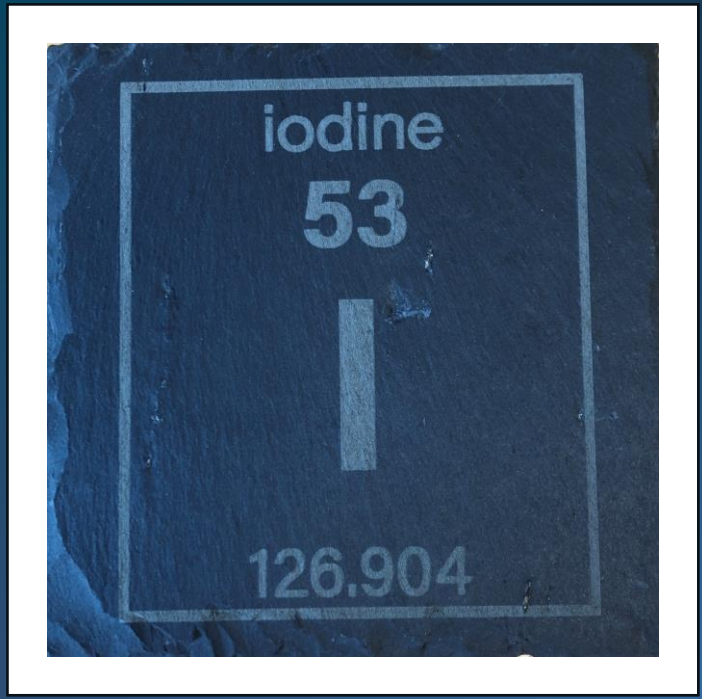
Iodine deficiency and the role of milk:

past, present and the future



Dr Sarah Bath

Senior Lecturer in Public Health Nutrition; Registered Dietitian

University of Surrey, UK

Key messages

Iodine is an overlooked but vital nutrient

Essential for thyroid function and brain development in early life

The UK and Ireland do not have salt iodisation policies

Milk and dairy products are the main source

Most milk alternatives are not iodine fortified

Iodine needs to be considered on plant-based diets

Past

Public-health policies

Present

Prevalence of deficiency

Reliance on milk

Future

Fortification

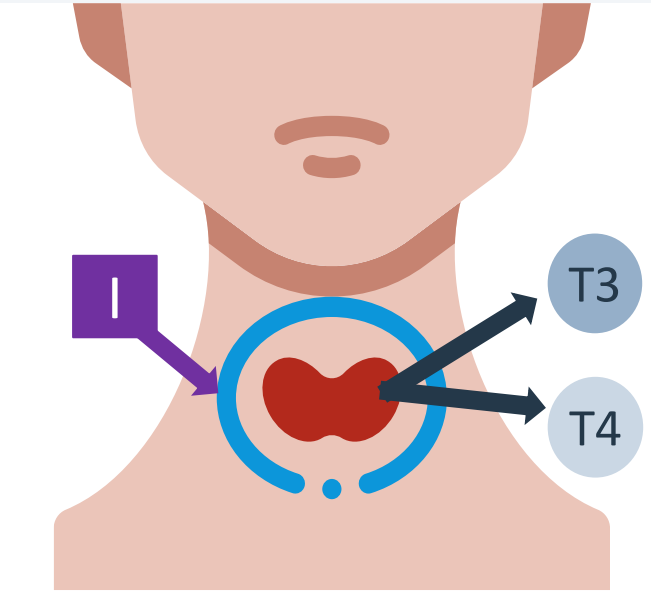
Education

UNIVERSITY OF SURREY

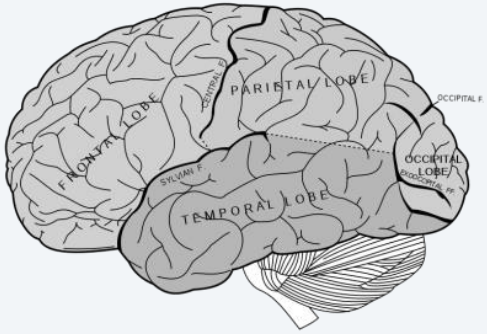
Past

Public health approach against
severe iodine deficiency

Role of iodine



Iodine deficiency



Severely iodine deficient populations

⬇

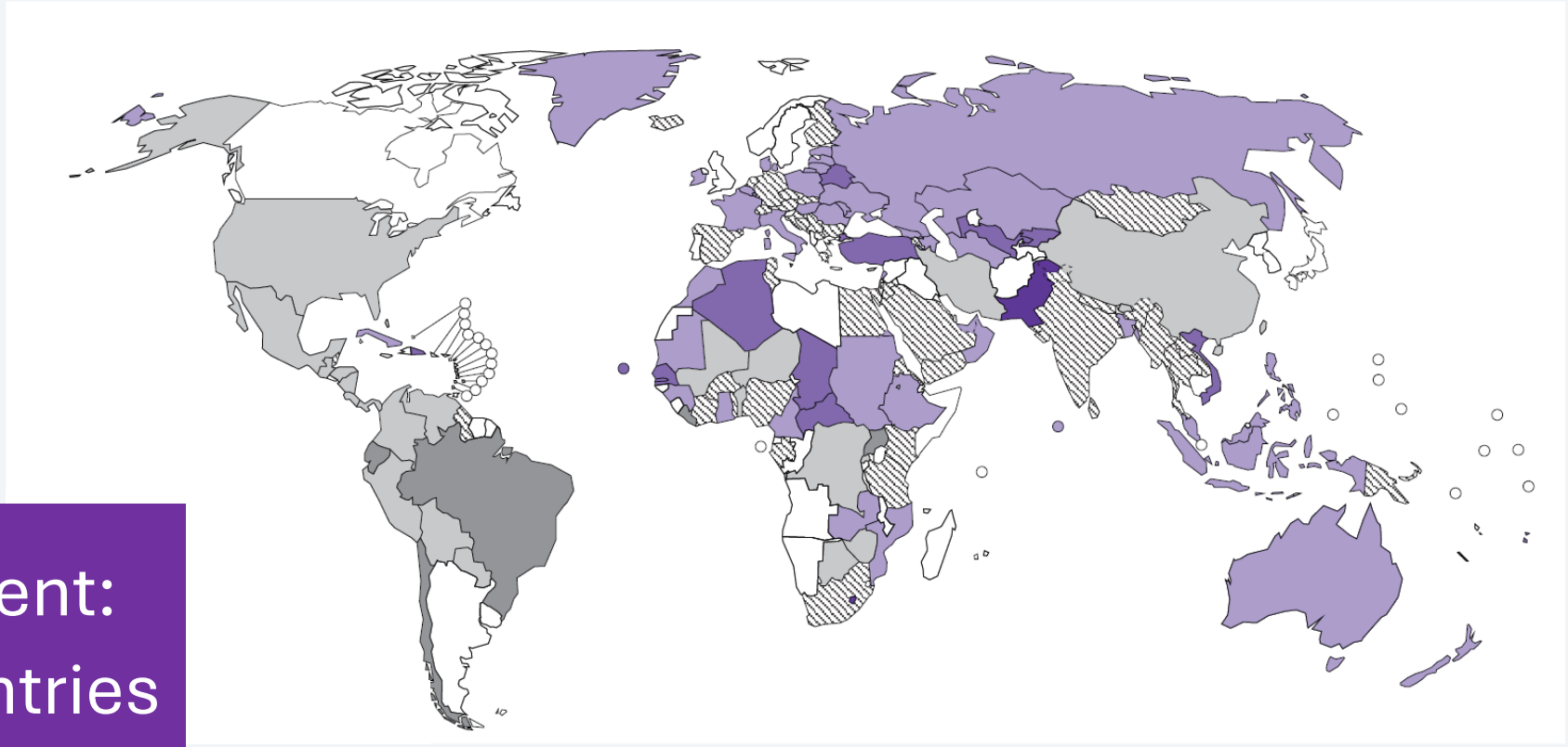
Mean IQ:
13.5 points lower than sufficient populations

Bleichrodt and Born 1994

"Iodine deficiency is the world's most prevalent, yet easily preventable, cause of brain damage"

Bath et al (2013) Lancet

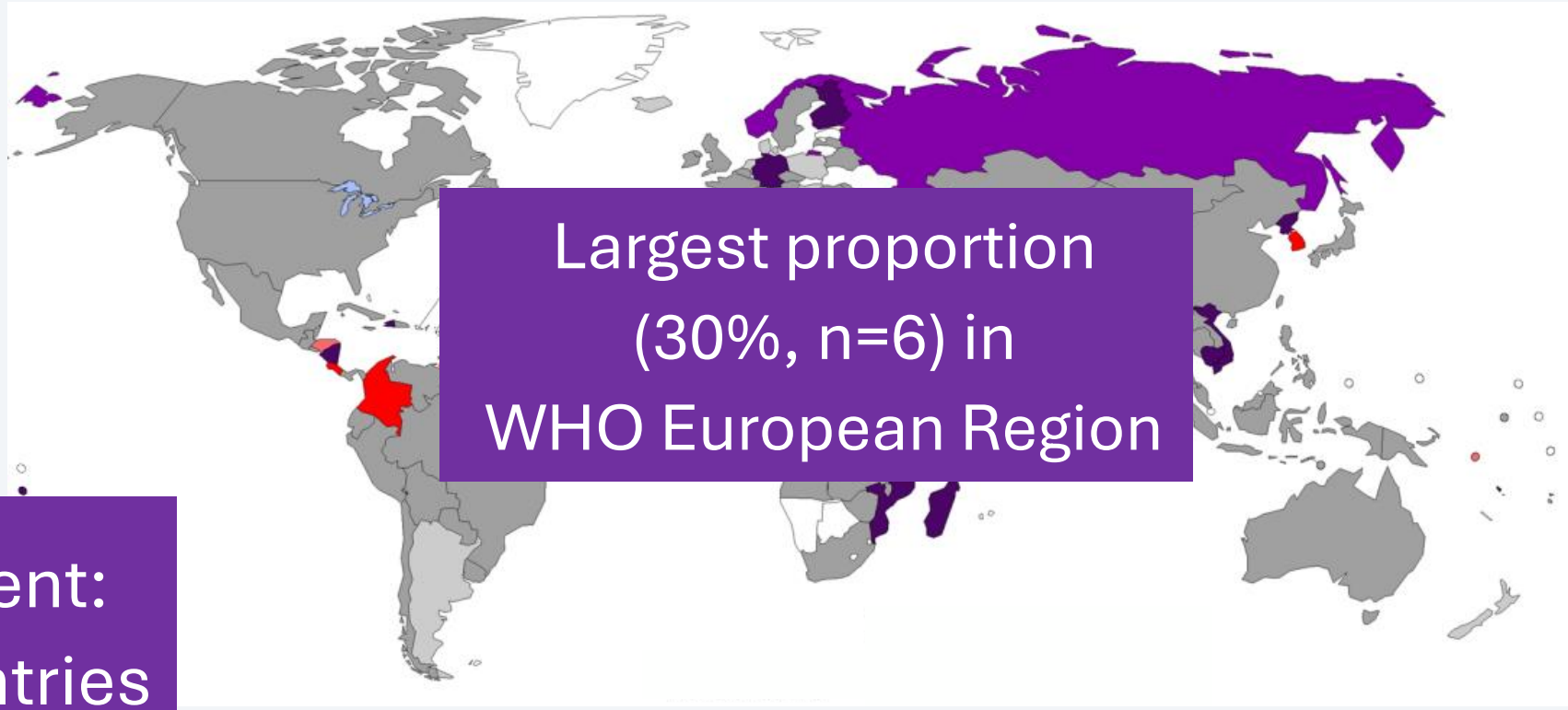
2003



Deficient:
54 countries

IGN Scorecard 2003

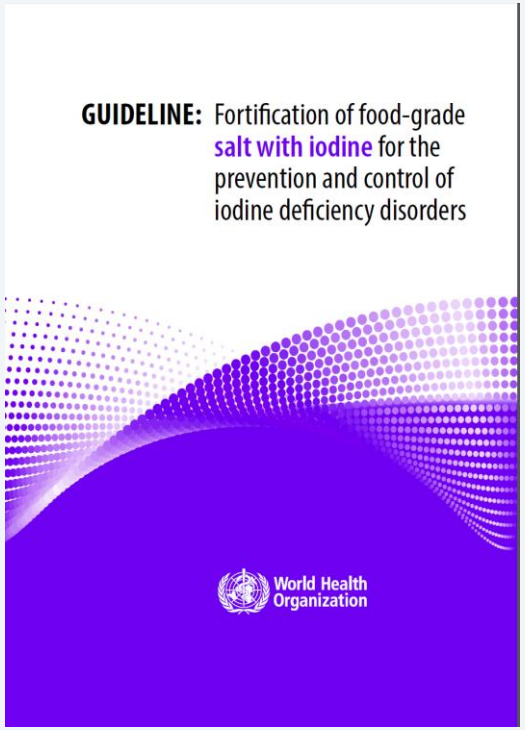
2021



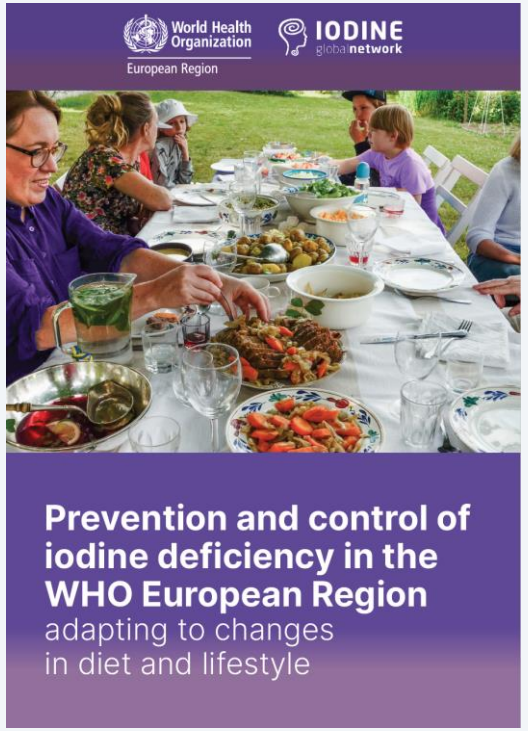
Largest proportion (30%, n=6) in WHO European Region

