Emerging evidence on iodine deficiency in the UK, public health implications

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Overview

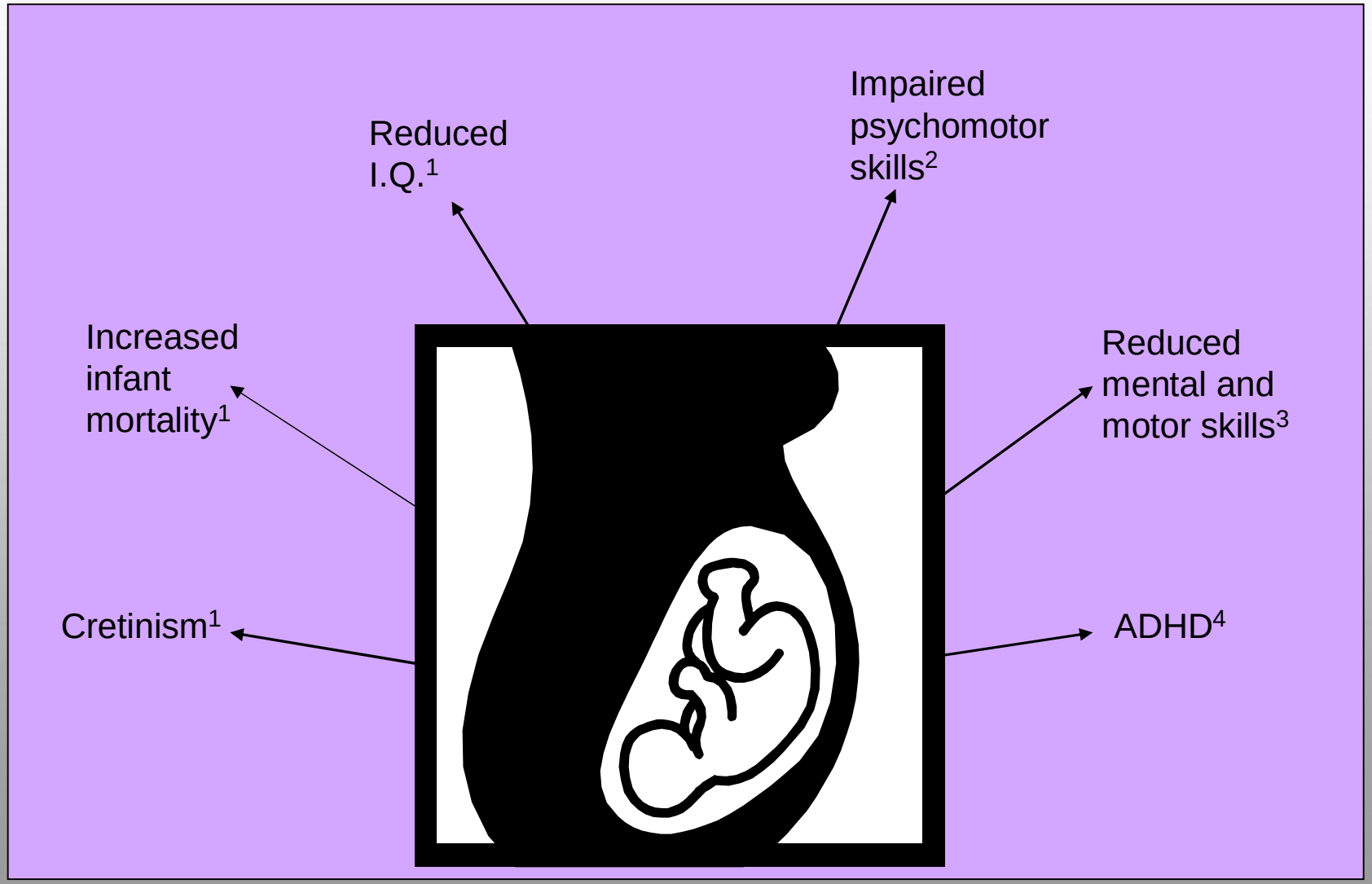
Iodine

Essential component of T4 and T3

Growth, development and metabolism

Brain and neurological development

Why iodine is important



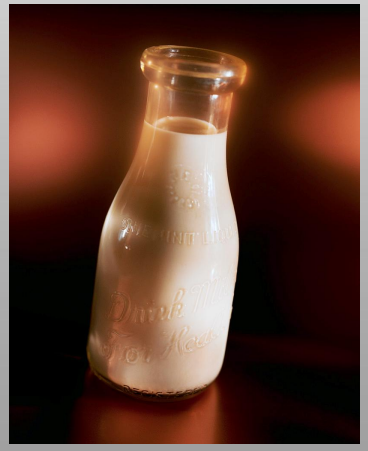
1. Delange 1994 *Thyroid*; 2. Pop 1999 Clin Endocrinol (Oxf); 3. Pop 2003 Clin Endocrinol (Oxf); 4. Vermiglio 2004 J Clin Endocrinol Metab

