

# Are Australian children iodine deficient?



Introduction:

Iodine is one of the essential trace elements for the growth and development of the human body. Insufficient iodine intake during pregnancy can cause stillbirths, miscarriages, and other major neurological damages of the fetus (Zimmermann et al., 2008). Globally, iodine deficiency is one of the important preventable causes of brain damage and mental retardation (UNICEF, 1998). It has major effects on intellectual development and in cases of severe deficiency, people suffer from cretinism (congenital hypothyroidism). According to the World Health Organization (WHO), Australia has been classified as a mildly iodine deficient country (de Benoist et al., 2004), and pregnant and lactating women and young children are at risk most. The specific purpose of this report is to summarise the health benefits and risks linked with iodine, the current iodine status and further recommendations to reduce the incidence and prevalence of iodine deficiency in Australia, especially in children who are susceptible to developing physical and neurological impairments due to iodine deficiency.

Iodine deficiency is not a new issue for Australia, as there is a history of iodine deficiency in some parts of Australia, especially in the south-eastern regions. To address iodine deficiency, efforts were applied during the early and mid-1900s (Gibson HB, 2006). In 2009, Food Standards Australia and New Zealand (FSANZ) established a mandatory iodine fortification standard to address the instruction from Health Ministers. In the new mandatory fortification standard, it was advised that the use of iodised salt in wheat-flour based breads, except organic bread, as a replacement of non-iodised salt at a range of 25-62 mg iodine per kilogram of salt. As 88% of Australian

population aged two years and over consume bread, bread is the most appropriate food vehicle for iodine fortification (Winger, 2007).

A community based group called Friends of Pure Food Australia (FoPFA), complained that mandatory iodine fortification causes several health risks due to extra iodine in their food supply. The iodine levels for mandatory fortification was designed to address the iodine requirement of all target groups in Australia, especially young children are protected from exceeding the recommended upper intake levels of iodine. However, the daily requirements are increased during pregnancy and lactation periods, pregnant and breast-feeding women might not get enough iodine during these periods. Therefore, they need additional iodine supplement to achieve their requirements. To address the risk perception of FoPFA group and increase the awareness of general population regarding iodine deficiency and health benefits of mandatory fortification of iodine, an effective communication and education strategy is essential.

Scope of the proposal- This proposal is looking for ongoing use of mandatory iodine fortification Standard, which is the most cost-effective strategy to reduce further incidence, prevalence, and severity of iodine deficiency in Australia.

#### Health benefits/ risk assessment and Risk Characterisation:

1. Possible health benefits - Few studies showed that children who are suffering mild to moderate iodine deficiency, have reported significant improvements of their iodine status within a year of fortification or supplementation. Children whose iodine level was reached to

adequate level from moderate deficiency, showed better performance on tests of visual recognition and problem solving, hand-eye synchronization, fast object naming etc (Zimmermann et al., 2006). A study on school going children in China showed that there was a significant improvement in psychomotor development and IQ in school children with moderate and severe iodine deficiency after successful salt iodisation programs (Tang et al., 2007). Furthermore, pregnant mothers with severe iodine deficiency may give birth children with low IQ compare to mothers with sufficient iodine supplementation (Qian et al., 2005).

Therefore, mandatory iodine fortification can play a vital role to reduce possible escalation of iodine deficiency in Australia and to improve intelligence and cognitive functions, and to prevent mental impairment in children and risk of thyroid dysfunction (hypo or hyperthyroidism) due to iodine deficiency.

2. Possible health risks – Joint FAO/WHO Expert Committee on Food Additives (JECFA, 2007) stated that there are few adverse effects related to excessive iodine intake, such as;

1. The most possible health risk is trouble in optimal thyroid function which would be either iodine-induced hyperthyroidism or hypothyroidism depending on prior and/or present thyroid dysfunction and individual's iodine status. In general, people including young kids can tolerate high amount of iodine up to 50 µg/kg/day and above. On the other hand, some reacts negatively to levels close to recommended daily intakes (3-7 µg/kg/day). A person can develop

iodine induced hyperthyroidism after iodine supplementation, if that individual exposed to low levels of iodine early in life. Thyroid dysfunction may be associated with alteration of thyroid size.

2. Iodine itself can cause sensitivity reaction (if oral exposure more than 300 mg/day) without alteration of normal thyroid function.
3. Rarely, iodine toxicity due to acute ingestion of large amount of iodine.
3. Risk Characterisation - According to Institute of Medicine (2001), iodine level of 1700 µg/day is considered as a lowest-observable-adverse-effect level (LOAEL) for sub-clinical hypothyroidism, which is divided by uncertainty factor of 1.5 to get upper intake level (ULs) of iodine 1133 µg/day (rounded down to 1100 µg/day).

