Iodine, Calcium and Vitamin D

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Overview

- Identifying deficiencies of calcium, vitamin D and Iodine
- Potential risks of this
- Why is Iodine so important?
- Case studies
- Where's the evidence
- Supplementation

Growth Vs Nutrition

'faltering growth'

- Infants or children whose weight gain occurs more slowly than expected for their age and sex"

"lesser degrees of faltering growth may not necessarily indicate a significant problem but merely represent variation from the usual pattern"

NICE guideline 2015

'Malnutrition'

- deficiencies, excesses or imbalances in a person's intake of energy and/or nutrients"

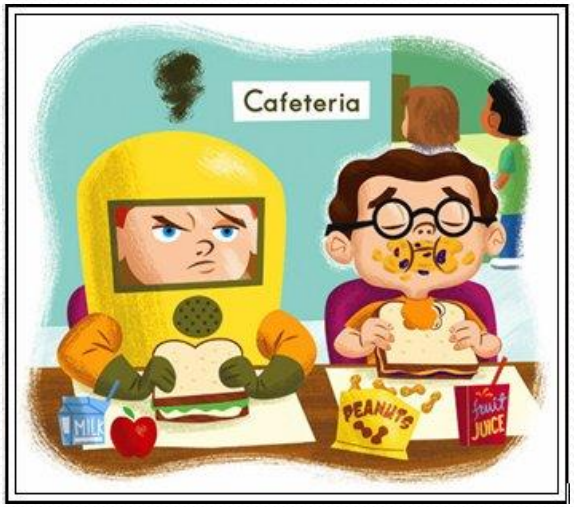
'Under nutrition'

- includes stunting, wasting, underweight and **micronutrient deficiencies** or insufficiencies (a lack of important vitamins and minerals)"

WHO, 2013

Common food allergies

- Cow's milk
- Egg
- Soya
- Wheat
- Fish
- Nuts



Children with allergies are more at risk of nutritional deficiencies and poor growth

Case study

- Referral from general paediatrics for SPT for peanut allergy age 12months
- Seen age 16 months in joint allergy clinic
- Weight 10.7kg 50th centile Height 84.2cm 91st centile
- History from mum
  - Reported immediate reactions to peanut butter and cows milk protein (yoghurt)
  - exclusively breast fed until he was 6 months of age
  - breast feeding until 12 months, mum took dairy out of her diet due to eczema.
  - Avoiding dairy and peanuts in weaning diet
  - No alternative to dairy given after 12 months

What are your concerns?

History continued

- Mum didn't take Vitamin D during her pregnancy
- walking when he was 9-10 months of age
  - problems with running and tends to fall over a lot
- 13 months of age -a sip of milk given – reacted with rash
- Soya milk tried once but refused therefore not re tried
- Not on any vitamins
- Growing well, good eater; 3 meals a day and snacks
- On examination:-

  pronounced bowing of his lower legs, slight thickening at his wrist joints, prominent forehead

Diagnosis?

What would you do now?

Further investigations/treatments?

What happens next…

SPT

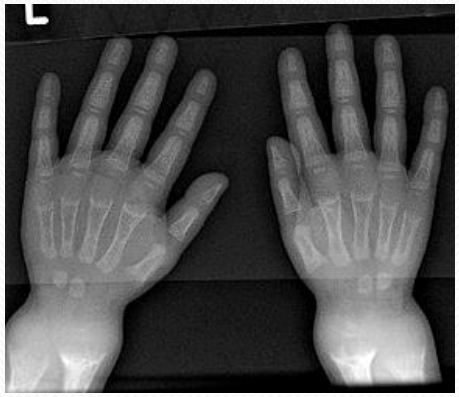
Histamine	negative control	peanut	cow's milk
5mm	0 mm	8 mm	2mm

