

Institution: University of Surrey		
Unit of Assessment: 3 Allied Health Professions, Dentistry, Nursing and Pharmacy		
Title of case study: UK dietary sources of Iodine: Impact on product reformulation, policy and public awareness		
Period when the underpinning research was undertaken: 2009 – 2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Prof Margaret Rayman	Professor of Nutritional Medicine	September 1997 – present
Dr Sarah Bath	Lecturer in Public Health Nutrition	June 2013 – present
Period when the claimed impact occurred: Aug 2013 – Dec 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words) We showed an association between mild-to-moderate iodine deficiency in pregnancy and lower child cognition. We identified milk as the principal determinant of iodine status hence recent dietary shifts towards organic milk/milk-alternative drinks which have significantly lower iodine content are problematic. As a result of our work: – the iodine content of the market-leading pregnancy supplement has been increased; – market-leading milk-alternative drinks have been fortified with iodine; – the iodine content of organic milk has been increased; – policy has changed to monitor UK iodine status; – healthcare professionals have become aware of the importance of iodine through the information we have provided on dietary iodine through media and resources.		
2. Underpinning research (indicative maximum 500 words) A major component of the thyroid hormones, iodine is vital for brain development, particularly in pregnancy. Women of childbearing age need to have adequate iodine status prior to and during pregnancy; however, data were lacking on the iodine status of the UK population. In studies between 2009 and 2011 we identified the presence of mild-to-moderate deficiency in pregnant women [for example 3.1] and mild deficiency in women of childbearing age [3.2]. Severe prenatal iodine deficiency is known to impair foetal brain development and may result in cretinism (Zimmermann 2009 <i>Endocr Rev</i> 30, 376-408). However, the effects of mild-to-moderate deficiency in pregnancy were less well known. Using data and samples from mother-child pairs in the Avon Longitudinal Study of Parents and Children (ALSPAC), we were the first to show that women with mild-to-moderate iodine deficiency (i.e., 67% of the cohort of 958 women) were more likely to have children with low verbal IQ, reading accuracy and comprehension at 8-9 years [3.3]. The Recommended Nutrient Intake (RNI) for iodine is 150 µg/day for adults and 250 µg/day for pregnant women. Many countries use the WHO-recommended approach of iodised salt to prevent population iodine deficiency; however, the UK has no such mandatory/voluntary policy. Although		

increased salt intake is discouraged, iodised salt can provide a non-animal source of iodine. We showed that iodised salt is not widely available in the UK [3.4] and that 96% of pregnant women rarely/never used it [3.1]. At the time, the main iodised-salt brand only provided 7.5% of the adult RNI per gram so it was unlikely to contribute meaningful quantities of iodine to the diet.

We found that milk intake was the strongest predictor of iodine status in our cohorts [3.1, 3.2]; data from the National Diet and Nutrition Survey (NDNS) shows that it provides 51% and 34% of total intake for children and adults, respectively. UK cows' milk is a good source of iodine owing to farming practices such as the use of iodine-supplemented cattle-feed for animal health and iodine-containing disinfectants in the dairy industry. However, some UK consumers prefer to buy less-intensively farmed produce, such as organic milk. We were the first to investigate the iodine concentration of organic milk in comparison with conventional milk. Our 2012 study analysed samples of organic and conventional milk purchased in 16 UK areas. The results caused concern to organic-milk producers as the iodine concentration of organic milk was only 58% of that of cows' milk [3.5].

More recently, shifts towards plant-based diets linked to environmental sustainability have increased sales of milk-alternative drinks. In 2015 we analysed the iodine concentration of 47 milk-alternative drinks (soya, almond, coconut, oat, rice, hazelnut and hemp) across 20 brands. Only one retail brand, not the market leader, was fortifying its soya, oat and rice drinks with iodine. The iodine concentration of the unfortified milk-alternative drinks (n=44) was extremely low, at just 1.7% of the value for conventional cows' milk [3.6]. This was of concern as the consumer shift towards these milk-alternatives is typically by young women of childbearing age, thus has the potential to increase their risk of iodine deficiency. Indeed, data from the National Diet and Nutrition Survey (NDNS; 2014-2017) showed that consumers of milk-alternatives had a significantly lower iodine intake than cows' milk consumers (median 94 vs 129 µg/day). Furthermore, with a significantly lower iodine status, consumers of milk-alternative drinks were classified as iodine-deficient by WHO criteria whereas milk consumers were iodine-sufficient (median urinary iodine concentration, 79 vs. 132 µg/L) [3.7].