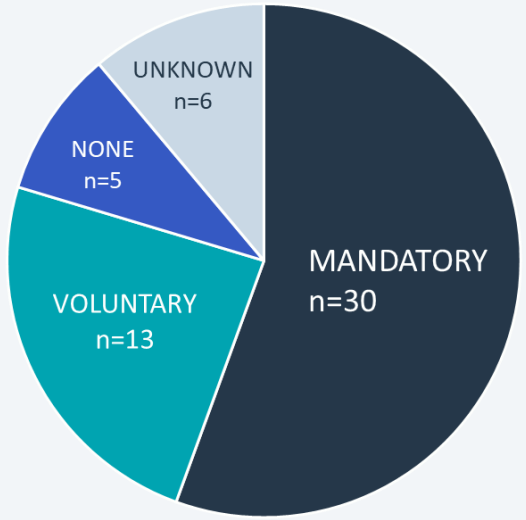
Deficient: 20 countries

Iodised salt – public health success



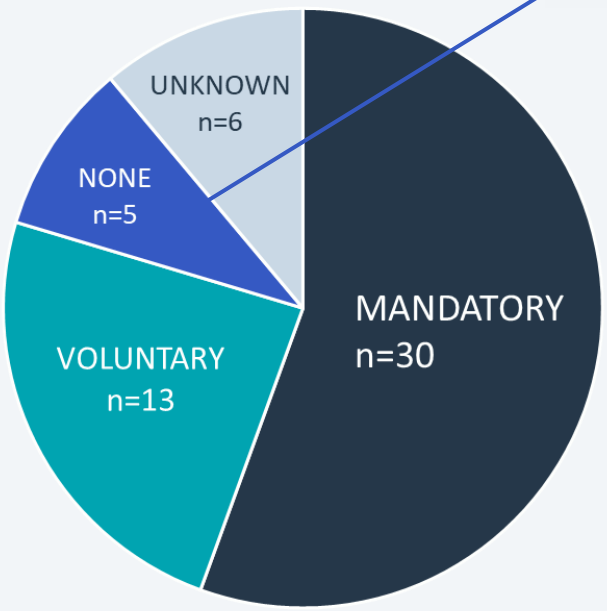
WHO recommended salt iodisation in all countries to control iodine deficiency





Mandatory salt iodisation in 55% of countries in WHO European region

Salt iodisation in the UK and Ireland



Public Health Nutrition: page 1 of 5 doi:10.1017/S1368980

Short Communication

Availability of iodised table salt in the UK – is it likely to influence population iodine intake?

Sarah C Bath, Suzanne Button and Margaret P Rayman*

European Journal of Clinical Nutrition
https://doi.org/10.1038/s41430-019-0518-6

BRIEF COMMUNICATION

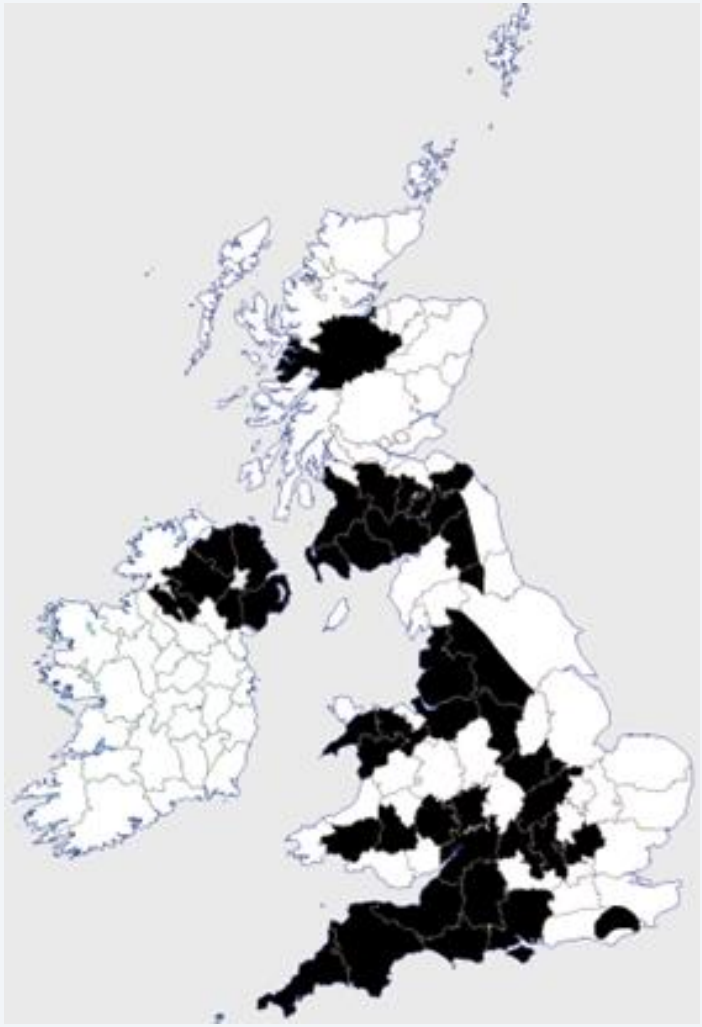
What is the availability of iodised salt in supermarkets on the Island of Ireland?

Mark Shaw[1] · Anne P. Nugent[2] · Breige A. McNulty[3] · Janette Walton[4] · Michaela McHugh[1] · Ashley Kane[1] · Aoibhin Moore Heslin[3] · Eoin Morrissey[4] · Karen Mullan[5] · Jayne V. Woodside[1]

12-20% availability in supermarkets

Not added to most processed foods

Goitre in the UK



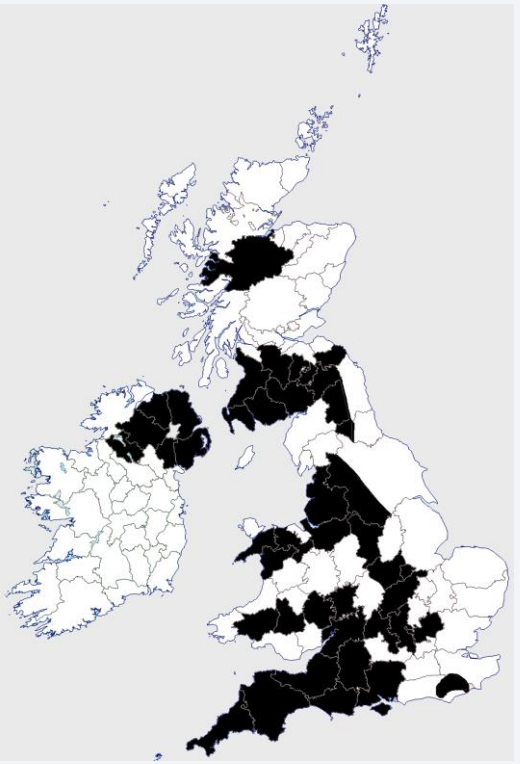
Map drawn with data from Kelly and Sneddon 1960 and Murray 1924

“Accidental public health triumph”

Journal of Epidemiology and Community Health 1997;51:391–393

Iodine, milk, and the elimination of endemic goitre in Britain: the story of an accidental public health triumph