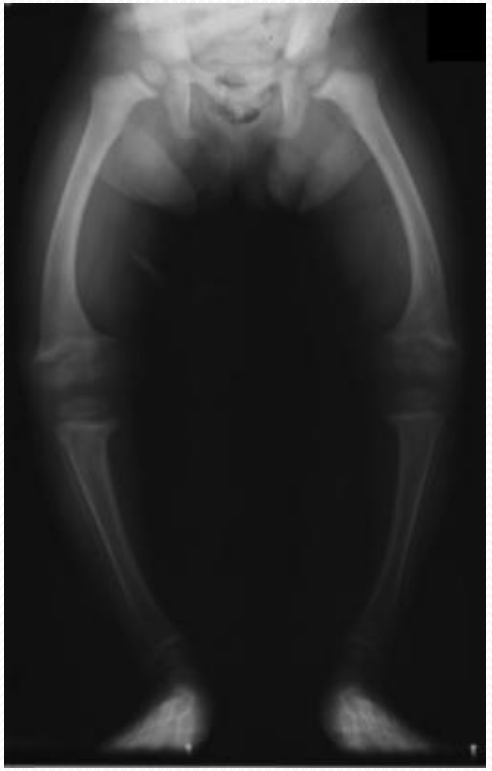
Vitamin D Profile (LCMS)

Total 25-Hydroxy Vitamin D		18.9	nmol/L
25-hydroxy vitamin D3		18.9	nmol/L
25-hydroxy vitamin D2		<0.8	nmol/L

25-hydroxy- vitamin D <25 nmol/L Deficient - high dose Vitamin D supplementation, according to local guideline, usually required.
25-hydroxy-vitamin D 25 - 50 nmol/L Increased disease risk Vitamin D supplementation according to local guideline or on specialist advice.
25-hydroxy-vitamin D >50 nmol/L Adequate-vitamin D supplementation not usually required except on specialist

Blood test results
Normal Urea and electrolytes/liver function tests
Bone profile
Adjusted calcium 1.88 mmol/L – (normal range 2.20 – 2.70)
Phosphate 1.08 mmol/L (normal range 1.1 – 2.0)
Alkaline Phosphatase 1412 u/L (normal range 69 – 434)
Serum iron 8.6 micromol/L (normal range 10 - 25)
Transferrin 2.79 g/L (normal range 2.20 – 3.37)
Iron saturation 12.3% (normal range 15 – 45)
Haemoglobin 128g/L (normal range 101 – 138)
Neutrophil count 0 .28 x 10^9/L (normal range 1 – 8.5)
MCV 71fl (normal range 73 – 88)
MCH 25.5 pg (normal range 24 – 30)
MCHC 358g/ (normal range 310 – 350)





Clinical History :
Investigation of possible clinical rickets
XR Wrist Lt :
Abnormal distal radial and ulnar metaphyses and the bones are osteopenic.
Appearances in keeping with metabolic bone disorder, most likely rickets.

XR Knee Lt :
Abnormal femora, tibia and fibula metaphyses and the bones are osteopenic.
Appearances in keeping with metabolic bone disorder, most likely rickets.

