DBN Review Nº 9
A resource about dairy-based nutrition
A product of the Consumer Education Project of Milk SA
www.rediscoverdairy.co.za

This review provides an overview of factors that affect dietary iodine status and highlights the importance of milk and dairy intake to prevent iodine deficiencies.

A publication for health professionals

Iodine: *The neglected nutrient in dairy*

Iodine
53
I
126.90

Given the general modern lifestyle, diet and environment, inadequate intake of vitamin D and omega-3 essential fatty acids may lead to commonly seen nutritional challenges. However, possible iodine deficiencies should sit squarely in our sights too, as this mineral is present in uneven and mostly insufficient quantities in food worldwide.[1] This can become a considerable dietary concern if we consider that iodine, like vitamin D and omega-3 fatty acids, facilitates some integral functions in the human body. For example, iodine is involved in the functioning of multiple hormones (both steroidal and metabolic), maintaining the integrity of the nervous system (both cognitive and sensory functions) and ultimately the metabolism of cells in the body, both directly and indirectly. Studies have shown that dairy products are important sources of iodine, especially in children,[2-4] and can contribute to between 13% and 64% of the recommended daily iodine intake.[5,6]

What is iodine?

Iodine is an essential trace element used by the body in both its natural forms, namely iodine and iodide. Dietary iodine is reduced to iodide, which is almost completely absorbed (>90%) through the lining of the stomach and small intestine. Under optimal conditions, the human body contains 15–20 mg of iodine, of which about 80% is stored in the thyroid gland. The rest is distributed across the breasts, skin, gastric mucosa and visceral organs. The uptake of circulating iodide by the thyroid depends on the iodine status of the individual. When the iodine status of an individual is optimal, less than 10% of the absorbed iodine will be taken up, whereas more than 80% is absorbed in iodine-deficient individuals.[6,7]

Functions of iodine

Iodine is an essential component of the thyroid hormones, T3 and T4, which are required for brain and neurological development, and is also present in many amino acids that are essential for normal metabolism. Iodine is a powerful antioxidant, moderates the body's cortisol response during stress and has a major role in maintaining the oestrogen balance in women by facilitating the body's increase of estriol while reducing estrone and estriadiol.[8] Iodine also increases hormonal sensitivity and binds heavy metals, thereby increasing the elimination of lead, mercury, cadmium, aluminium, fluoride and bromide from the body.[4,6,7,9]

Global iodine status

Globally, iodine deficiency is the most common preventable cause of brain damage, with more than 2 billion people from 130 countries at risk, including an estimated 241 million children of schoolgoing age.[10,11] Iodine deficiency impairs mental functioning, with an estimated intellectual loss of 7.4–15 intelligence quotient (IQ) points in children born to mothers with a poor iodine status. To maintain a sufficient iodine status, the World Health Organization (WHO), the United Nations Children's Fund (UNICEF) and the International Council for Control of Iodine Deficiency Disorders (ICCIDD) recommend that the daily iodine intake should be 90 µg for preschool children (0–59 months), 120 µg for children between the ages of 6 and 12 years, and 150 µg for adults (older than 12 years). The recommendation for pregnant and lactating women has recently been revised to 250 µg per day.[1,4]

Available data indicate that the prevalence of dietary deficiencies for iron, vitamin A, iodine, zinc and folate in pregnant women and women of reproductive age in a number of African countries (Ethiopia, Kenya, Nigeria and South Africa) is of public health concern based on the WHO criteria. These underlying deficiencies appeared to relate to inadequate dietary intakes.[12] Prior to legislation introduced in 1995, which required all manufactured salt to contain potassium iodate, iodine deficiency was seen in many areas of South Africa. The iodisation policy has successfully eliminated iodine deficiency in the majority of South African citizens.[1,10,13]

Iodine deficiency

Despite considerable progress in eliminating the prevalence of iodine deficiency through salt iodisation programmes,[11] adequate iodine intake continues to be an important aspect of public health owing to iodine's essential role in neurological and brain development. Recent evidence suggests that even moderate iodine deficiency during early pregnancy is associated with impaired cognition in children, presenting as lower IQ and reading scores.[6,14,15] This is due to the foetus being dependent on the mother's T4 production during the first and second trimester for healthy brain development.[15]