D I W Phillips



Fortified cattle feed

Iodophor disinfectant

Milk Marketing Board

UNIVERSITY OF SURREY

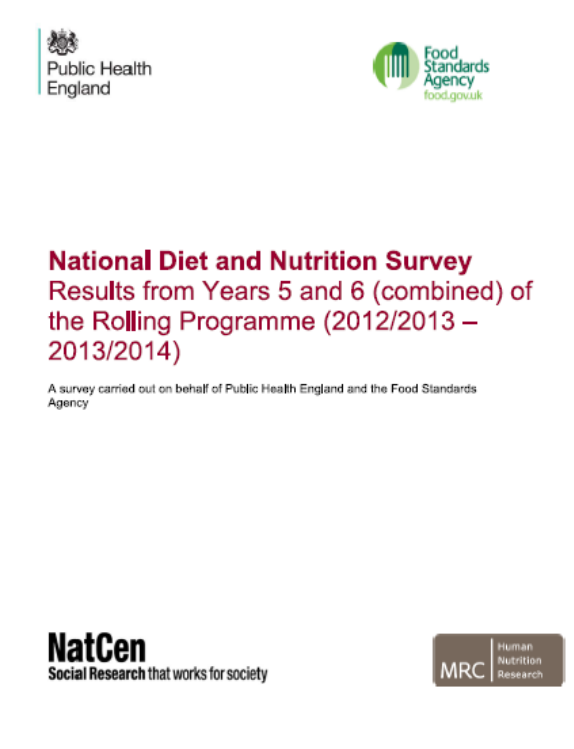
Present

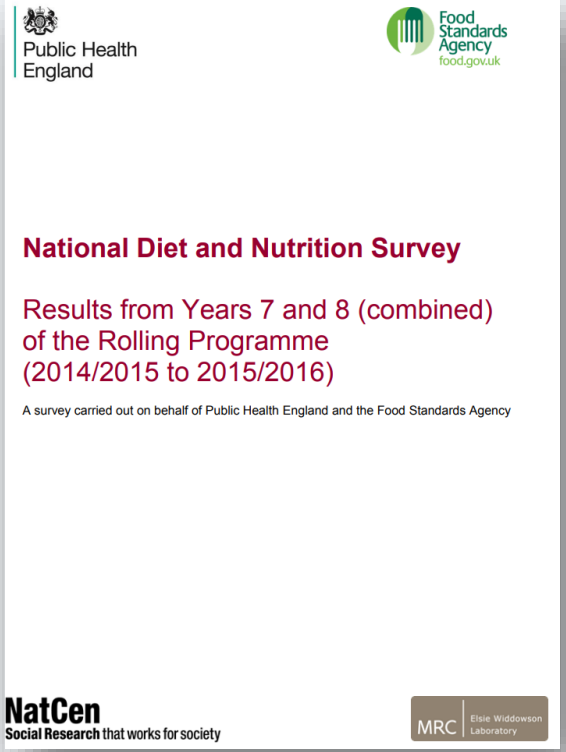
Prevalence of deficiency

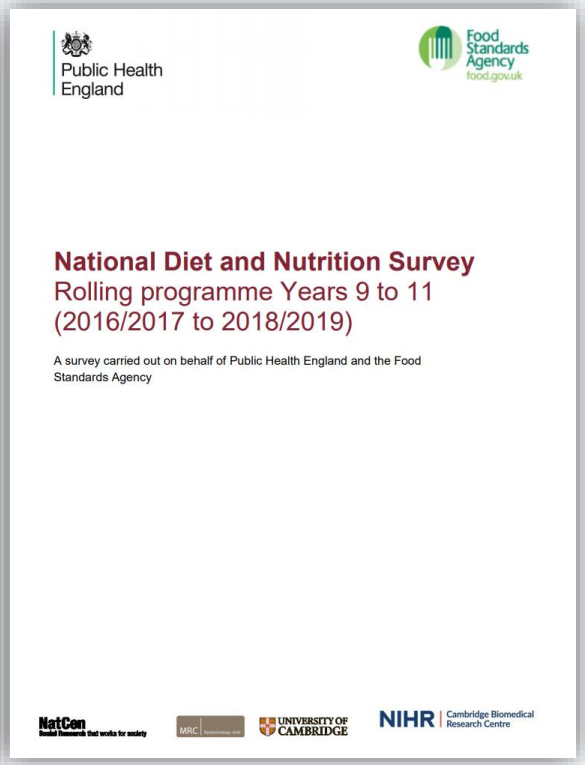
Changing diets

Reliance on milk

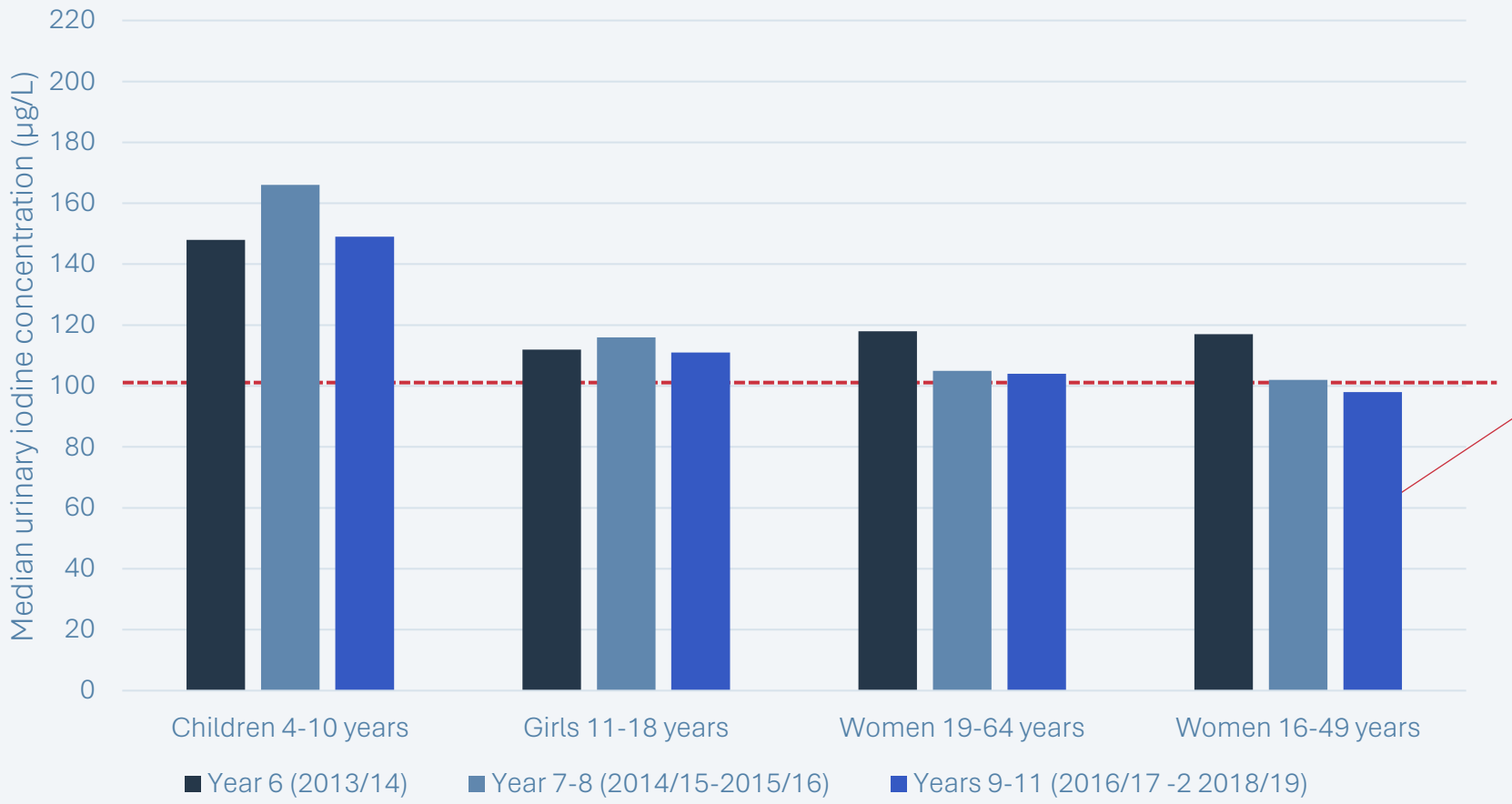
Monitoring in the UK 2013







Trend in iodine status in the UK



Women of childbearing age: now classified as iodine deficient

NDNS Years 9-11 Report

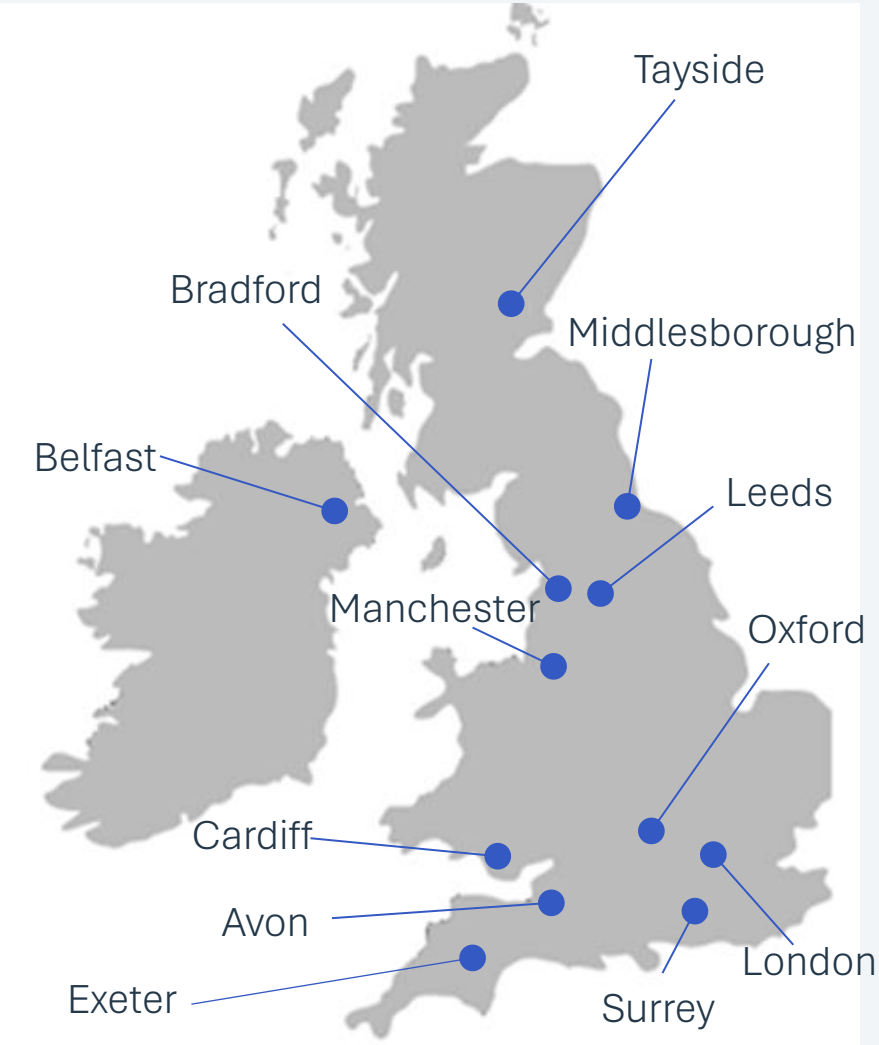
Vulnerable groups of population

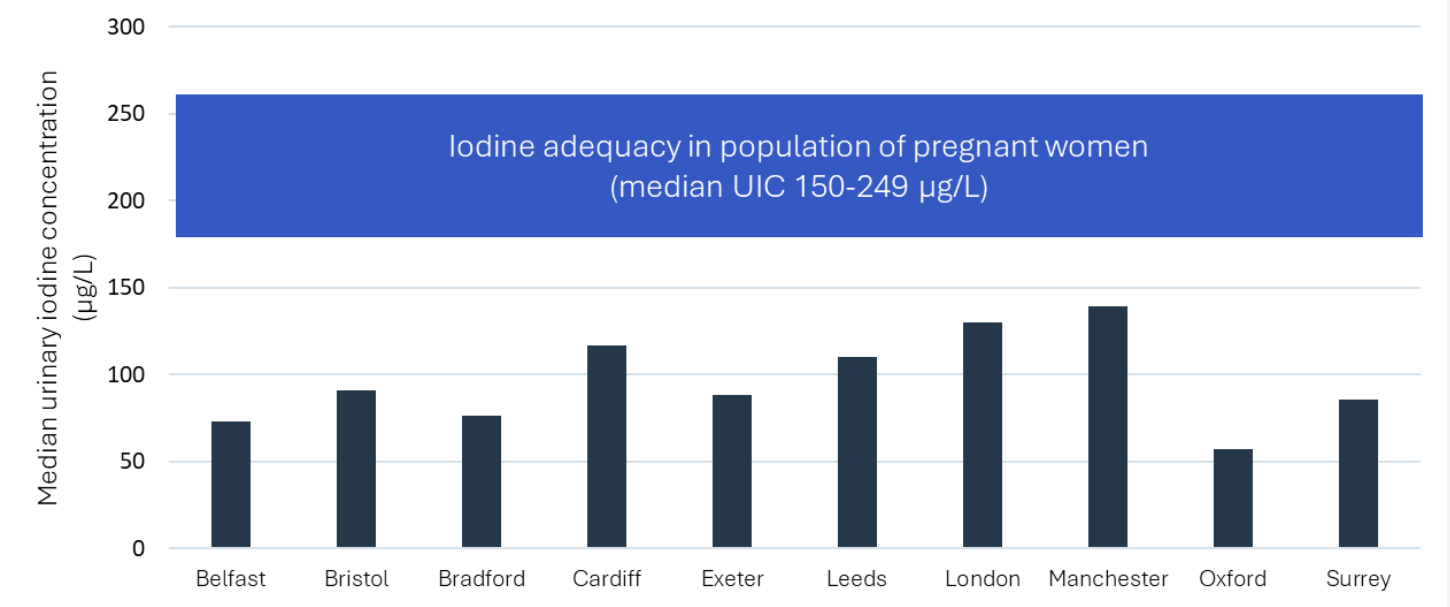
- Deficiency more likely in adults and pregnancy
  - Dietary sources more commonly consumed by children
- Requirements are higher in pregnancy and lactation
- Reflected in WHO but not UK Reference Nutrient Intake (RNI)

	WHO RNI (µg/d)	UK RNI (µg/d)
Adults	150	140
Pregnancy	250	140
Lactation	250	140

WHO 2007; Department of Health 1991

Iodine status in pregnant women

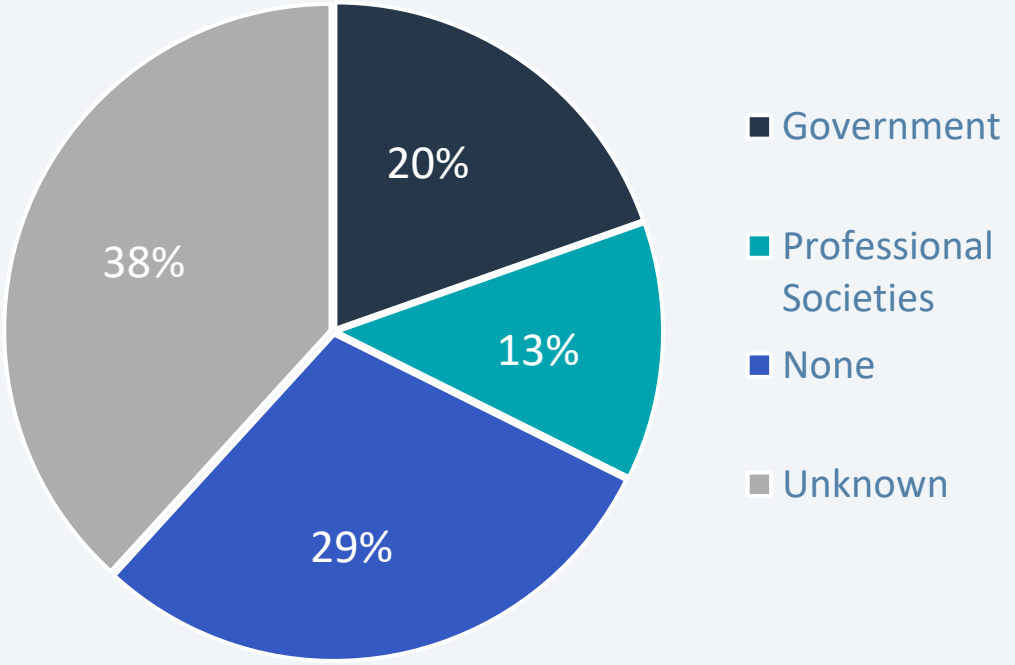




1. Barnett et al. 2002; 2. Kibirige MS et al. 2004; 3. Pearce et al 2010; 4. Bath et al 2013; 5 Bath et al 2014; 6. Bath et al 2015; 7. Knight et al. 2016; 8. Snart et al. 2019; 9. McMullen et al. 2019; Threapleton et al. 2020