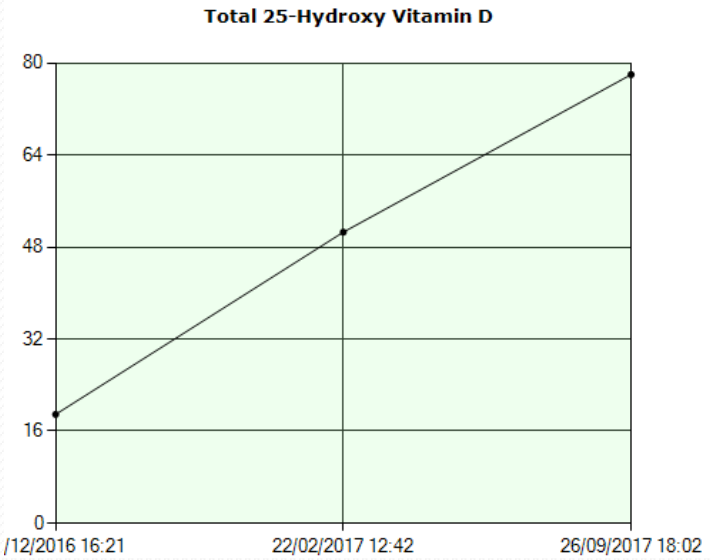
Plan

- Colecalciferol 3,000 units per day, once daily for 6 weeks
- Calcium carbonate (CACIT) 150 mg four times a day
- Referral to specialist bone team
  - no family history of bone disease
- Mum to retry the soya milk/soya yoghurt.
- Mum advised on calcium and vitamin D for herself
- SPT negative but still sensitive on exposure
- Continue regular meals and advice on increasing dietary calcium and iron intake given.
- Review 2 months

On review; 2 & 9 months

Vitamin D Profile (LCMS)		
Total 25-Hydroxy Vitamin D	78.0	nmol/L
25-hydroxy vitamin D3	78.0	nmol/L
25-hydroxy vitamin D2	<5.0	nmol/L

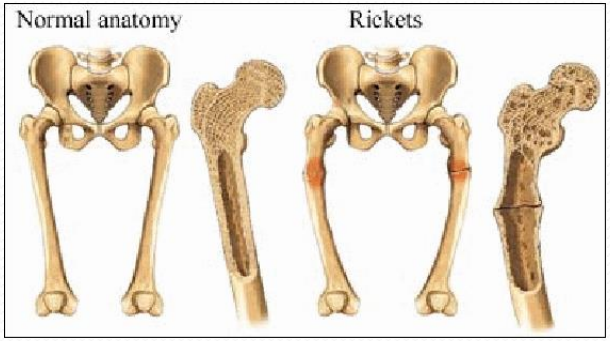
25-hydroxy- vitamin D <25 nmol/L Deficient - high dose Vitamin D supplementation, according to local guideline, usually required.
25-hydroxy-vitamin D 25 - 50 nmol/L Increased disease risk Vitamin D supplementation according to local guideline or on specialist advice.
25-hydroxy-vitamin D >50 nmol/L Adequate-vitamin D supplementation not usually required except on specialist advice.
Analysis performed by LC-MS



PARATHYROID HORMONE - (across all investigations) [pmol/L]

Reference range: (1.6 - 6.9) Units: pmol/L

Sample Received Date	Sample ID	Value
26 Sep 2017 18:01:00	BG202670K	*8.7
22 Feb 2017 12:42:00	BG324111N	*21.5
20 Dec 2016 16:21:00	BG178860H	*36.4



ALKALINE PHOSPHATASE - (across all investigations) [u/L]

Reference range: (90 - 540) Units: u/L

Sample Received Date	Sample ID	Value	Range
26 Sep 2017 18:02:00	BG202668Z	*354	(60 - 300)
22 Feb 2017 12:43:00	BG329374E	*519	(60 - 370)
22 Feb 2017 12:43:00	BG324109K	*523	(60 - 370)
17 Jan 2017 12:02:00	BG222689V	*743	(69 - 434)
04 Jan 2017 11:22:00	BG183910C	*1024	(69 - 434)
20 Dec 2016 16:20:00	BG178858V	*1412	(69 - 434)
22 Oct 2015 15:18:00	BG481759F	446	(90 - 540)

XR Leg Length Measurement Both :
Bowing of both femora and to a lesser extent the tibiae is noted. Satisfactory growth plate.
XR Hand & Wrist (Bone Age) :
Bone age is equivalent to a male standard of 2 years 8 months (G&P).
The Standard Deviation for a child of 2 years and 4 months is about 5.4 months.
Generalised reduction in bone density. No additional specific radiological feature of rickets.