When the physiological requirements for iodine are not met, thyroid hormone synthesis is impaired, which can result in hypothyroidism and a host of functional and developmental abnormalities, collectively known as iodine deficiency disorders (IDDs). These IDDs include thyroid function abnormalities, endemic goitre, mental retardation, cretinism (severe hypothyroidism in infants and children) and reproductive failure. The most serious disorder due to iodine deficiency is irreversible mental retardation, which establishes during the critical period between foetal development and three months of age.[1,4,15] Iodine deficiency has also been found to be a common factor in oestrogen-dependent breast or ovarian cancer, thyroid carcinoma, fibrocystic breast disease and oestrogen dominance.[13,16,17]

Some groups, especially women of childbearing age and individuals who avoid dairy and fish owing to an intolerance, allergy or lifestyle choice (e.g. vegans), have a higher risk of iodine deficiency. This has been confirmed in a recent study, which revealed a high prevalence of iodine deficiency among children with a cow's milk protein allergy.[18] A high incidence of thyroid carcinoma has also been described in iodine-deficient areas in Europe. Przybylik-Mazurek et al.[17] showed that dietary patterns appear to modify the risk of thyroid carcinoma, as the consumption of vegetables, fruit, saltwater fish and cottage cheese was reported to be significantly lower in patients with differentiated thyroid carcinoma.

Sources of iodine

Most adults who include milk, dairy products and fish in a healthy, balanced diet should be able to meet their iodine requirements (Table 1). In many countries, including South Africa, salt is fortified with iodine.[1,13]

Table 1

Average iodine content per portion of food item[1,6]

Food	Portion size	Average Iodine content (µg)
Iodised salt	1 g	45–50
DAIRY		
Cow's milk	200 ml	50–100*
Organic cow's milk	200 ml	30–60*
Yoghurt	150 g	50–100*
Cheese	40 g	15
FISH**		
Haddock	120 g	390
Cod	120 g	230
Salmon fillet	100 g	14
Tinned tuna	100 g	12
Prawns	60 g	60
OTHER		
Eggs	1 egg (50 g)	25
Meat/Poultry	100 g	10
Nuts	25 g	5
Bread	1 slice (36 g)	5
Fruit and vegetables	1 portion (80 g)	3

* Depending on the season; higher value in winter.

** White fish contains more iodine than oily, dark-coloured fish.

In the case of a diagnosed iodine deficiency, an iodine supplement may help an individual to meet dietary iodine needs. However, it is essential to seek professional guidance when taking iodine supplements, especially in the case of thyroid disease. Iodine in supplements should be in the form of potassium iodide or iodate and should not exceed the daily adult requirement of 150 µg. Seaweed or kelp supplements should not be used as an iodine source as it can lead to the intake of excessive quantities of this mineral.[4,5]

Iodine in dairy

Cow's milk is a rich source of iodine,[5] owing to dairy farming practices. Milk iodine concentrations in industrialised countries range from 33 µg/L to 534 µg/L. The specific concentration is influenced by the iodine intake of dairy cows, goitrogen intake (substances that occur naturally in foods such as cabbage, kale, Brussels sprouts, cauliflower and broccoli), milk yield, season (iodine levels are higher in the winter months), teat dipping with iodine-containing disinfectants, type of farming, and processing methods. Based on country-specific food intake data, it is estimated that approximately 13–64% of the recommended daily iodine requirement can be obtained from milk and dairy.[3,5]

In the Total Diet Study (2003–2004), the US Food and Drug Administration measured iodine in more than 250 foods from three locations each in four regions. The data showed that dairy products were the single largest contributor to total iodine intake in all age groups other than infants and across both sexes. Dairy consumption accounted for 70% of iodine intake among children aged 6–10 years, whereas consumption of grains accounted for approximately 15% among this age group.[2]

