The effects of drinking water with high iodine concentration on the intelligence of children in Tianjin, China

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INTRODUCTION

- Iodine deficiency has been identified as a global public health problem and a threat to child health, particularly in developing countries.
- WHO estimated that there were about 2 billion people worldwide still not acquiring sufficient iodine.
- Clinically iodine deficiency is associated with endemic goitre and endemic cretinism.
- More concerning is the effect on the impairment of cognitive development, intellectual abilities, and school performance.

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INTRODUCTION

- The detrimental effects of iodine deficiency on intellectual development in children have been well documented in many studies in both developing and developed countries.
- In all these studies intelligence quotient (IQ) was used as an assessment of intelligence.
- Results from a meta-analytical study of 37 studies conducted in China suggested that children living in iodine sufficient areas scored a higher IQ more than 12 points than those who in severely deficient areas without iodine supplement.

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INTRODUCTION

- Universal salt iodisation and dietary supplement are the primary intervention strategies.
- Concerns have been raised about the effects of excessive iodine intake and child health.
- It has been recognised that excessive iodine intake is also the cause of endemic goitre and associated with large thyroid volumes in children.
- The association between high iodine intake and large thyroid volume may due to an autoimmune process of lymphoid infiltration of the thyroid resulting in an inhibition of thyroid hormone release and triggering a process similar to iodine deficiency.

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INTRODUCTION

- Iodine deficiency → endemic goitre & low IQ
- Excessive iodine → endemic goitre What about IQ??

Aim of the study:
To investigate the effect of drinking water with high iodine concentration on the IQ of children.

Hypothesis:
Children with excessive iodine intake will have a lower IQ than those who receive a sufficient level of iodine.

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METHODS

Study design: population-based health survey with a randomised cluster sampling design.

Sampling for water and subjects
Water samples were randomly collected from 18 separate administrative areas, including the metropolitan city of Tianjin and three major outskirt rural regions, utilising a population proportion sampling technique.

Subjects: primary students aged 8 to 10 years, recruited using a two-stage process with stratification according to the population size of children within the target age range in each of the 18 areas.

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METHODS

Assessment of exposure:
- Iodine intake in drinking water
- Concentration analysed using arsenic-cerium redox method.

Assessment of potential confounder:
- Birth cohort -National dietary iodine supplement program implemented since 1995, there might be variations in program implementation and prenatal exposure.
- Salt iodine intake by children.
- Salt samples were collected and chemically analysed using the iodometric titration method recommended by the International Council for the Control of Iodine Deficiency Disorders (ICCIDD)

Assessment of the outcome:
- IQ was assessed using the Combined Raven's Intelligence test

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METHODS

Data Management
- IQ treated as a continuous variable
- Water iodine concentration was categorised into non-high(<150 µg/L); high (150-300 µg/L); and very high (>300 µg/L).

Data analysis
- Linear regression modellings were applied to test for the association between drinking water iodine concentration and IQ after adjusting for potential confounding factors.
- The cluster sampling effect was adjusted statistically using appropriate survey design techniques.

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RESULTS

The sample

- A cluster random sample was obtained from 30 different schools and 58 different classes resulting in a total of 1229 students.
- Slightly more females (52%) than males.

The outcome – Mean IQ 105.8 (95%C.I.=104.2 to107.3), median 106.

The exposure

Geographical locations	Iodine concentration (µg/L)	
	Median	Samples>150 µg/L
Metropolitan city	7.7	0 (0%)
Rural regions 1	47.5	0 (0%)
Rural regions 2	137.5	29 (47%)
Rural regions 3	234.7	302 (78%)

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RESULTS

Results obtained from the multiple linear regression analyses*

Water iodine concentration levels	β (95%C.I.)	p value
Rural regions 3 (Very high)	-8.7 (-15.9- -1.4)	0.020
Rural region 2 (High)	-1.6 (-4.7 - 1.5)	0.291

* Adjusted for salt concentration ,age, and school year, and cluster sampling effect

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CONCLUSION

- Children who have been exposed to very high water iodine concentrations, on average have a lower IQ by nearly 9 points compared to those who live in areas with lower water iodine levels.
- High iodine intake is detrimental to the mental and cognitive development of children.
- Possible mechanism for the association between higher Iodine intake and lower IQ may include synthesis and release of thyroid hormone .

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CONCLUSION

Public Health implications:

- Need for an urgent response to the population who are at high risk of exposure.
- The overall policy of the implementation of the national dietary iodine supplement program

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Thank You