Learning points

- Education in primary care is key along with full allergy focused history
- 30-40% population have a plasma 25(OH)D concentration of <25nmol/l in winter
  - 400IU (10µg)/day for the general population in autumn and winter
  - Children 1-4 years 400IU (10µg)/day
  - Infants under 1 year (Breast fed 8.5-10µg/day)
  - If taking >500mls formula per day no vitamins required
- Growth alone is not a good indicator of deficiencies
- Really important to ensure alternative sources of calcium are in the diet
- Calcium and vitamin d need to be given together – always check intake vs requirements for age

Age	RNI
0 - 12mths	525mg
1 - 3yrs	350mg
4 - 6	452mg
7 - 10	552mg
11 – 18yrs(boys)	1000mg
11 – 18yrs(girls)	800mg
Breastfeeding	1250mg

Why the interest in Iodine?

- Allergy patients presenting to Endocrine with diet related Iodine deficiency
- Could be preventable – not just allergy, a national concern
- Krakow declaration on Iodine 2018 Europe wide–
  - targeting Iodine deficiency disorders and prevention programs
  - 50% new-borns in EU exposed to iodine deficiency

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Health

Worrying levels of iodine deficiency in the UK

By Michelle Roberts
Health reporter, BBC News

12 April 2011 Share

Researchers are warning iodine deficiency could be becoming endemic in the UK and are suggesting manufacturers should start adding it to table salt.

The researchers suggest fortifying salt with iodine would help

A study involving more than 700 teenage girls at nine UK centres found more than two-thirds had a deficiency.

Experts say the problem stems from children drinking less milk, which is a common source of iodine.

Women of childbearing age are most at risk - even mild deficiency can harm a baby's developing brain.

Iodine deficiency is the most common cause of preventable mental impairment worldwide, affecting a third of the world's population. It also causes thyroid problems.

Since 1993 the World Health Organization (WHO) has conducted a global programme of salt iodisation to boost dietary levels and prevent deficiency, largely in th

Fortification

Dr Vanderpump, a consultant physician at the Royal Free Hampstead NHS Trust, said it was time to look at adding iodine to dietary salt.

"The World Health Organization has made iodine-deficiency a global priority and has been campaigning for at-risk countries to add iodine to their salt, a campaign which has been very successful.

"If it turns out that we do have a problem, this could be the most viable solution."

Cathy Collins, a spokeswoman for the British Dietetic Association, said it might be simpler to target teenage girls and advise them to drink more milk and eat more of other foods rich in iodine, such as seafood.

"I'm not surprised by the findings because teenage girls do not tend to drink a lot of milk or eat a lot of oily fish.

"Getting girls to have a bit more of these in their diet might help, or taking a multivitamin every day would give them 100% of the iodine they need."

She said it was unclear whether other age groups were also deficient, but said it was likely that many people were not getting as much as they ideally need.

A Department of Health spokesman said: "We monitor the nutritional status of the population through a rolling programme of diet and nutrition surveys. We keep track of emerging research and will consider the need for assessing iodine status through urinary analysis in future surveys."

THE UK IODINE GROUP
Promoting the importance of iodine

About News Info Media Professionals

Our Mission Statement

The Eradication of Iodine Deficiency in the UK.

OUR VISION
To ensure optimal iodine nutrition in all sectors of the UK population in order to avoid the adverse effects of iodine deficiency.

OUR MISSION
As a group of experts in iodine nutrition, thyroid disease and public health, to promote awareness of the importance of iodine in the diet and to make evidence-based recommendations to eradicate iodine deficiency in the UK.

AIMS OF THE GROUP

- To identify relevant gaps in the current iodine literature and influence the research agenda in the UK.
- To eliminate iodine deficiency in women who are planning pregnancy or who are pregnant, and women who are breast-feeding, in order to safeguard their children's development, and brain development in particular.
- To respond to the results of the newly introduced measurement of iodine status of children and adults in the UK National Diet and Nutrition Survey.
- To ensure the surveillance of iodine status of the most vulnerable groups, namely pregnant and lactating women, that are not covered by the National Diet and Nutrition Survey.
- To provide appropriate advice on dietary and supplemental sources of iodine on Government web sites and through other appropriate means, particularly those aimed at pregnant and lactating women.

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IODINE global network

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Adding iodine to salt could help children reach full academic potential

Experts want iodine to be added to salt after research showed that a lack of the mineral in pregnant women stops half of all children reaching their full academic potential.