Iodine supplementation in pregnancy

- National recommendations vary across European countries
  - Government recommendations in 20% (n=11)
- No recommendations in UK or Ireland
- Targeted (not blanket) supplementation policies may be needed



WHO Europe Report 2024

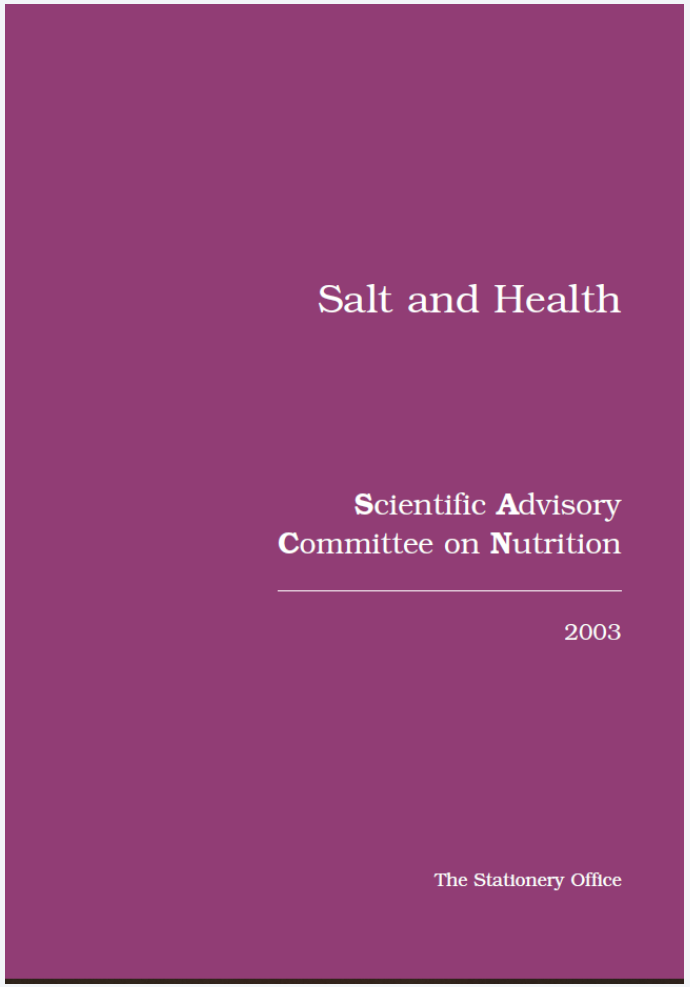
Present

Prevalence of deficiency

Changing diets

Reliance on milk

Salt reduction



UNIVERSAL SALT IODIZATION AND SODIUM INTAKE REDUCTION

COMPATIBLE, COST–EFFECTIVE STRATEGIES OF GREAT PUBLIC HEALTH BENEFIT

World Health Organization

INTRODUCTION

The United Nations Decade of Action on Nutrition aims to accelerate action to address malnutrition in all its forms, including conditions associated with undernutrition (wasting, stunting and micronutrient deficiencies) along with overweight, obesity and diet-related noncommunicable diseases (NCDs) *(1)*. This commitment will contribute to the achievement of the Sustainable Development Goals (SDGs), particularly Goals 2 (Zero Hunger) and 3 (Good Health and Well-Being). The coexistence of all forms of malnutrition is known as the double burden of malnutrition, and offers a unique opportunity for integrated nutrition action, or "double duty actions" (Box 1) *(2)*.

Box 1. Double Duty Actions

- Aim to simultaneously tackle both undernutrition (macro- and micro nutrient deficiencies) and problems of overweight, obesity and diet-related NCDs.
- Are based on the rationale that all forms of malnutrition share common drivers that can be leveraged for double impact. These drivers include nutrition in early life, diet diversity, food environments and socioeconomic factors.

The World Health Organization (WHO) promotes the implementation of programmes to reduce population dietary sodium intake as one of the cost-effective strategies to reduce the burden of NCDs, as well as Universal Salt Iodization (USI) to prevent and control iodine deficiency disorders (IDD). While the convergence of these policies is relevant in all age groups, it is particularly critical for women's health, as their babies may suffer the effects of maternal iodine deficiency and women themselves are prone to elevated blood pressure and its consequences.

This brief outlines why and how policies for USI to eliminate IDD and the reduction of dietary sodium intake to prevent and control raised blood pressure – and, in turn, the risk of cardiovascular diseases (CVDs) – are compatible and cost-effective. It calls upon policy-makers, academics and programme managers to bring together the salt fortification and sodium reduction communities to develop and implement double-duty sodium-related policies and actions, which have the potential to deliver significant public health benefit.

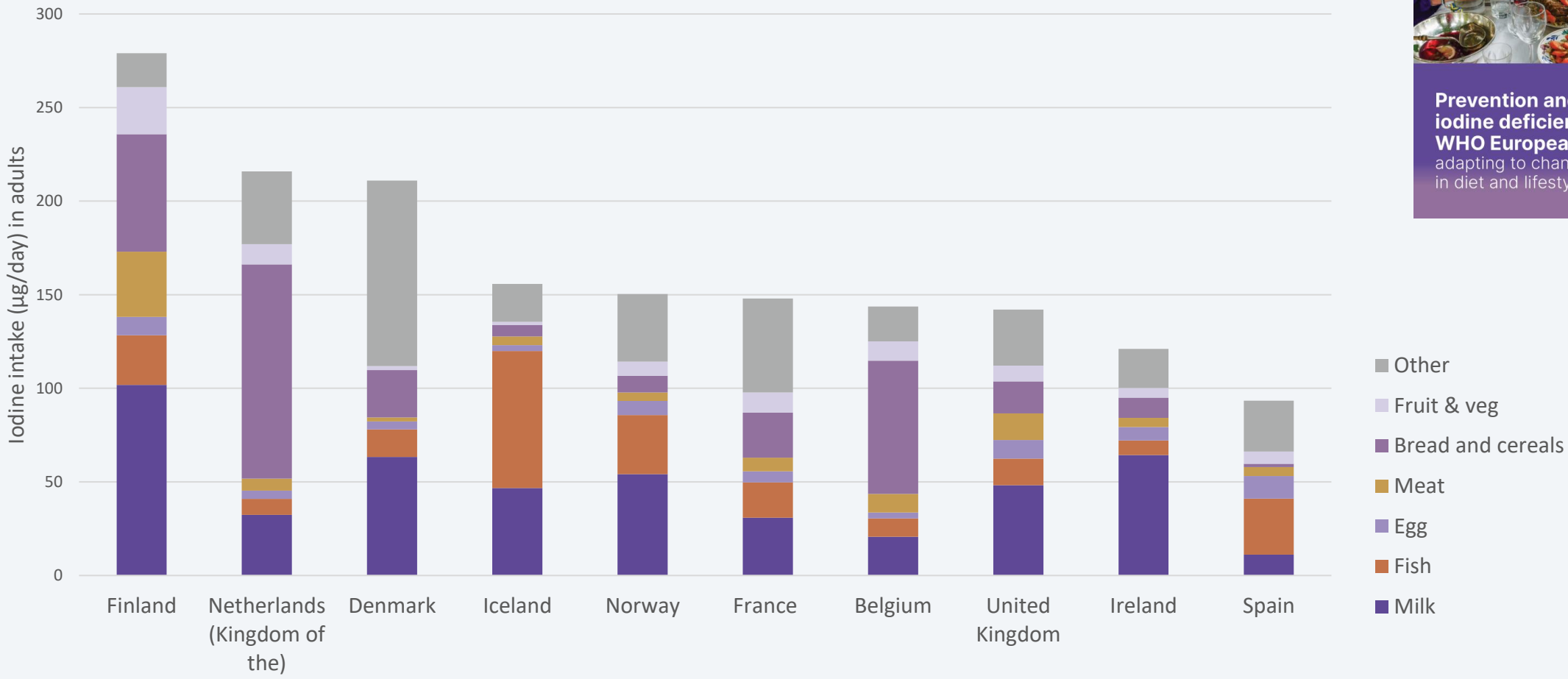
SODIUM REDUCTION

WHO recommends a daily sodium intake among adults of less than 2 g (equivalent to 5 g or a teaspoon of salt). For children, the level of intake should be adjusted downward based on their energy requirements according to age *(3)*. The current estimated global average sodium intake in adult populations is 3.89 g to 4.01 g per day. This is equivalent to 9.88 g to 10.21 g of salt per day, which is almost twice the recommended intake *(4)*. Excessive consumption of

WHO recommends a sodium intake of less than **2 grams/day** (equivalent to 5 g, or a teaspoon of salt)

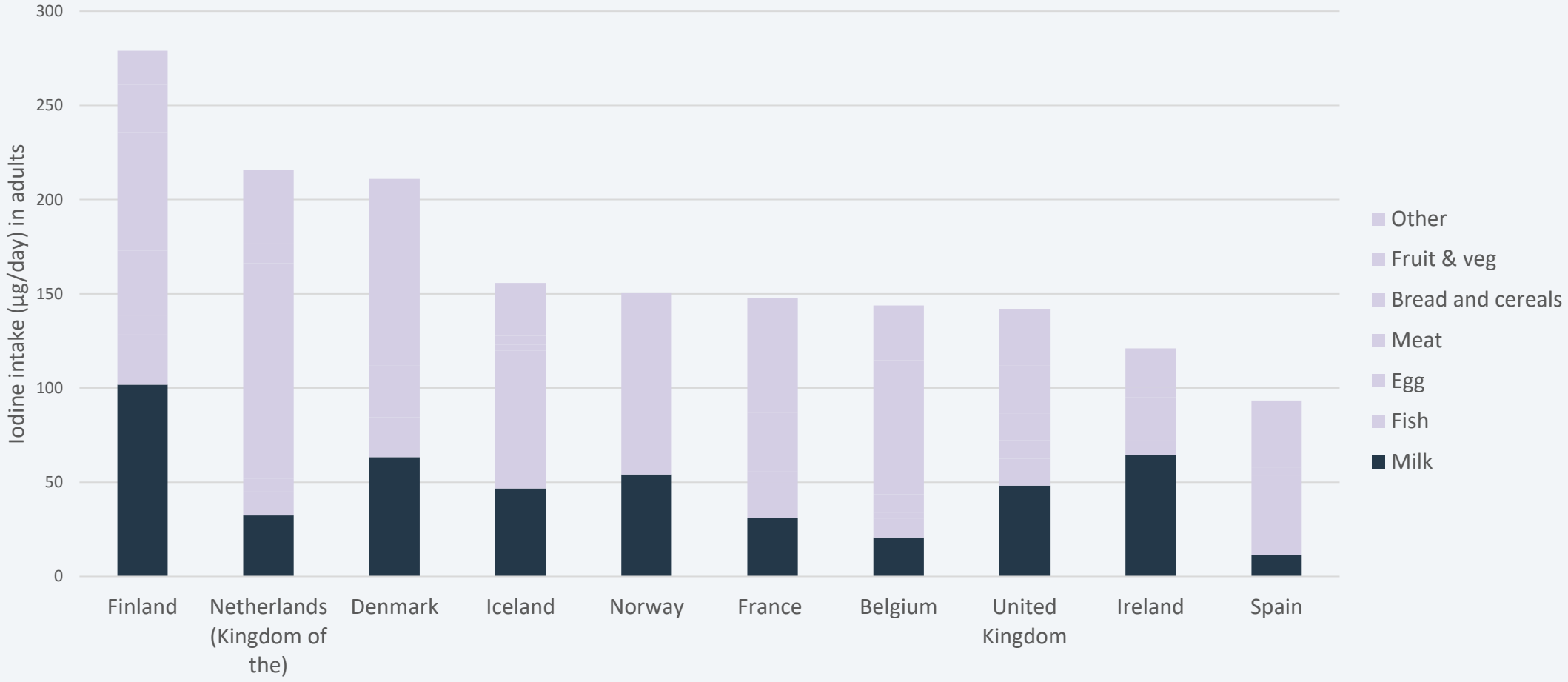
1

Food sources of iodine in Europe



Data source: Bath et al. 2022 Nutr Revs

Food sources of iodine in Europe



Data source: Bath et al. 2022 Nutr Revs

Food sources of iodine in Europe

Milk and dairy

Fish

Egg

Fortified bread

Animal-source foods provide up to 80% of intake in adults in some countries

Figure source: authors of WHO report 2024. Data source: Bath et al. 2022 Nutr Revs