ñOn a worldwide basis, **iodine deficiency** is the single most important preventable cause of **brain damage**ò

WHO 2007

Sources of iodine

- Food iodine levels are dependent on soil levels
- Food of marine origin *e.g. fish*
- Milk and dairy products
  - Seasonal variation
- Meat and eggs
- Iodised salt
- Nutritional Supplements
  - Kelp supplements should be avoided ï can lead to excessive iodine intake



Iodine requirements

Pregnancy is the life stage with the highest iodine requirements

- Adult requirement 150 µg/day[1]
- Recent WHO advice: 250 µg/day during pregnancy[2]

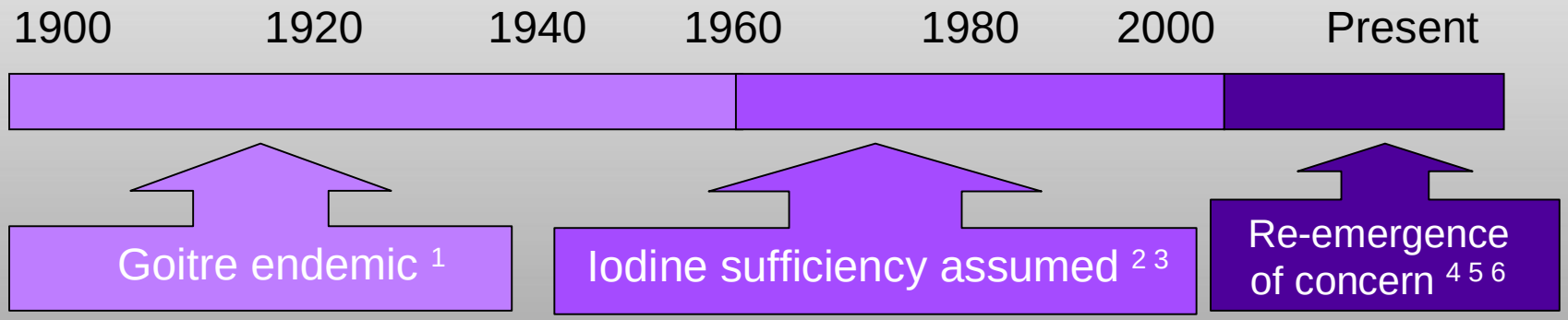
1. WHO, 2007; 2. Andersson *et al.* 2007 *Public Health Nutr*

Use of a biomarker for assessment of iodine status

- Iodine status is determined from urinary iodine concentration
- 90% of iodine ingested is assumed to be excreted
- For an individual, 24-hr urinary iodine excretion is the best measure
- For a population, a spot-urine sample is used
- Spot urine samples cannot be used for diagnosis of iodine deficiency in individuals