Iodine is an essential nutrient for foetal brain development, but studies across the UK have shown that high numbers of expectant mothers suffer from a deficiency of it.

The figures in the six studies range from 40 per cent in Scotland and 47 per cent in the North East of England to 73 per cent in the South West. At 15, the children of mothers who lacked iodine during their pregnancy perform up to 5.6 per cent worse in language tests than their classmates, researchers have found.

A group of leading European nutrition experts warned last month that up to 50 per cent of all newborns do not reach their full cognitive potential because of an iodine deficiency.

> read more

Iodine

- Mineral that forms part of the thyroid hormones thyroxine T4 and T3
- These are necessary for regulating metabolism, thermoregulation, protein synthesis and growth
- Goitre the earliest clinical sign of deficiency
- In the fetus and neonates protein synthesis in the brain and central nervous system is dependent on iodine or iodine containing compounds.
- ***Selenium*** and Iodine work together in the thyroid
  - deficiency of selenium affects utilisation of iodine
- Severe ***iron*** deficiency
  - If not treated affects iodine utilisation/absorption
- Very challenging to test for deficiency
- Variation in iodine content of food due to water soluble nature

Food		Portion	Average iodine/ portion (mcg) (actual iodine content will vary)
Milk and dairy products	Cow's milk	200ml	50-100**
	Organic cow's milk	200ml	30-60**
	Yoghurt	150g	50-100**
	Cheese	40g	15
Fish	Haddock	120g	390
	Cod	120g	230
	Plaice	130	30
	Salmon fillet	100g	14
	Canned tuna	100g	12
Shellfish	Prawns	60g	6
	Scampi	170g	160
Other	Eggs	1 egg (50g)	25
	Meat/Poultry	100g	10
	Nuts	25g	5
	Bread	1 slice (36g)	5
	Fruit and vegetables	1 portion (80g)	3

**Depending on the season, higher value in winter

Percent contribution of selected food groups to daily mean iodine intakes for adults aged 19-64 years in 2008/09 – 2009/10c

Food group	Percentage contribution
Milk and milk products total,	33%
of which cows' milk	23%
Fish and fish dishes	11%
Beer and lager	11%
Cereal and cereal products	10%
Eggs and egg dishes	6%
Other	29%

[c] Secondary analysis of data from the NDNS 2008/09 – 2009/10 (Bates *et al.*, 2011). Food sources only (excluding supplements).

Iodine Requirements

UK Dietary Reference Values for iodine (DH, 1991)

Age	Lower Reference Nutrient Intake (LRNI) (µg/day)	Reference Nutrient Intake (RNI) (µg/day)
0-3 months	40	50
4-6 months	40	60
7-9 months	40	60
10-12 months	40	60
1-3 years	40	70
4-6 years	50	100
7-10 years	55	110
11-14 years	65	130
15-18 years	70	140
19-50 years	70	140
50+ years	70	140
Pregnancy	No increment	
Lactation	No increment	

The World Health Organisation recommendations are in the table.

Population group	World Health Organisation Recommended Nutrient Intake (RNI) (µg/day)
Children 0-5 years	90
Children 6-12 years	120
Adults >12 years	150
Pregnancy	250
Lactation	250