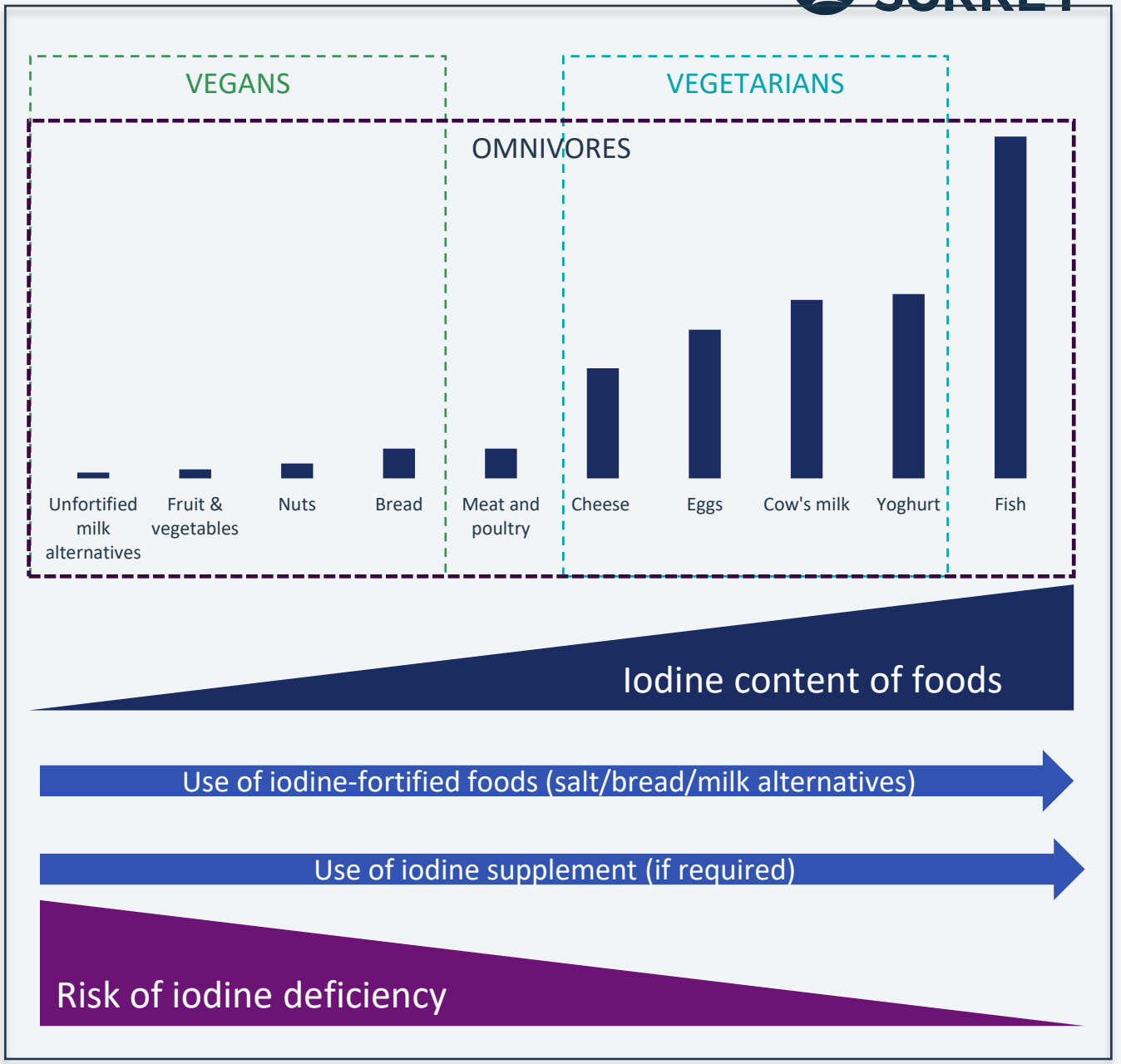
nature reviews endocrinology
https://doi.org/10.1038/s41574-024-00983-z

Review article
Check for updates

Thyroid function and iodine intake: global recommendations and relevant dietary trends

Sarah C. Bath

Changing diets: risk of iodine deficiency



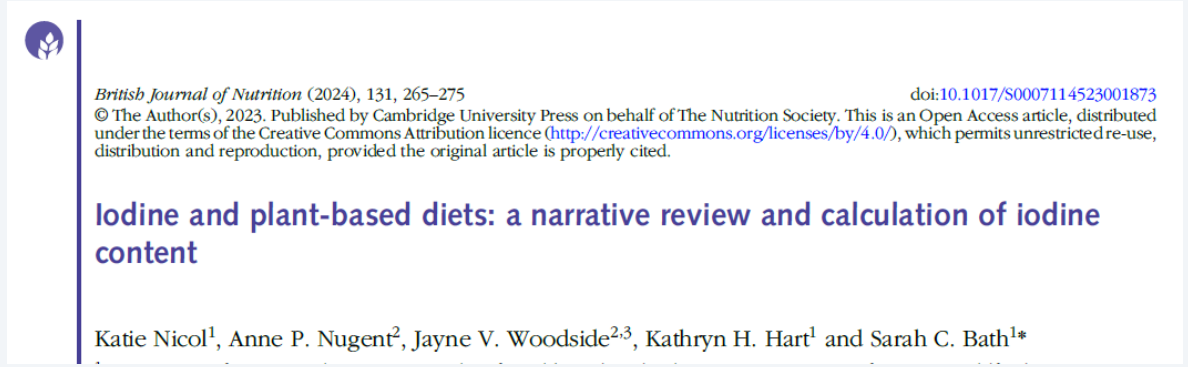
Bath 2024; Nature Reviews Endocrinology

Plant-based guidelines

The Lancet Commissions

Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems

Walter Willett, Johan Rockström, Brent Loken, Marco Springmann, Tim Lang, Sonja Vermeulen, Tara Garnett, David Tilman, Fabrice DeClerck, Amanda Wood, Malin Jonell, Michael Clark, Line J Gordon, Jessica Fanzo, Corinna Hawkes, Rami Zurayk, Juan A Rivera, Wim De Vries, Lindiwe Majele Sibanda, Ashkan Afshin, Abhishek Chaudhary, Mario Herrero, Rina Agustina, Francesco Branca, Anna Lartey, Shenggen Fan, Beatrice Crona, Elizabeth Fox, Victoria Bignet, Max Troell, Therese Lindahl, Sudhvir Singh, Sarah E Cornell, K Srinath Reddy, Sunita Narain, Sania Nishtar, Christopher J L Murray

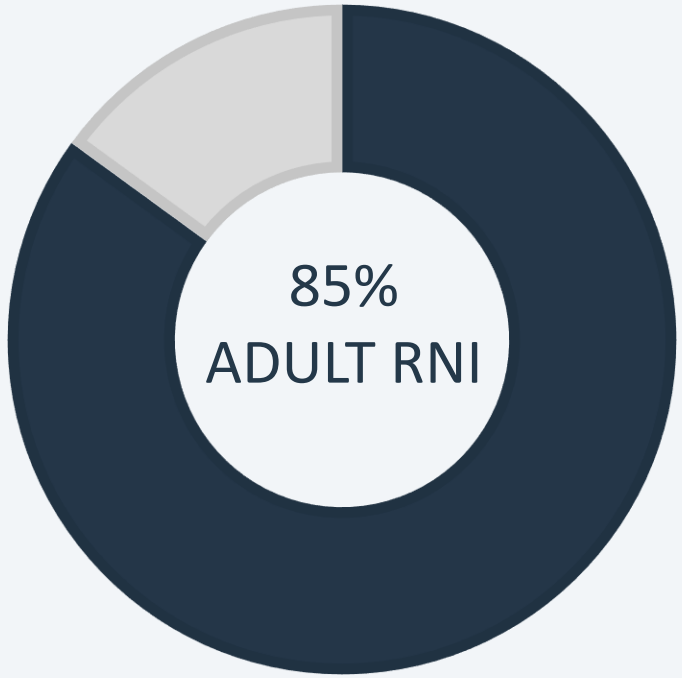


British Journal of Nutrition (2024), 131, 265–275 doi:10.1017/S0007114523001873

Iodine and plant-based diets: a narrative review and calculation of iodine content

Katie Nicol[1], Anne P. Nugent[2], Jayne V. Woodside[2,3], Kathryn H. Hart[1] and Sarah C. Bath[1]*

UK: EAT Lancet diet = 128 µg/d



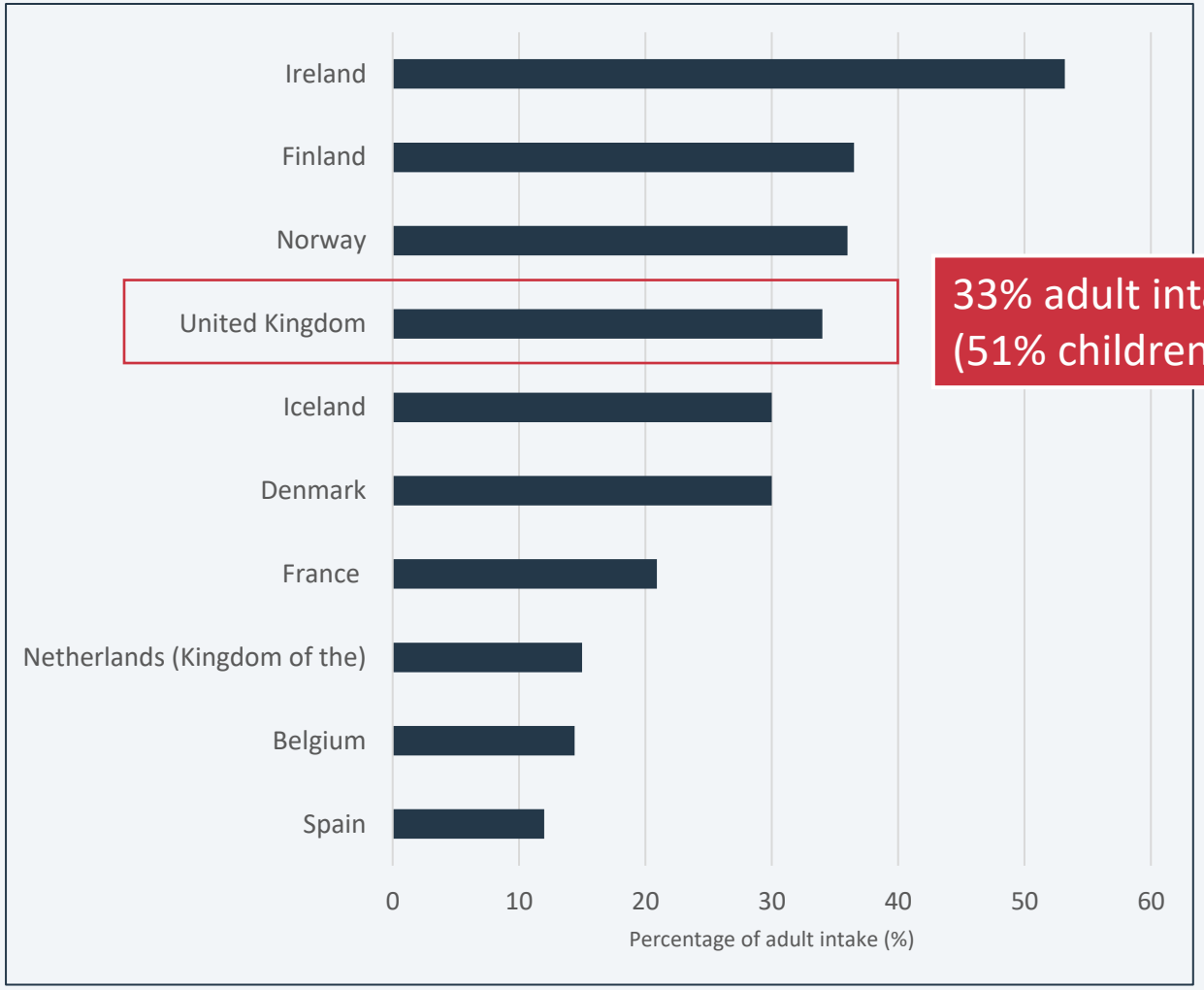
Present

Prevalence of deficiency

Changing diets

Reliance on milk

Percentage of adult iodine intake from milk and dairy products



Data source: Bath et al. 2022 Nutr Revs

UK and Irish milk is high in iodine

Data from 2024 systematic review (Tattersall et al 2024); milk data from year-round, conventional milk samples only

Milk and iodine

Iodine, milk, and the elimination of endemic goitre in Britain: the story of an accidental public health triumph

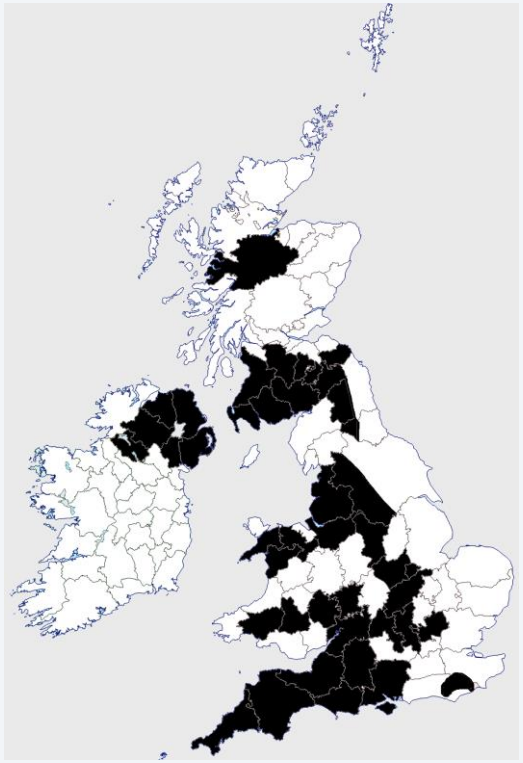
D I W Phillips

REVIEW ARTICLE

WILEY

Iodine status in UK–An accidental public health triumph gone sour

Jayne V. Woodside[1] | Karen R. Mullan[2]