Zimmermann 2008 *Br J Nutr* **99** S2-9

Summary of Iodine Status of UK



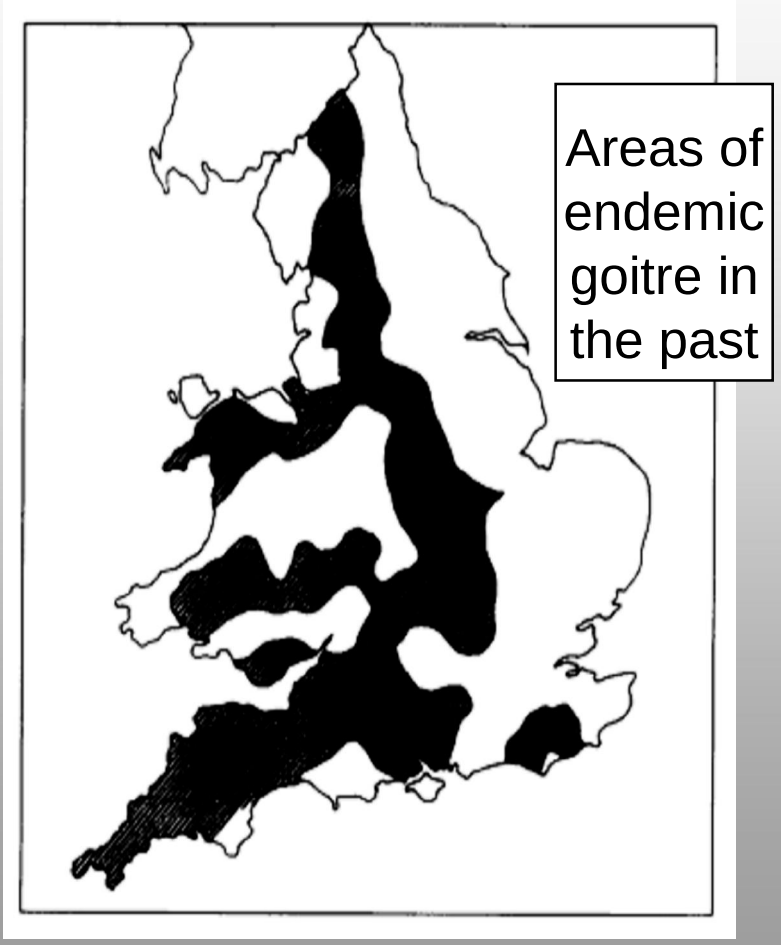
1. Phillips, 1997 2. Wenlock *et al.*1984 *Br J Nutr* 3. Lee *et al.* 1994 *Br J Nutr* 4. Lazarus *et al.* 2008 *Lancet* 5.Barnett *et al.* 2002 *J Endocrinol. Invest* 6. Kibirige *et al.* 2004 *Arch Dis Child Fetal Neonatal Ed*

Historical Iodine Status of the UK

- Iodine deficiency used to be widespread in Britain
  - Goitre belt extended from West Country, into Derbyshire and parts of Wales
- Cretinism reported in some areas

  e.g. Dorset
- Goitre present up until 1960s in some areas

  e.g. Sheffield



Map taken from: Phillips 1997, Iodine, milk, and the elimination of endemic goitre in Britain: the story of an accidental public health triumph *J Epidemiol Community Health* **51** 391-3