A study aimed at evaluating iodine status in school-aged UK children and monitoring the use of iodised salt in school canteens and households showed that lower consumption of milk, yoghurt and iodised salt was associated with a higher risk of iodine deficiency.[19] As the UK has no legislation regarding iodine fortification and iodised salt is not readily available, consumers are very reliant on dairy products for iodine intake. This is supported by results that show milk and dairy products to account for approximately 33% of the intake in adults (19–64 years) and 40% in adolescents (11–18 years). In addition, consumption of cow's milk has been positively associated with iodine status in pregnant women, women of childbearing age, adolescent girls and children 8 –10 years old in the UK.[3]

A number of other studies have analysed the iodine content of dairy. In an analysis of 18 brands of milk in the US, Pearce et al.[20] found that the products contained at least 88 µg iodine per 250 ml (range: 88–168 µg). In another study, mean iodine content of cow's milk was found to be significantly higher in winter months than during the summer,[17] similar to findings from a Norwegian study.[21] A daily intake of 400 ml milk would supply 25% of the recommended iodine intake for adults (150 µg/day) during summer and more than 60% during winter.

Unfortunately research regarding the iodine content of South African milk is limited. In the only study found,[22] data showed that 75% of the samples tested contained 25–30 µg iodine/L. Three servings of 250 ml milk per day would therefore supply 12.5%–15% of the daily recommended amount for adults and 25% for children. However, it is important to note that this study was conducted in the 1980s and that current analysis of South African dairy may show different figures.

Effect of salt reduction on iodine status

Salt iodisation is an effective strategy to optimise population-wide iodine levels. However, reduced dietary sodium (salt) intake is currently encouraged[23] to curb the prevalence of hypertension and the associated negative health effects and high costs of treatment and management. Reduced dietary salt consumption could result in a considerable reduction in iodine intake and so lead to a risk of iodine deficiency. In a US study that evaluated the association between dietary salt restriction and iodine deficiency among adults, a positive association was found among women but not men.[24] Another study showed that reducing salt intake by 1.9 g/day in children and 2.9 g/day in adults led to a decrease in iodine intake of 19.3% and 11.4% in children and adults, respectively.[25]

To ensure maximum impact of salt reduction initiatives on public health, there is an urgent need for coordination and collaboration between the various advisory bodies, particularly in disseminating consistent messages and monitoring salt and iodine intake across a population to obtain the data needed to inform appropriate policy changes or consensus statements. If iodine intakes decrease owing to public health efforts to reduce salt intake, milk and dairy products may become increasingly important sources of dietary iodine in the future.

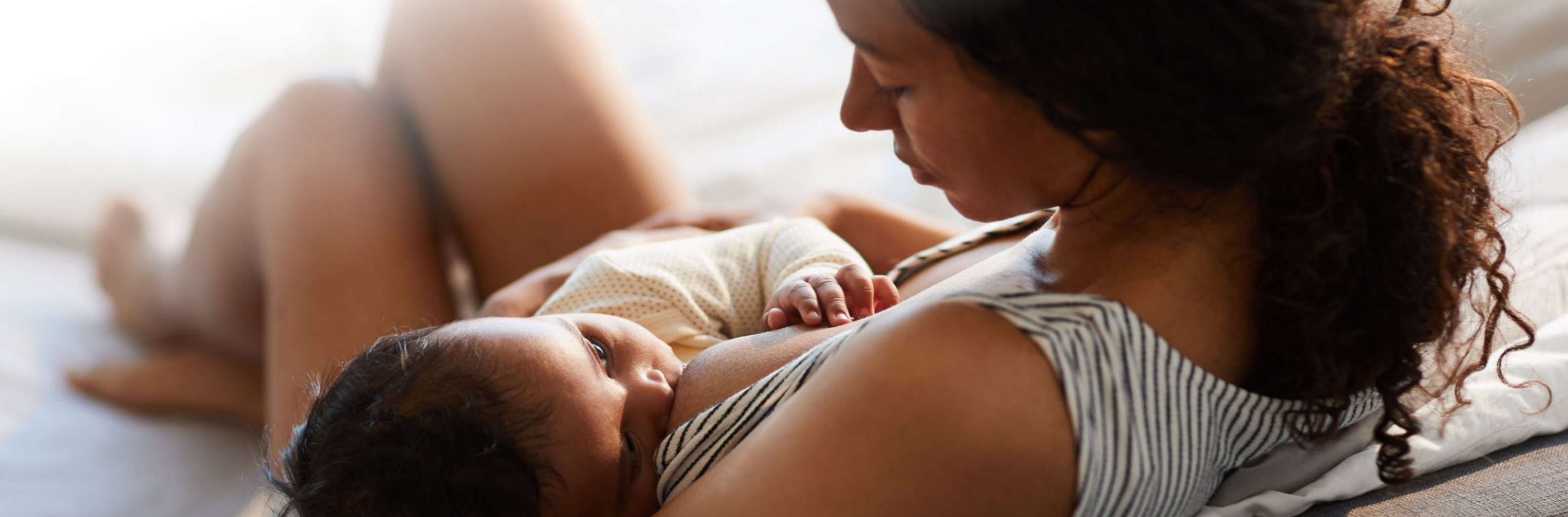
Is dietary iodine intake safe in the case of iodine allergy?