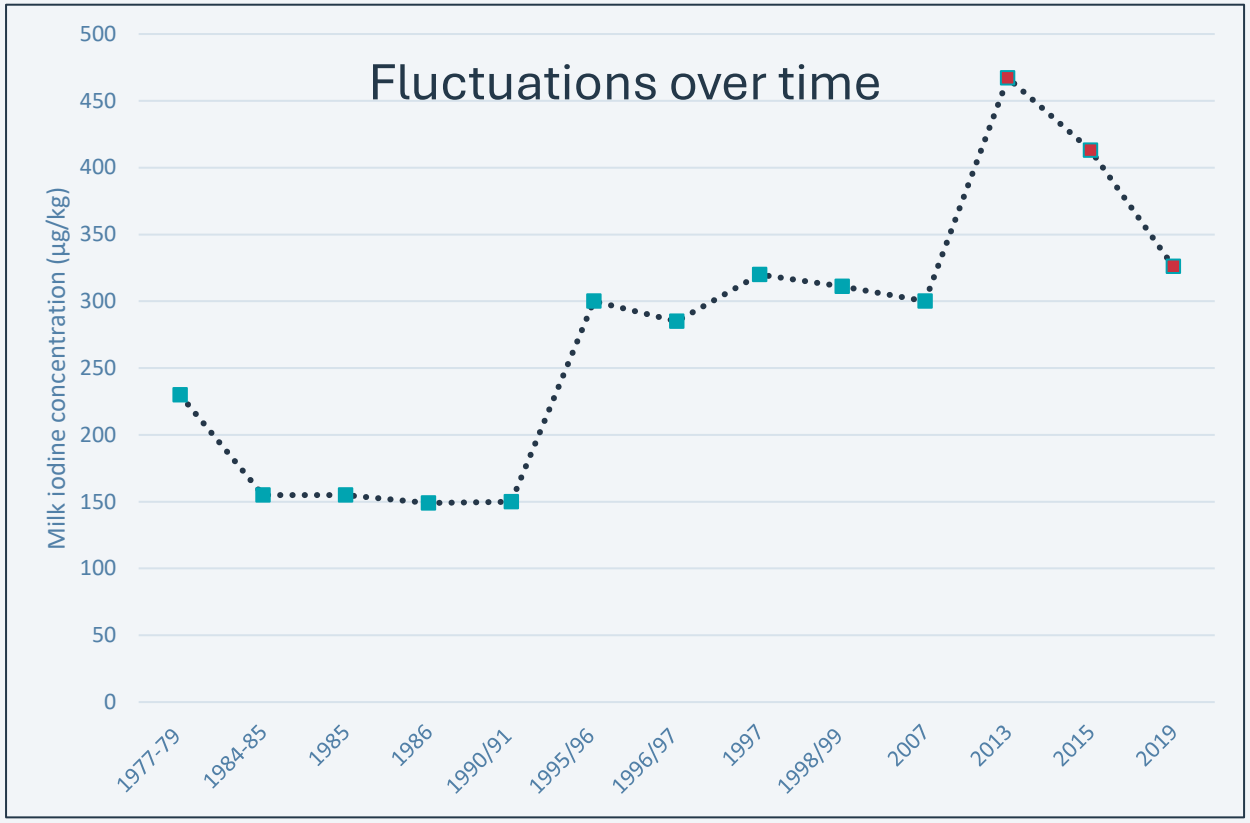


UK iodine intake is vulnerable to changes in:

1. milk-iodine concentration
2. milk consumption

Phillips (1997); Woodside & Mullan (2020)

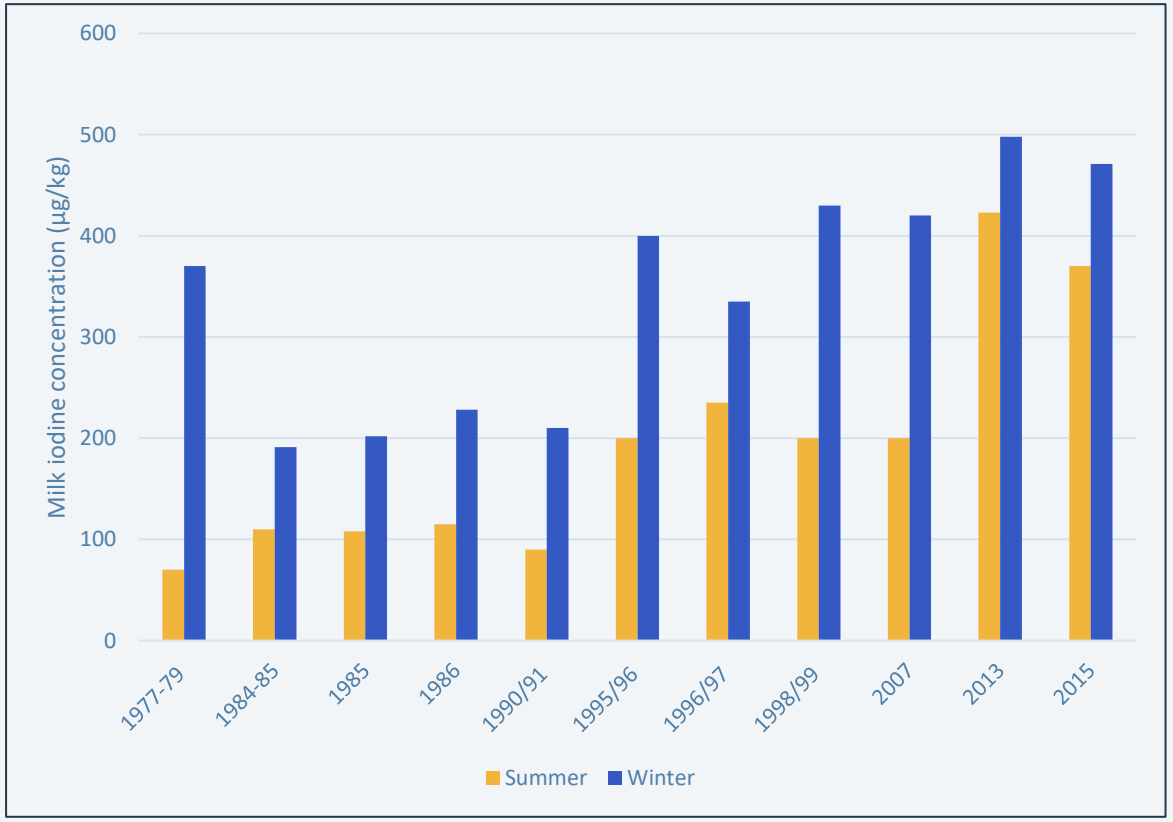
Changes in UK milk-iodine concentration



Studies of retail milk; red dots: research studies

Drawn from data in Bath & Stewart chapter in “Iodophor” book 2020

Effect of season on milk-iodine concentration



Food Chemistry 459 (2024) 140388

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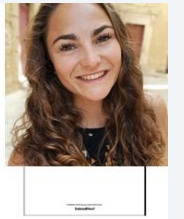
journal homepage: www.elsevier.com/locate/foodchem



Review

Variation in milk-iodine concentration around the world: a systematic review and meta-analysis of the difference between season and dairy-production system

(a)

Study or Subgroup	Summer µg/100g Mean [µg/100g]	SD [µg/100g]	Total	Winter µg/100g Mean [µg/100g]	SD [µg/100g]	Total	Weight	Mean Difference IV, Random, 95% CI
Bosnia and Herzegovina, Crnkić et al. 2015	5.1	5.1	40	8.4	8.8	50	4.7%	-3.30 [-6.21, -0.39]
Denmark (Conventional), Rasmussen et al. 2014	12	1	20	13	1	22	4.8%	-1.00 [-1.61, -0.39]
Denmark (Organic), Rasmussen et al. 2014	8	2	21	13	4	26	4.8%	-5.00 [-6.76, -3.24]
Latvia, Neimane et al. 2017	45.4	15.7	11	54.5	31.9	11	1.8%	-9.10 [-30.11, 11.91]
Netherlands(Conventional), van de Kamp et al. 2019	14.2	3.9	8	18.1	3.9	8	4.6%	-3.90 [-7.72, -0.08]
Netherlands (Organic), van de Kamp et al. 2019	10.3	6	8	16.5	2.1	8	4.5%	-6.20 [-10.61, -1.79]
Norway								
Norway								
Norway								
Republi								
Slovaki								
South A								
Spain,								
Spain (								
Switzeri								
UK: Eng								
UK: Eng								
UK: Eng								
UK: Eng								
UK: Eng								
UK: NI (Conventional), O'Kane et al. 2018	42.3	4.9	15	49.8	3.1	12	4.7%	-7.50 [-10.54, -4.46]
URo Tanzania, Ams-Glaser et al. 2021	23.2	13.3	70	25	14	86	4.5%	-1.80 [-6.10, 2.50]
USA (Conventional), Sakai et al. 2022	60	42.6	34	38.6	15.1	34	2.6%	21.40 [6.21, 36.59]
USA (Organic), Sakai et al. 2022	26.5	16.3	49	40.8	36.2	49	3.3%	-14.30 [-25.42, -3.18]
Total (95% CI)			1145			1350	100.0%	-5.97 [-9.57, -2.37]

Heterogeneity: Tau² = 69.71; Chi² = 1176.20, df = 23 (P < 0.00001); I² = 98%
Test for overall effect: Z = 3.25 (P = 0.001)

Mean Difference IV, Random, 95% CI

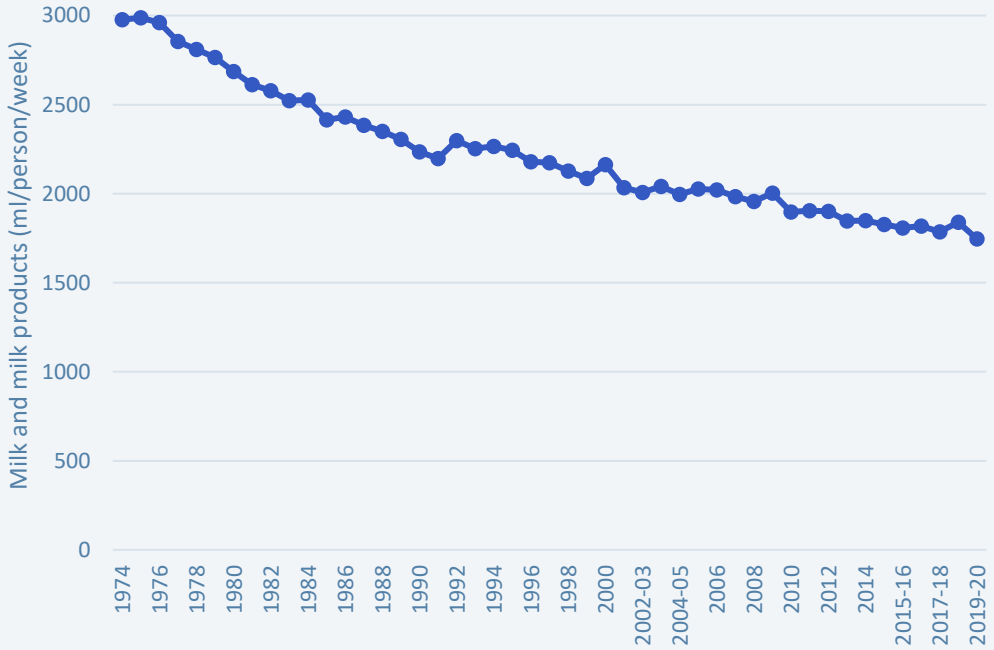
-20 -10 0 10 20
Higher MIC in Winter Higher MIC in Summer

