function performance than positive symptoms.¹² Psychopathology has also been linked with intellectual defects by various studies.¹³
- Chosen test (children): Strengths & Difficulties Scale for Children (SDQ),¹⁴ which is a behavioral screening questionnaire that assesses emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and pro-social behavior. SDQ are scored on these 5 scale. The total score is the addition of the emotional scale, conduct scale, hyperactivity scale and peer problem scale. Calculation of the Total Difficulty Score in this way allows clinicians to reflect on not only the total score for the instrument, but also the sub-scale scores which may be more clinically useful. We have collected the responses from only mothers whereas at least one more source such as the teacher or the child or both could have given a more robust evidence for clinically significant emotional problems in children in this study.
- Validity test: Goodman;¹⁵ Singh and colleagues¹⁶

Dexterity/ Motor Coordination

- Reason for interest in domain: Skeletal fluorosis is characterized by immobilization of joints of the axial skeleton and major joints of the extremities, effectively impacting dexterity by increasing cases of fracturing, osteoarthritis and impaired joint mobility.¹⁷ Poor performance may also be “a sign of deficits in complex, visually guided, or coordinated movements which are likely mediated by circuits involved with the basal ganglia”.¹⁸ Fluoride may play a role in basal ganglion calcification,¹⁹ which can cause deterioration of motor function, speech, seizures, and other involuntary movement.
- Chosen test: Purdue Pegboard Test,²⁰ which measures manual dexterity, speed, and fine motor coordination
- Validity evidence (methodology used with Indian population): von Ehrenstein and colleagues;²¹ Choi and colleagues¹
- General test validity: Tiffin and Asher²²

Grip Strength

- Reason for interest in domain: Decline in grip strength has been observed to possibly indicate cognitive decline (though most studies have focused on the elderly population); better grip strength has also been associated with improved reaction time and nutritional health.^{23–26}
- Chosen test: Grip Strength Dynamometer Test, which measures individuals hand and forearm grip strength
- Validity evidence (methodology used with Indian population): Barr and colleagues;²⁷ Dash and Telles;²⁸ Koley and Singh;²⁹ Kaur and Koley;³⁰ Varte and colleagues³¹ ; Firth and colleagues³²
- Normal grip strength over life course: Ramírez- Vélez and colleagues;³³ Dodds and colleagues³⁴

1.2 Mothers

IQ

- Chosen test: The Bhatia Battery of Performance Tests of Intelligence³⁵ — Short scale consists of Koh's Block Design Test and Pass Along Test.³⁶ Both reaction times and accuracy of performance are scored. In this test, the total IQ of the patient is calculated by extrapolation/interpolation of the performance quotient (PQ) scores. Raw scores were initially calculated and then converted to weighted scores as per the norms appropriate to age and level of education.
- Validity evidence: Murthy;³⁷ Grover and Colleagues³⁸

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