3. References to the research (indicative maximum of six references)

- [3.1] Bath, S.C., Furmidge-Owen, V.L., Redman, C.W. and Rayman, M.P. (2015). Gestational changes in iodine status in a cohort study of pregnant women from the United Kingdom: season as an effect modifier. *The American Journal of Clinical Nutrition*, 101(6), pp.1180-1187. DOI: [10.3945/ajcn.114.105536](https://doi.org/10.3945/ajcn.114.105536)
- [3.2] Bath, S.C., Sleeth, M.L., McKenna, M., Walter, A., Taylor, A. and Rayman, M.P. (2014). Iodine intake and status of UK women of childbearing age recruited at the University of Surrey in the winter. *British Journal of Nutrition*, 112(10), pp.1715-1723. DOI: [10.1017/S0007114514002797](https://doi.org/10.1017/S0007114514002797).
- [3.3] Bath, S.C., Steer, C.D., Golding, J., Emmett, P. and Rayman, M.P. (2013). Effect of inadequate iodine status in UK pregnant women on cognitive outcomes in their children: results from the Avon Longitudinal Study of Parents and Children (ALSPAC). *The Lancet*, 382(9889), pp.331-337. DOI: [10.1016/S0140-6736\(13\)60436-5](https://doi.org/10.1016/S0140-6736(13)60436-5)
- [3.4] Bath, S.C., Button, S. and Rayman, M.P. (2014). Availability of iodised table salt in the UK – is it likely to influence population iodine intake? *Public Health Nutrition*, 17(2), pp.450-454. DOI: [10.1017/S1368980012005496](https://doi.org/10.1017/S1368980012005496)
- [3.5] Bath, S.C., Button, S. and Rayman, M.P. (2012). Iodine concentration of organic and conventional milk: implications for iodine intake. *British Journal of Nutrition*, 107(7), pp.935-940. DOI: [10.1017/S0007114511003059](https://doi.org/10.1017/S0007114511003059)
- [3.6] Bath, S.C., Hill, S., Infante, H.G., Elghul, S., Neziyanya, C.J. and Rayman, M.P. (2017). Iodine concentration of milk-alternative drinks available in the UK in comparison with

cows' milk. *British Journal of Nutrition*, 118(7), pp.525-532. DOI: [10.1017/S0007114517002136](https://doi.org/10.1017/S0007114517002136)

[3.7] Dineva, M., Rayman, M.P. and Bath, S.C. (2020). Iodine status of consumers of milk-alternative drinks v. cows' milk: Data from the UK National Diet and Nutrition Survey. *British Journal of Nutrition*, 1-9. DOI: [10.1017/S000711450003876](https://doi.org/10.1017/S000711450003876)

4. Details of the impact (indicative maximum 750 words)

Our research provided the first evidence of a significant association between mild-to-moderate iodine deficiency in UK pregnant women and poorer child cognition [3.3]. Inferior cognitive development can set children on a trajectory for poorer school attainment, examination grades and employment opportunities. Even a slight reduction in IQ affects population economic success and productivity (Jones & Schneider 2006, *J Econ Growth*; 11:71–93).

It is imperative that UK women of childbearing age maintain adequate iodine intake and that recent shifts towards consumption of organic milk or plant-based milk-alternatives do not have a detrimental effect on population iodine status. With the rise in popularity of plant-based/vegan diets, non-animal dietary sources, such as iodised salt, can also help.

Impact on product formulation of plant-based milk-alternatives

As a direct result of our research [3.6], the market leader, {Text removed for publication} [5.1]. Furthermore, following discussions with us [5.2], in November 2019, 'Oatly' started to fortify their oat drinks with iodine and in July 2020, added iodine to their yoghurt alternative. The fortified iodine content of {Text removed for publication} and Oatly drinks, at 22.5 µg/100ml, supplies 30% of the adult requirement per glass, thus providing non-dairy consumers with an iodine source. Iodine fortification by market leaders means that there is now increased accessibility to iodine-fortified milk; prior to our publication it was only available from Marks & Spencer. Since our research was published, Marks & Spencer have also increased the iodine concentration of their plant-based milk-alternatives to 30 µg/100ml and have extended it to the whole range. Furthermore, since September 2020, Asda has fortified its milk-alternative drinks, at 25-28 µg/100ml.

Beneficiaries: consumers of milk-alternative drinks; vegans.

Impact on policy and practices in organic dairy farming

As a result of our publication demonstrating lower iodine concentration in organic milk [3.5], the organic dairy industry became concerned, and in 2014 the Organic Milk Suppliers Co-operative (OMSCo) launched a farming project to increase the iodine content of organic milk. This resulted in an increase in iodine concentration of organic milk to a value close to that of conventional milk [5.3].