Overall: higher in winter milk

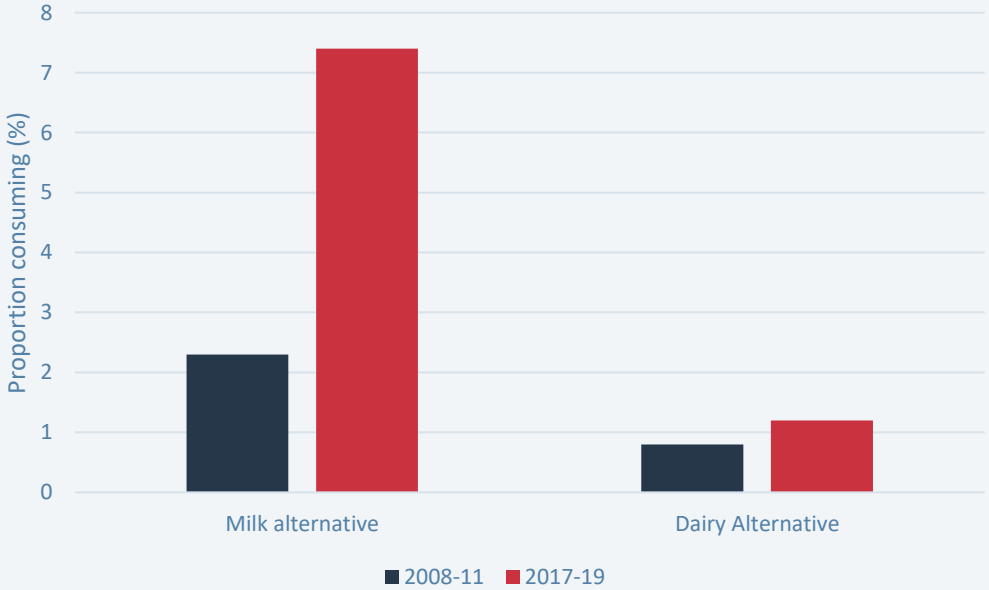
Difference: 59.7 µg/kg
(95% CI 2.37, 9.57, p = 0.001)

Changes in milk consumption

Milk consumption trend since 1970s in the UK

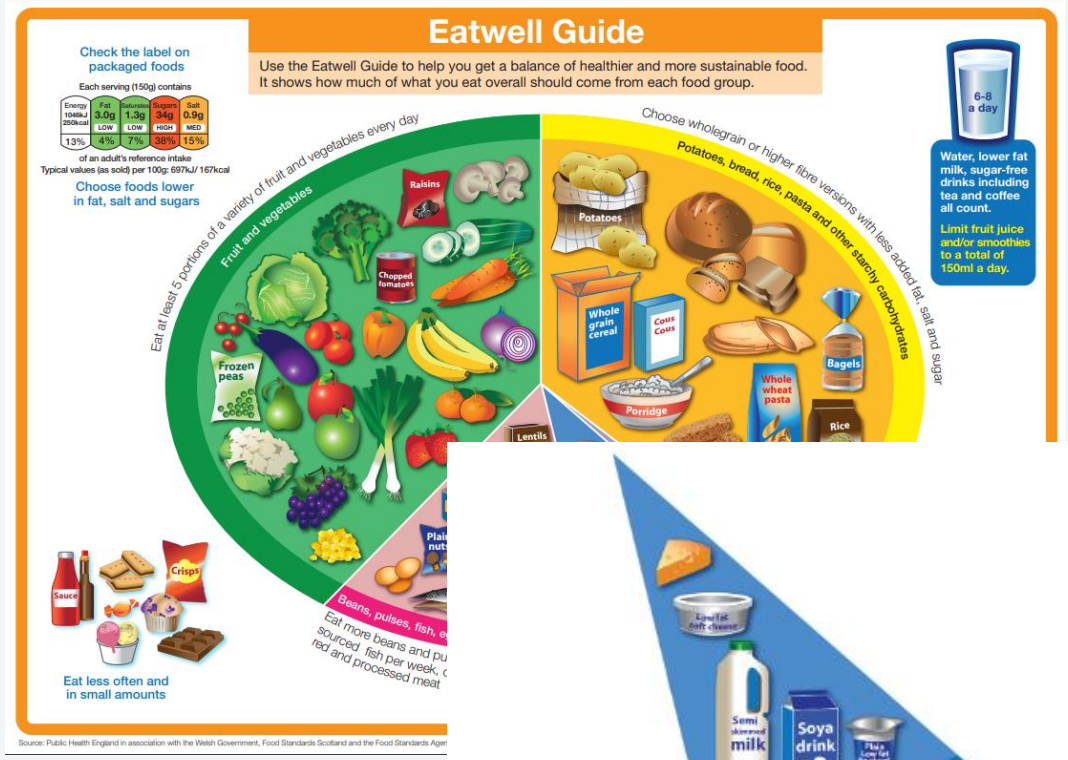


Plant-based alternatives trend since 2008 in the UK



1. National Food Survey (1942-2000) & Family Food Survey from 2002; 2. Alae-Carew et al 2022

Iodine and milk alternatives



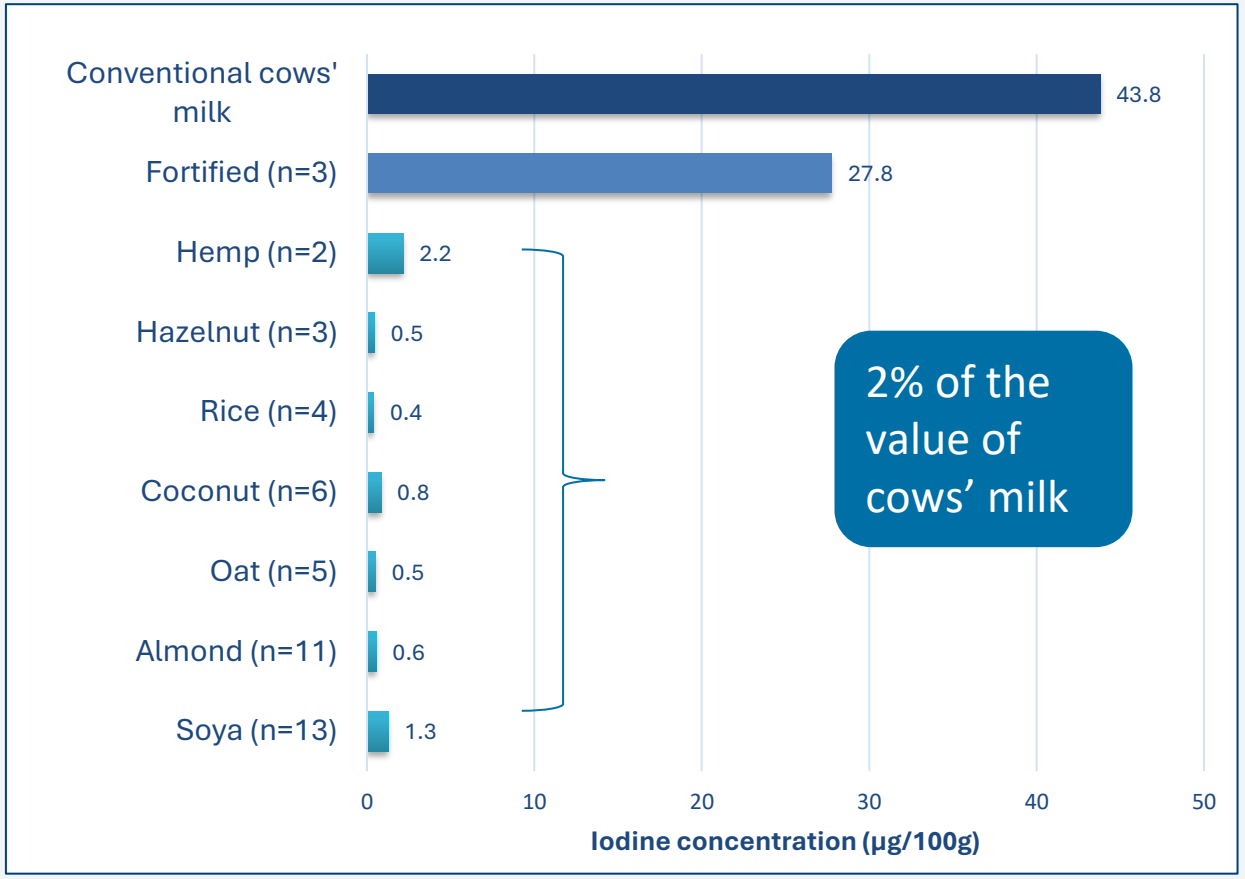
Have some dairy or dairy alternatives (such as soya drinks and yoghurts)

Iodine and milk alternatives

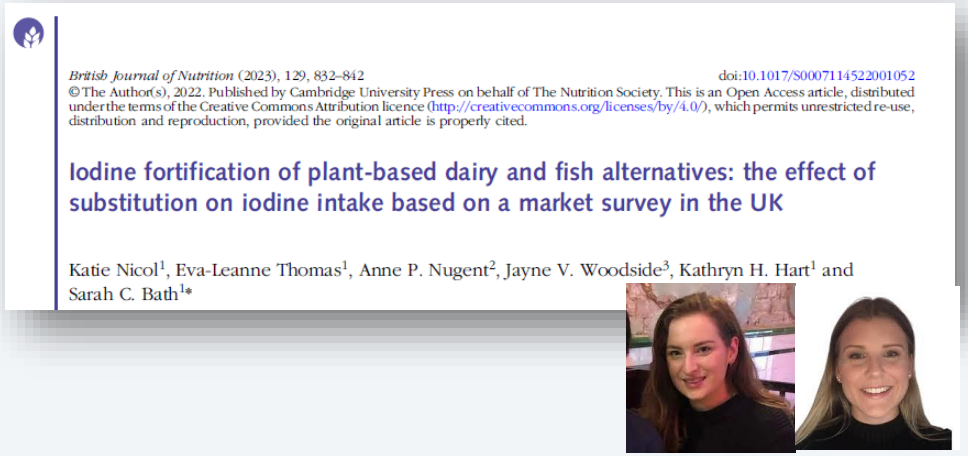
British Journal of Nutrition, page 1 of 8 doi:10.1017/S000711
© The Authors 2017

Iodine concentration of milk-alternative drinks available in the UK in comparison with cows' milk

Sarah C. Bath[1], Sarah Hill[2], Heidi Goenaga Infante[2], Sarah Elghul[1], Carolina J. Nezianya[1] and Margaret P. Rayman[1]*



Fortification of dairy alternatives

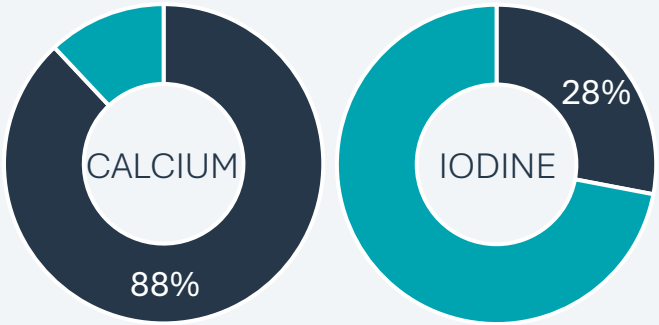

British Journal of Nutrition (2023), 129, 832–842 doi:10.1017/S0007114522001052

Iodine fortification of plant-based dairy and fish alternatives: the effect of substitution on iodine intake based on a market survey in the UK

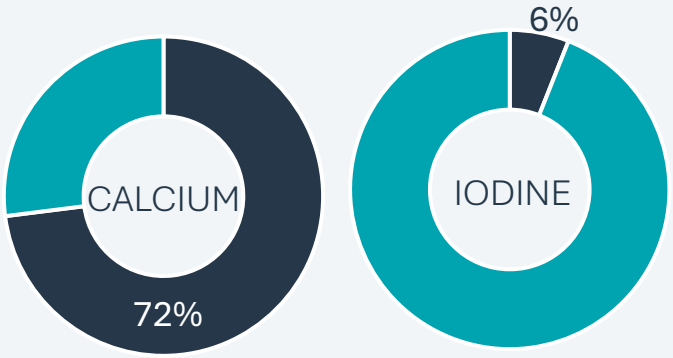
Katie Nicol[1], Eva-Leanne Thomas[1], Anne P. Nugent[2], Jayne V. Woodside[3], Kathryn H. Hart[1] and Sarah C. Bath[1]*

Market survey December 2020

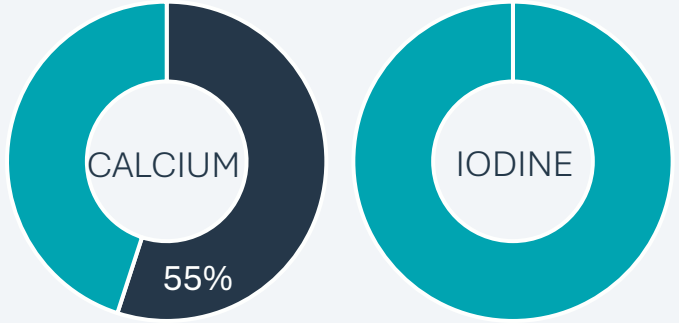
Milk alternatives (n=105)



Yoghurt alternatives (n=70)



Cheese alternatives (n=66)



Provision of iodine

British Journal of Nutrition (2023), 129, 832–842 doi:10.1017/S0007114522001052

Iodine fortification of plant-based dairy and fish alternatives: the effect of substitution on iodine intake based on a market survey in the UK

Katie Nicol[1], Eva-Leanne Thomas[1], Anne P. Nugent[2], Jayne V. Woodside[3], Kathryn H. Hart[1] and Sarah C. Bath[1]*

Cows' milk products


+

+

= 124 µg

Unfortified plant-based products

+


+


= 2.6 µg

97.8% reduction

Nicol et al 2022

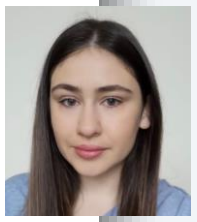
Does consumption plant-based milk alternative increase the risk of iodine deficiency?