Table: Upper levels of iodine intake for different age groups after adjustment of adult ULs based on body weight

Age group (years)	Upper intake level (µg/day)
1-3	200
4-8	300
9-13	600

14-18 900

≥ 19 1100

This age-specific upper intake levels of iodine are not indicative of absolute thresholds for toxicity, but rather denote daily intake limits with comfortable border of safety. However, if this estimation shows a health and safety risk for young children, we should look at several factors. For example, young children with low body weight are more prone to develop excess iodine than adult, so body weight is an important factor here. For this reason, young children should take lower end of estimated range of iodine intakes to avoid any adverse effects.

There are some vulnerable groups like individuals with prolonged history of iodine deficiency and/ or any types of thyroid disorders (e. g. multinodular goitre or Graves' disease), the estimated ULs are not suitable for them due to high risk of developing hyperthyroidism.

4. Assessment of the Health Consequences following Mandatory Iodine Fortification – According to FSANZ iodine fortification report (2016), the estimated increase in the mean daily iodine intakes over pre-fortification of bread for age 2-3 years, 4-18 years, age 19-69 years, age ≥70 years and women of child-bearing age (16-44 years) were 23 µg/day, 42-53 µg/day, 55-57 µg/day, 59 µg/day and 51 µg/day respectively. Therefore, the estimated mean usual iodine intakes are increased in different age groups Australian population ranged from

37-64 µg/day. For this reason, the incidence of iodine-deficiency health problems especially neurological impairment in children would be reduced. On the other hand, possible adverse effects can be visible if people exceed the ULs which is undesirable. However, evidence indicates that young children can tolerate up to 2-3 times above the estimated ULs without any negative outcomes. A survey has been done following mandatory iodine fortification on population aged 5 years and over by Australian Health Survey, showing the highest median urinary iodine concentration (MUIC = 177 µg/L) was found in children aged 5 to 11 years (Karen et al., 2016), which was a major improvement compared to school-going children (8-10 years) across five states in Australia (Li et al., 2006). Another study (Charlton et al., 2013) was conducted in 2008, on pregnant women attending a public clinic in NSW, Australia, where MUIC before fortification was 87.5 µg/L (n = 110) and after fortification, it was improved to 145.5 µg/L (n = 106) in 2011 and 166 µg/L (n = 95) in 2012 (sufficiency  $\geq 150 \mu\text{g/L}$ ).

After considering above information, it would say that mandatory iodine fortification would improve existing iodine deficiency and prevent further serious consequences related to iodine deficiency especially in children and neurological impairment in newborns.

#### Risk management:

There are several potential issues and risks have identified from mandatory iodine fortification including public health risks, social, economic, or technical issues etc. To mitigate these potential risks, we should consider the following strategies.

Public health risks:

Friends of Pure Food Australia (FoPFA), a community based group complained that mandatory iodine fortification causes several health risks due to extra iodine in their food supply. To address this issue,

- We should educate people especially women in child bearing age to take iodine supplement as they need an additional iodine (100-200 µg/day) during pregnancy and breast-feeding periods (Eastman, 2005).
- A small percentage of young children may exceed the upper intake level of iodine following mandatory fortification. However, additional salt should not be used in their food (FSANZ, 2008).
- The risk of iodine induced hyperthyroid toxicity is low in people with normal thyroid function, as FSANZ has approved a conservative approach of fortification, which includes a prescribed level (25-65 mg iodine per kg of salt) of iodine (FSANZ, 2008). However, an exclusive monitoring system would highly recommended to identify this type of health risk.
- People with pre-existing thyroid disorders like Graves' Disease, are prone to develop thyroid toxicity in iodine fortification. As most of them are under medical care, medical professionals can play a significant role in informing patients regarding mandatory iodine fortification. Here general food labelling laws are important, so consumers can select or avoid foods with iodised salt.

Technical issues :



- About 88% of people in Australia aged  $\geq 2$  years, eat bread. So, bread is the most appropriate food vehicle for iodine fortification. According to Professor Winger, adding extra iodised salt into the bread is not associated with any technological issues, means technologically feasible with low trade impacts (Winger, 2007).
- Rest of 12 percentages of people do not consume bread or may consume different types of breads like salt free or gluten free etc, may have limited advantage from this mandatory iodine fortification. Therefore, use of iodised salt in gluten free bread may solve this problem.
- The recommended range of iodine 25-65 mg per kg salt should be maintained by the salt industry, and proper use of generic labelling is required to advise consumers about iodine fortified foods.
- Education messages regarding fortified bread with iodine should emphasise on bread as a source of extra iodine, rather than salt.

#### Economic issues :

As it is difficult to quantify the benefits of mandatory iodine fortification, the centre for health economics research evaluation (CHERE, 2007) analysed the cost-effectiveness of iodine fortification of bread in Australia. It suggested that the number of people with mild or moderate iodine deficiency was decreased significantly. Therefore, in terms of cost effectiveness ratio, the cost of decreasing the risk of iodine deficiency illnesses appears low compared to possible benefits including better health, reduced health care expenses and improvements in productivity and Gross Domestic Product (GDP).