Beneficiaries: Producers and consumers of organic milk.

Impact on pregnancy supplements

Informed by our publication that showed that mild-to-moderate deficiency in pregnancy affected child cognition [3.3], {Text removed for publication} [5.4] and Wassen International changed the formulation of its Efalex "Mother and Baby" supplement [5.5] to incorporate 150 µg iodine.

Beneficiaries: Supplement manufacturers; women of childbearing age.

Impact on product formulation of iodised salt

Cerebos, until Nov 2019 the only UK brand of iodised salt, decided to increase the iodine concentration of its salt to 20 mg iodine/kg (previously low at 11.5 mg/kg) after consulting with us [5.6]. Also, based on evidence from our research that deficiency was a problem in the UK, British Salt has recently formulated a version of iodised salt for the UK market [5.7]. Its product, which contains 30 mg/kg, went on sale in October 2019; a 1g portion provides 20% of the adult RNI.

Beneficiaries: The public; vegans.

Policy change for monitoring of UK iodine status in the general population

Our research publications [3.3, 3.4, 3.5] contributed significantly to the evidence base for the Scientific Advisory Committee on Nutrition (SACN) report on iodine [5.8] which recommended that iodine should be monitored in the National Diet and Nutrition Survey (NDNS). As a result, the UK has been monitoring population iodine status, providing national data on adults and children to identify iodine deficiency and inform any future need for intervention. NDNS data are also used by the Global Iodine Scorecard to classify the status of the UK population (<https://www.ign.org/scorecard.htm>); this scorecard is used by WHO, UNICEF and the Iodine Global Network to track global progress on iodine status.

Beneficiaries: The public; policy makers

Increased awareness of iodine deficiency among the public and health professionals

To better inform health professionals and the public about the importance of dietary iodine, we have increased the information available through media, print resources and online materials. Results of our studies have raised awareness of the issue of iodine deficiency, particularly in pregnancy, through our personal or research contributions to various information resources [5.9] and through extensive media interviews and coverage [5.10]. This has enabled healthcare professionals (e.g., dietitians) to have a greater knowledge of iodine [5.9].

Beneficiaries: The public, particularly women of childbearing age; pregnant women; health professionals.

5. Sources to corroborate the impact (indicative maximum of 10 references)

[5.1] Testimonial from {Text removed for publication} (Confidential)

[5.2] Testimonial from Oatly (PDF)

[5.3] Press releases from OMSCO (PDF)

[5.4] Testimonial from {Text removed for publication} (Confidential)

[5.5] Efalex "Mother and Baby" product information sheet – citing our work (PDF)

[5.6] Testimonial from Premier Foods/Cerebos (PDF)

[5.7] Testimonial from British Salt (PDF)

[5.8] SACN statement on Iodine and Health (Feb 2014), citing our work. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/339439/SACN_Iodine_and_Health_2014.pdf

[5.9] Information resources

- a. Iodine Food Fact Sheet endorsed by the British Dietetic Association Available at: <https://www.bda.uk.com/uploads/assets/4097b9d9-1018-4dfe-aeee8d6b3205e08b/iodine-food-fact-sheet.pdf>
- b. The Infant and Toddler Forum included information on iodine in pregnancy in their Pregnancy Factsheet as a result of our work. Available at: https://infantandtoddlerforum.org/media/upload/pdf-downloads/Pregnancy_Factsheet_5.1.pdf
- c. Dairy UK produced a booklet on iodine in 2016 and cited our data; they received orders for 2138 booklets in 2017; (PDF)
- d. Our evidence on iodine has been used in health information sheets by First Steps Nutrition, <https://cutt.ly/swR0PzU>.

For dietitians/health professionals, we have produced information on iodine in: BNF Nutrition Bulletin, Nov 2013; Proceedings of the Nutrition Society, May 2013; Network Health Dietitians, May 2014; Dietetics Today Sept 2014; Complete Nutrition, April 2015 and January 2020.

[5.10] Media interviews and coverage:

- a. Prof Rayman presented a programme on BBC Radio 4, Awesome Iodine, 3 Jan & 5 Feb 2018, Available at: <https://www.bbc.co.uk/programmes/b09plrq0>
- b. Dr Giles Yeo, BBC 2, Trust me, I'm a doctor, 28 Nov 2018;
<https://www.bbc.co.uk/programmes/articles/TrHg6p9yCtBktCPztf7Kd6/can-i-go-vegan-and-stay-healthy>
- c. Jamie and Jimmy's Friday Night Feast, focusing on nutrient content of milk-alternatives 24 Jan 2019, Available at: <https://www.jamieoliver.com/features/pros-cons-plant-based-drinks/>