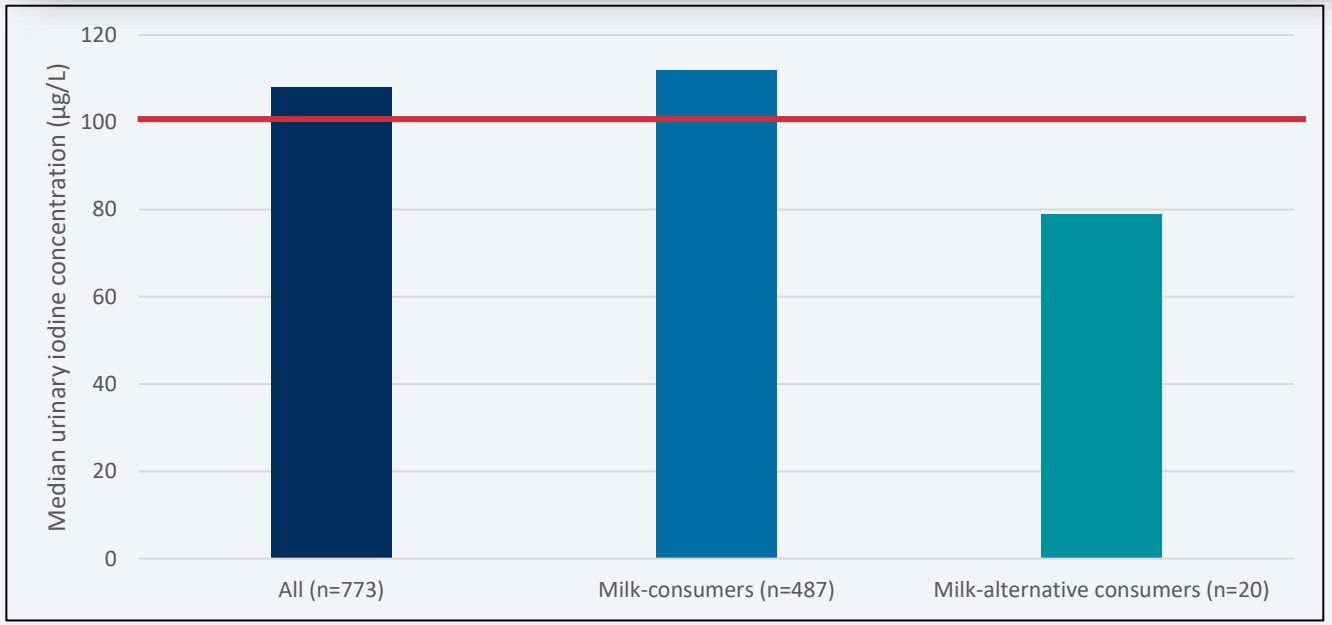
British Journal of Nutrition (2021), 126, 28–36 doi:10.1017/S0007114520003876

Iodine status of consumers of milk-alternative drinks *v.* cows' milk: data from the UK National Diet and Nutrition Survey

M. Dineva, M. P. Rayman and S. C. Bath*

Department of Nutritional Sciences, Faculty of Health and Medical Sciences, University of Surrey, Guildford GU2 7XH, UK





Data from National Diet and Nutrition Survey (2014-2017)

Dineva et al. 2021 Br J Nutr

Iodine deficiency: not cured but controlled

Case reports of goitre in UK vegan[2-5]:

- toddlers
- children
- women of childbearing age

Pregnant women:

- 36% (n=89) in Bradford had palpable goitre[6]

"IDD can therefore return at any time after their elimination if program success is not sustained"[1].

1; WHO 2007 2. Yeliosof & Silverman (2018). J Pediatr Endocrinol Metab; 3. Brandt et al. (2018). Endocrine Abstracts;
4. Park et al. (2005) Endocrine Abstracts; 5. Shaikh et al. (2003). J Pediatr Endocrinol Metab; 6. Threapleton et al. Nutrients

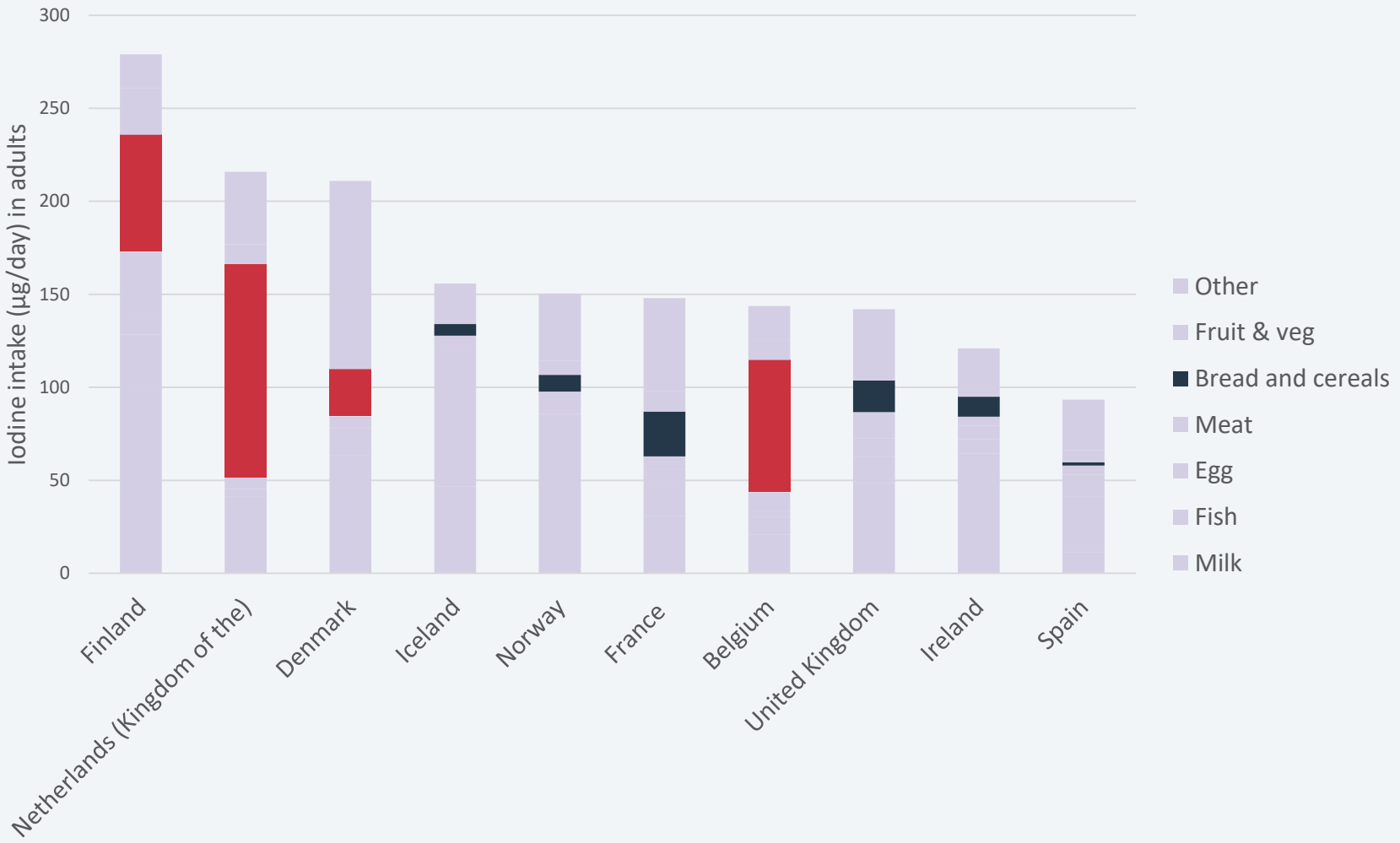
Future

Iodised salt in bread

Fortification of milk-alternatives

Education

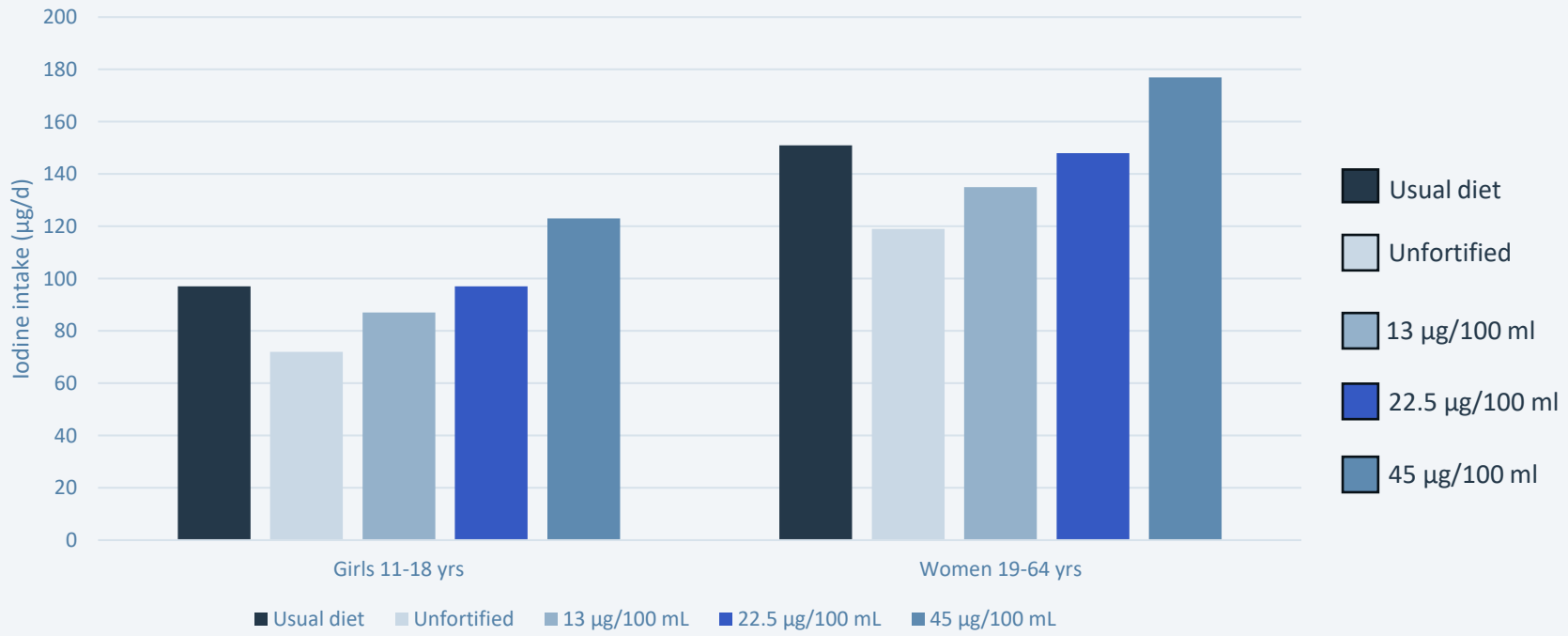
Iodised salt in bread



WHO Europe Report 2024

Fortification of milk alternatives

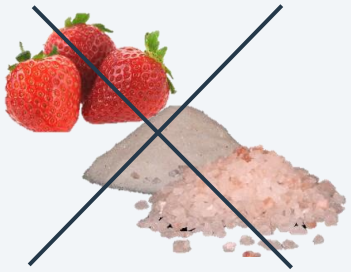
Fortification at ≥ 22.5 and < 45 µg iodine/100 mL required to minimize the impact on iodine intake



Education

91 %

UK women could not identify milk/dairy as a source of iodine



Myths around dietary sources

Caution against kelp as a plant-based source

EUthyroid2

- EU study to raise knowledge and awareness in women and children
- Involvement of healthcare professionals

- Interventions in two UK centres
  - University of Surrey
  - Queen's University Belfast

EUthyroid2: co-funded through EU Horizon Europe and UKRI

Key messages

Iodine is an overlooked but vital nutrient

Essential for thyroid function and brain development in early life

The UK and Ireland do not have salt iodisation policies

Milk and dairy products are the main source

Most milk alternatives are not iodine fortified

Iodine needs to be considered on plant-based diets

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WHO/IGN Report

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EUthyroid2

Thank you for your attention

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