Severe dental fluorosis and cognitive deficits

Choi et al. (2014) is a pilot study of the association of exposure to fluoride with cognitive function of children in a Chinese community. Although limited it provides more useful information than almost all the studies included in the earlier review by Choi et al. (2012). Most of the reports considered in that review were very brief with little detail or consideration of confounding factors.

Political activists, unfortunately, use Choi et al. (2012) in their campaigns against community water fluoridation (CWF). They claim that it “proves” that CWF damages children’s brains (see for example Mercola, 2013). Although the authors warned this interpretation is unwarranted (Choi and Grandjean, 2012), Grandjean and Landrigan (2014) used Choi et al. (2012) as evidence that fluoride is a neurotoxicant. Chassemi (2014) also stresses that this current pilot study is also not relevant to CWF.

Choi et al. (2012) did highlight the need for further research. Broadbent et al. (2014) showed no effect of fluoride on IQ at the optimum drinking water concentrations used in CWF. However, most of the reports reviewed by Choi et al. (2012) considered data from areas of endemic fluorosis where drinking water fluoride concentrations are higher. The pilot study (Choi et al., 2014) aims to test their hypothesis that increased fluoride exposure is related to impairments in neuro-behavioral development among school children in China where endemic fluorosis is common.

This study includes data from several neuropsychological measurements as indicators of IQ. It also includes urine F concentration and the prevalence and severity of dental fluorosis as indicators of fluoride exposure. Most reports have only considered drinking water fluoride concentrations.

I believe dental fluorosis could be important to understanding the data for cognitive deficits reported in this study and in the reports reviewed by Choi et al. (2012) and hope its measurement is retained in future studies.

Choi et al. (2014) did not find a statistically significant association of drinking water fluoride concentration with any of the neuropsychological measurements. But they did find one for moderate and severe dental fluorosis with the WISC-R digit span subtest. Because dental fluorosis is related to fluoride intake I expect that a study with a larger number of children might produce a significant relationship of outcome deficits with fluoride water concentration. However, dental fluorosis is known to be influenced by genetic (Everett, 2011) as well as environmental factors besides fluoride (Butler et al., 1985). The strong association with medium/severe dental fluorosis may have significance quite apart from the relationship of dental fluorosis to fluoride uptake.

Emotional problems in children have been related to physical anomalies, including obvious oral health problems like severe tooth decay (Hilsheimer and Kurko, 1979). Cognitive deficits can sometimes be related to emotional problems and subsequent learning and behavior problems. Quality of life – particularly oral health related quality of life – is negatively related to tooth decay and severe dental fluorosis. It is possible that negative oral health quality of life feelings in children could induce learning and behavior difficulties which are reflected in neuropsychological measurements.

Sixty percent of the children in the Choi et al. (2014) pilot study had dental fluorosis graded as moderate or severe. This likely reflects the endemic fluorosis of the study area. Only a few percent of individuals in areas exposed to the optimum levels of drinking water fluoride used in CWF have dental fluorosis that severe. For example, a recent oral health survey in New Zealand found 2% of individual had moderate dental fluorosis and 0% had severe dental fluorosis (Ministry of Health, 2010). Similarly a US survey found only 2% of individuals exhibited moderate dental fluorosis and less the 1% severe dental fluorosis (Beltrán-Aguilar et al., 2010).

Approximately 19% of the children in the Choi et al. (2014) study exhibited very mild/mild dental fluorosis and another 21% had none/questionable dental fluorosis. The corresponding figures for New Zealand and the US were approximately 20% and 80% respectively.

Tooth decay and other oral defects negatively impact a child’s quality of life as assessed by children and parents (Barbosa and Gavião, 2008; Nurelhuda et al., 2010; de Castro et al., 2011; Aguilar-Díaz et al., 2011; Biazovic et al., 2008; Abanto et al., 2012; Krisdapong et al., 2012; Bönecker et al., 2012; Locker, 2007). Quality of life impacts have also been found for dental fluorosis, but there is a marked difference in physical appearance and quality of life assessments for children with moderate/severe dental fluorosis compared with those having none/questionable or very mild/mild forms.

The physical appearance of moderate and severe forms of dental fluorosis is generally considered undesirable so we could expect these forms to be associated with poor quality of life and this appears to be the case (Chankanka et al., 2010; Do and Spencer, 2007; Chikte et al., 2001). In contrast, most studies report no effect or a positive effect of questionable, very mild and mild forms of dental fluorosis on quality of life (Do and Spencer, 2007; Chankanka et al., 2010; Peres et al., 2009; Biazovic et al., 2008; Büchel et al., 2011; Michel-Crosato et al., 2005).

Given the different patterns of dental fluorosis severity in areas of endemic fluorosis and areas where CWF is practiced and fluoride intakes are likely to be optimal it seems reasonable to expect a difference in ways fluoride intake influences health-related quality of life and possibly cognitive factors.

Quality of life and cognition assessments are likely influenced by common features like learning, confidence, memory and engagement. Consequently it would not be surprising to find some degree of overlap between health-related quality of life ranking and intelligence ranking. It is just possible that the negative quality of life associated with oral defects like severe dental fluorosis contribute to cognitive deficits reported by Choi et al. (2012, 2014). Cognitive deficit assessments can also include subjective elements. Such cognitive deficits could have many causes or influences – genetic, environmental and/or social. Researchers need to be careful not to limit...
their possible hypotheses or research approaches. Unfortunately Choi et al. (2014) appear to be doing just this with their plans for a larger scale study targeted only at “fluoride’s developmental neurotoxicity.”

**Transparency document**

The Transparency document associated with this article can be found in the online version.

**References**


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