Risk communication:

It is recognized that the mandatory iodine fortification is an effective way of improving iodine intakes across the population. It will improve the current iodine deficiency and will stop future deficiency, especially in children. To raise the awareness regarding mandatory fortification of iodine, an effective Communication and Education Strategy should develop. This strategy should contain specific messages which must be accurate, have balanced perception on the issues and must echo the needs of the different target audiences. It is important to use of a wide range of communication medias to improve the risk perception of general population regarding iodine deficiency and to reach the target audiences which are;

- Pregnant and lactating women- Iodine is a vital element like folic acid for the development of a foetus. Pregnant and lactating women may need additional iodine supplement as the mandatory iodine fortification may not adequate for their daily requirements.
- Parents of young child- Iodine fortified bread is a very good source of iodine for young children. Therefore, parents or carers should not use and extra salt in cooking or at the table, as it may exceed the upper level of iodine intakes for children.
- Population with iodine sensitivity and thyroid disorders- The recommended level of iodine fortification is established for reduction of any possible health risks. Proper labelling on all packed foods are very important as individuals with thyroid dysfunctions can consume or avoid those foods according to their needs. They can ask advice from

medical professionals regarding their health condition and iodine requirements.

- Individuals who do not eat bread- The dietary sources of iodine are eggs, dairy products, kelp, seafood etc. Manufacturers can make different foodstuffs using iodised salt other than bread and proper labelling also important too. These individuals can seek medical advice regarding iodine intakes.

#### Limitations:

There are some limitations of mandatory iodine fortification, such as;

- Through this mandatory fortification of iodine, all Australian will not get sufficient iodine especially non-bread consumers, pregnant and breast-feeding women. Therefore, they need extra supplement of iodine during these periods.
- An exclusive and effective communication and education strategy is necessary to support mandatory fortification program.
- This fortification program needs extensive monitoring to find out the iodine status of population, which may permit to take adequate measures such as,
  - The concentration of iodine in iodised salt might need to increase.
  - Adding iodised salt in foodstuffs other than bread.
  - Discovering another form of iodine supplement other iodised salt to the food supply.

For proper consideration of these potential options, we need adequate data on the effect of the mandatory fortification of iodine.

### Conclusion:

As requested by the Australian Food and Nutrition Agency (AFNG), I have considered the continuation of mandatory iodine fortification of the food supply, to reduce the prevalence of iodine deficiency in Australia, especially in children, pregnant and lactating women. According to the existing evidence, I would say that the mandatory fortification of foods with iodised salt at 25-65 mg of iodine/ kilogram of salt, would bring net-benefits to Australia. The range of iodisation in salt has been designed for all target groups to maximise iodine intakes, and prevent to exceeding the upper intake levels especially in young children. However, mandatory fortification can serve adequate of iodine to the public, but a big portion of pregnant and lactating women will not get adequate amount of iodine. Therefore, it is necessary to take extra supplementation during these periods. There are some reasons for this consideration, such as;

1. Evidence showed that the iodine status of general population has improved after mandatory fortification of bread with iodine which is considered as the most cost-effective strategy to reduce the prevalence of iodine deficiency and provides net-benefits to Australia.
2. As about 88 percentage of population aged 2 years and over in Australia, consumes bread. Therefore, bread is the most appropriate food vehicle for iodine fortification. It is estimated that iodine

deficiency in Australian  $\geq 2$  years of age, is reduced from 43% to 5% following mandatory fortification.

3. It is internationally well tested that iodine fortification in bread with iodised salt is technologically feasible.
4. According to CHERE, the number of people with mild or moderate iodine deficiency has decreased significantly after mandatory fortification. Therefore, in term of cost effectiveness ratio, the cost of decreasing the risk of iodine deficiency illnesses appears low compared to possible benefits including better health, reduced health care expenses and improvements in productivity and Gross Domestic Product (GDP).
5. Small portion of people are concerned about the adverse effects iodine overdose. The individuals with existing thyroid disorders or children with low body weight, might prone to develop adverse health effects due to iodine sensitivity. However, the level of iodine for mandatory fortification does not pose general population health and safety at risk. It has been set to reduce any possible health risks. An effective communication and education strategy is vital to address risk perception of general population regarding this matter.

For implementing an effective mandatory program, monitoring is considered as an essential component and the health and regulatory agencies at the Commonwealth and State/Territory levels in Australia and New Zealand are responsible for active monitoring. Monitoring will ensure the constant effectiveness, safety and wellbeing related to mandatory fortification to decrease the incidence and prevalence of iodine deficiency in Australia.

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