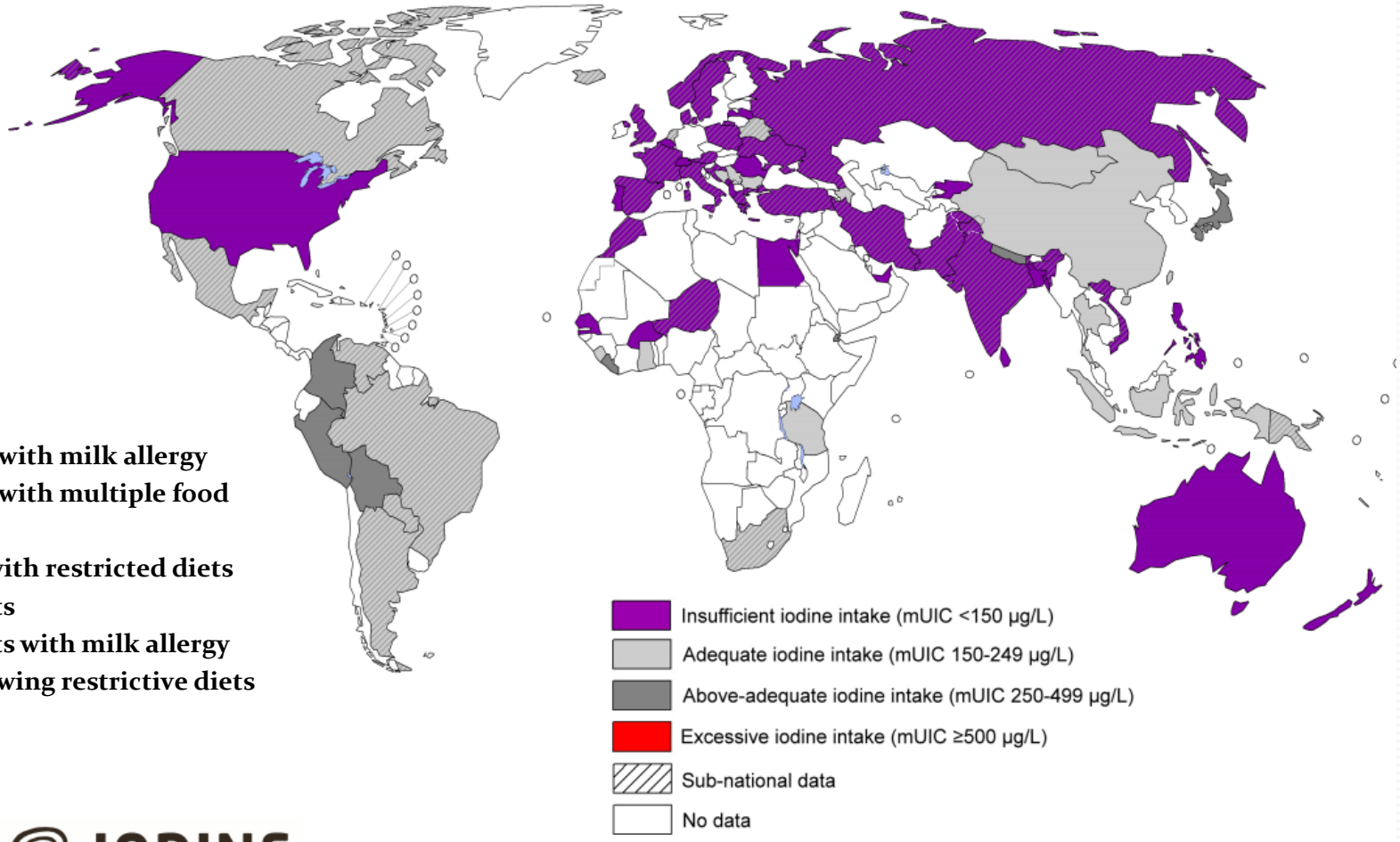
WHO, 2007

Life stage	Iodine required per day (mcg)*
Adults	150
Pregnant women	200
Breastfeeding women	200

*European Food Safety Authority (EFSA) recommendations.

Global Scorecard of Iodine Nutrition 2017

Based on median urinary iodine concentration (mUIC) in pregnant women



WHO IS AT RISK?