The term 'iodine allergy' is used frequently, and usually refers to a history of an allergic reaction to seafood or iodated radiological contrast media. There is a considerable misunderstanding regarding the role of iodine in seafood allergy, contrast media sensitivity and contact dermatitis to topical antiseptics that contain povidoneiodine. This misconception is clinically important because patients may be denied essential procedures or consumers may be avoiding certain food items unnecessarily.

As iodine is a normal trace element in our bodies, it cannot be an allergen, yet seafood allergies have become associated with iodine intake. Although both fish and shellfish contain iodine, it is not the iodine that is the source of food allergies, but rather a protein present in the specific food. Seafood allergy mostly involves an IgE-mediated reaction to a protein called tropomyosin in shellfish. Tropomyosins are protein allergens, with cross-reactivity shown between crustaceans and molluscs but not fish. Individuals who present with an allergic reaction to fish are most likely sensitised to the parvalbumin protein in fish, which shows broad cross-reactivity between fish species. Therefore, individuals allergic to shellfish are unlikely to also be allergic to fish, and vice versa. Screening tests for seafood and fish allergies are available, as well as for the allergen-specific proteins tropomyosin and parvalbumin.[26]

Conclusion

Although substantial progress has been made over the past several decades, iodine deficiency remains a considerable health concern worldwide and affects both industrialised and developing nations. Continued monitoring of population-wide iodine status remains critically important and particular attention may need to be paid to monitoring the status of vulnerable groups such as pregnant women and infants. There is also a need for continued monitoring of the intake of iodised salt and other dietary sources of iodine such as milk and dairy in order to prevent not only insufficient but also excessive iodine intake.



References

1. Jooste PL, Zimmermann MB. Progress towards eliminating iodine deficiency in South Africa: Invited review. S Afr J Clin Nutr. 2008; 21(1):8-14.

2. Perrine CG, Sullivan KM, Flores R, Caldwell KL, Grummer-Strawn LM. Intakes of dairy products and dietary supplements are positively associated with iodine status among U.S. children. J Nutr. 2013; 143(7):1155-1160.

3. Bath SC, Button S, Rayman MP. Iodine concentration of organic and conventional milk: Implications for iodine intake. Br J Nutr. 2012; 107:935-940.

4. National Institutes of Health [internet]. Iodine: Fact sheet for health professionals. NIH. Available from: https://ods.od.nih.gov/factsheets/Iodine-HealthProfessional

5. Van der Reijden OL, Zimmermann MB, Galetti V. Iodine in dairy milk: Sources, concentrations and importance to human health. Metabolism. 2017; 31(4):385-395.

6. Association of UK Dietitians [internet]. Iodine facts. BDA. Available from: https://www.bda.uk.com/foodfacts/iodine_facts

7. Abraham GE, Flechas JD, Hakala JC. Orthoiodo-supplementation: Iodine sufficiency of the whole human body. Original Internist. 2002; 9:30-41.