- **Everyone**
- **Allergy patients with milk allergy**
- **Allergy patients with multiple food restrictions**
- **Young females with restricted diets**
- **Breast fed infants**
- **Breast fed infants with milk allergy and mums following restrictive diets**

IODINE global network

Note: The boundaries, colours, denominations, and other information shown on this map do not imply any judgment on the part of the Iodine Global Network concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Iodine Status and Growth in CMA, JPGN, 2017

"It is important that HCPs are aware that children with CMPA may be at higher risk of developing an iodine deficiency, that this needs to be included in dietary advice to ***optimising maternal elimination diets for iodine intake and revisiting levels of iodine in hypoallergenic formula."***

Segal H, Meyer R, Shah N: JPGN: Volume 64, Number 5, May 2017

Iodine Content of prescription formulas

Formula	Iodine content µg per 100ml
Nutramigen LGG stage 3	15.5
Neocate Junior	15.0
Nutramigen LGG	14.3
Neocate LCP	13.8
Aptamil Pepti	12.0
Althera	11.0
Alfamino	11.0
Nutramigen Puramino	10.1
Similac Alimentum	10.0

Product	Kcals/100mls	Protein g/100mls	Fat g/100mls	Calcium mg/100mls	**Iodine** µg per 100ml
Alpro soya Junior	64	2.5	2.2	120	24.5
Soya milk	34-44	3.3	1.9-2.1	120	0
Oat milk	45	1	1.5	120	0-5
Coconut milk	28	0.3	1.9	120	0
Oatly barista	60	1	3	120	5
Almond milk	14-30	0.5	0.3-1.8	120	0
Rice milk	50	0.1	1	120	0
Cow's milk	64	3.2	3.6	120	25-50
Made without dairy M&S Soya	43	3.6	2	144	22.5
Made without dairy M&S Oat	46	0.89	1.3	120	28.9
Made without dairy M&S Coconut	29	0.2	1.9	120	30.7
Asda Free from oat milk	49	<0.5	1.6	148	30

Iodine concentration of milk-alternative drinks available in the UK in comparison with cows' milk. Br J Nutr 2017

"Although many milk-alternative drinks are fortified with Ca, at the time of this study, **just three of forty-seven drinks were fortified with iodine. Individuals who consume milk-alternative drinks that are not fortified with iodine** in place of cows' milk **may be at risk of iodine deficiency** unless they consume alternative dietary iodine sources"

Br J Nutr 2017 Oct;118(7):525-532 Bath SC et al

Where's the Evidence

- ***SACN statement on iodine and health, Feb 2014***
  - Iodine deficiency with or without other nutritional deficiencies most common cause of Goitre.
- ***National Diet and Nutrition Survey (NDNS), Bates et al 2012***
  - Indicates ~1/5 of non pregnant girls ages 11-18 years in the general population are at risk of low intakes
  - indicates milk consumption has fallen since previous surveys.
- ***SACN Subgroup on Maternal and Child Health (SMCN)***
  - Insufficient evidence but the pre pregnancy iodine status of the women could be crucial
- ***WHO, 2009*** suggests the UK population as a whole are now iodine deficient.
- ***ALSPAC 2013 and Gordon et al 2009***
  - concluded mild maternal iodine deficiency could prevent offspring from attaining their full intellectual potential
- ***Thomassen et al, 2017***
  - Iodine status and growth in 0-2 year old infants with cows milk protein allergy
  - >30% iodine deficient
  - Higher risk in breast fed children with CMPA
- ***Dietary restriction causing iodine-deficient goitre, Cheetham et al, 2015***
  - Case review by the Newcastle team

Standard Practice following this

- Awareness
- Urinary testing and dietary analysis unhelpful
- ***Prevention*** rather than treatment in those on restrictive diets
- Suitable multivitamin and mineral supplement containing iodine to be started
- Encourage infant formula if age appropriate
- Some alternatives now fortified with Iodine and Iron
- Prevent mum from restricting diet unnecessarily
- Education on supplementation for mums
  - Prenatal/postnatal/lactation
- Normalise diet asap

Summary

- Iodine deficiency is on the rise
- The government need to be making Iodine and Vitamin D a public health concern
- Raises the question that children's behavioral and intellectual progress could be linked with deficiency
- Full dietary history from mum and child essential
- Adequate supplementation needed
- Growth isn't always a helpful indicator of deficiency
- Children on Milk/Fish/Egg/Wheat free diets need regular Dietetic Input to liberalise diet