8. Wright JV. Bio-identical steroid hormone replacement: Selected observations from 23 years of clinical and laboratory practice. Ann NY Acad Sci. 2005; 1057:506-524.

9. Abraham GE. The safe and effective implementation of orthoiodosupplementation in medical practice. Original Internist. 2004; 11(1):17-36.

10. Pearce EN, Andersson M, Zimmermann MB. Global iodine nutrition: Where do we stand in 2013? Thyroid. 2013; 23(5):1-6.

11. Zimmermann MB, Andersson M. Update on iodine status worldwide. Curr Opin Endocrinol Diabetes Obes. 2012; 19(5):382-387.

12. Harika R, Faber M, Samuel F, Kimiywe J, Mulugeta A, Eilander A. Micronutrient status and dietary intake of iron, vitamin A, iodine, folate and zinc in women of reproductive age and pregnant women in Ethiopia, Kenya, Nigeria and South Africa: A systematic review of data from 2005 to 2015. Nutrients. 2017; 9(10):e1096.

13. Santos JE, Kalk WJ, Freitas M, Carreira IM, Branco CM. Iodine deficiency and thyroid nodular pathology – epidemiological and cancer characteristics in different populations: Portugal and South Africa. BMC Res Notes. 2015; 8:284.

14. Bath S, Hill S, Infante H, Elghul S, Nezianya C, Rayman M. Iodine concentration of milk-alternative drinks available in the UK in comparison with cows' milk. Br J Nutr. 2017; 118(7):525-532

15. Bath SC, Rayman MP. A review of the iodine status of UK pregnant women and its implications for the offspring. Environ Geochem Health. 2015; 37(4):619-629.

16. Thomas BS, Bulbrook RD, Goodman MJ, et al. Thyroid function and the incidence of breast cancer in Hawaiian, British and Japanese women. Int J Cancer.1986; 38:325-329.

17. Przybylik-Mazurek E, Hubalewska-Dydejczyk A, Kuźniarz-Rymarz S, et al. Dietary patterns as risk factors of differentiated thyroid carcinoma. Postepy Hig Med Dosw. 2012; 66:11-15.

18. Thomassen RA, Kvammen JA, Eskerud MB, Júlíusson PB, Henriksen C, Rugtveit J. Iodine status and growth in 0-2-year-old infants with cow's milk protein allergy. J Pediatr Gastroenterol Nutr. 2017; 64(5):806-811.

19. Costa Leite J, Keating E, Pestana D, et al. Iodine status and iodised salt consumption in Portuguese school-aged children: The Iogeneration Study. Nutrients. 2017; 9(5):e458.

20. Pearce EN, Pino S, Bazrafshan HR, Lee SL, Braverman LE. Sources of dietary iodine: Bread, cows' milk, and infant formula in the Boston area. J Clin Endocrinol Metab. 2004; 89:3421-3424.

21. Dahl L, Opsahl JA, Meltzer HM, Julshamn K. Iodine concentration in Norwegian milk and dairy products. Br J Nutr. 2003; 90:679-685.

22. Van Ryssen JBJ, Van Malsen S, Van Blerk JG. The iodine content of fresh milk samples in Natal and the effect of iodiphor teat dips on milk iodine content. J S Afr Vet Assoc. 1985; 56:181-185.

23. World Health Organization [internet]. WHO issues new guidance on dietary salt and potassium. WHO. Available from: http://www.who.int/mediacentre/news/notes/2013/salt_potassium_20130131/en

24. Tayie FAK, Jourdan K. Hypertension, dietary salt restriction, and iodine deficiency among adults. Am J Hypertens. 2010; 23(10):1095-1102.

25. He FJ, Ma Y, Feng X, et al. Effect of salt reduction on iodine status assessed by 24 hour urinary iodine excretion in children and their families in northern China: A substudy of a cluster randomised controlled trial. BMJ Open. 2016; 6(9):e011168.

26. Lloyd M. Iodine allergy: A medical myth. Curr Allergy Clin Immunol. 2015; 28(2):112.

Please visit our website for more evidence-based reviews on dairy nutrition and health.
www.rediscoverdairy.co.za