How Goitre was eradicated in the UK

Iodine concentration of milk increased

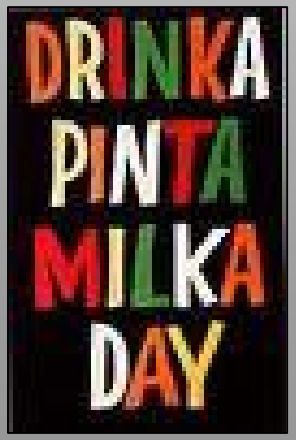
Milk consumption increased

Three-fold increase in iodine intakes between 1950s and 1980s*

*Phillips *J Epidemiol Community Health* 1997

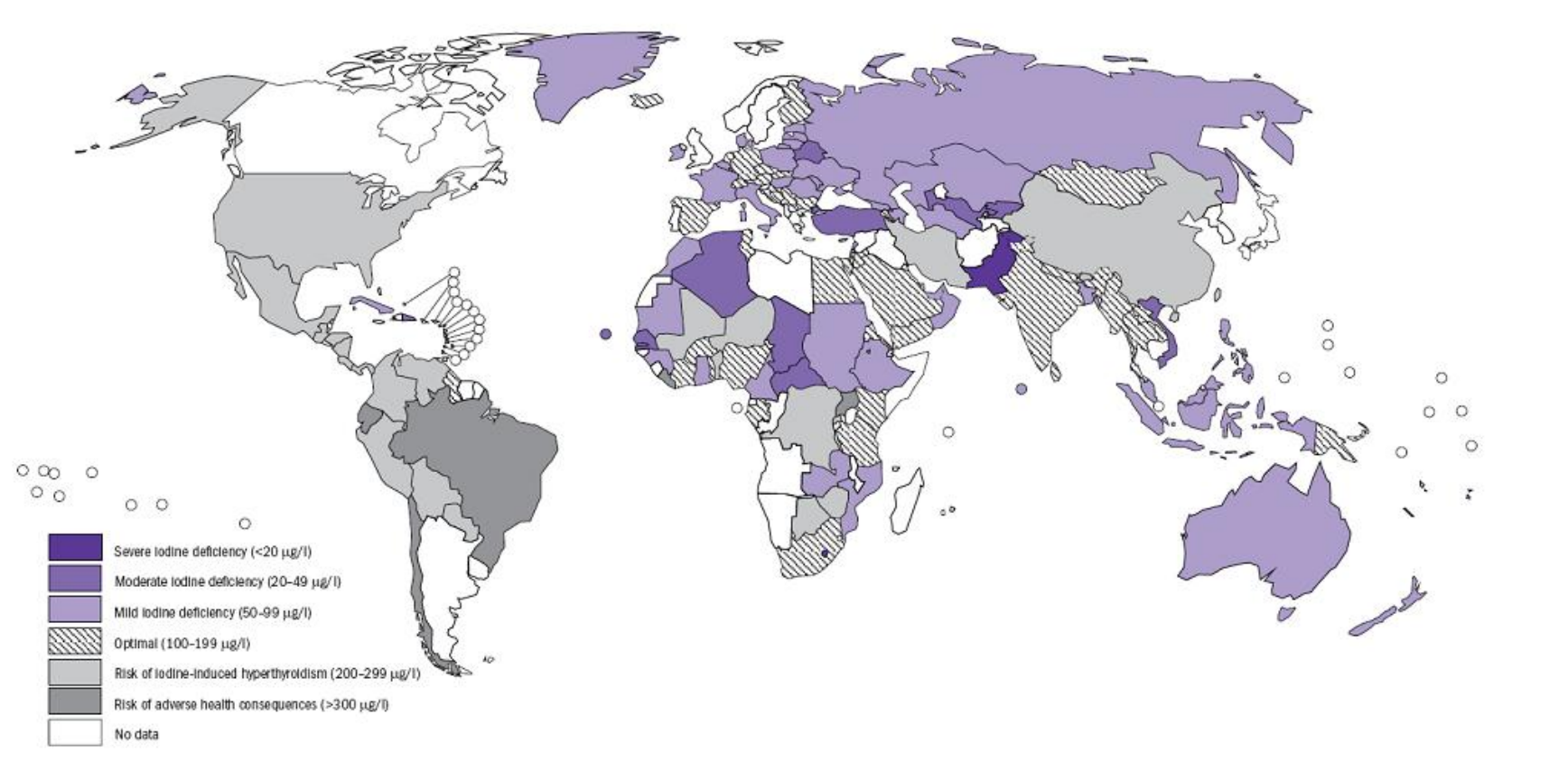
Milk-iodine concentration increased

Milk consumption increased



UK Population Monitoring

- Very poor monitoring of UK iodine status
- UK was one of few countries worldwide with no data on iodine status of population (until 2011)*

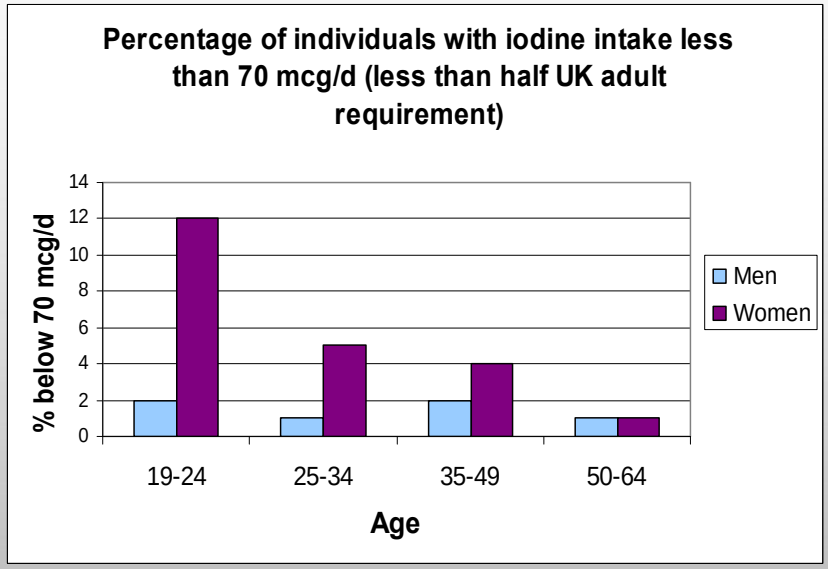


*ICCIDD 2010

Recent Iodine Intake in the UK

Adults: National Survey 2000/01[1]

- Mean daily intake above RNI for adults
- 12% of young women had an intake < 70µg/day
- Intake had fallen since 1986/87 and figures from 2008/09 show further fall[2]

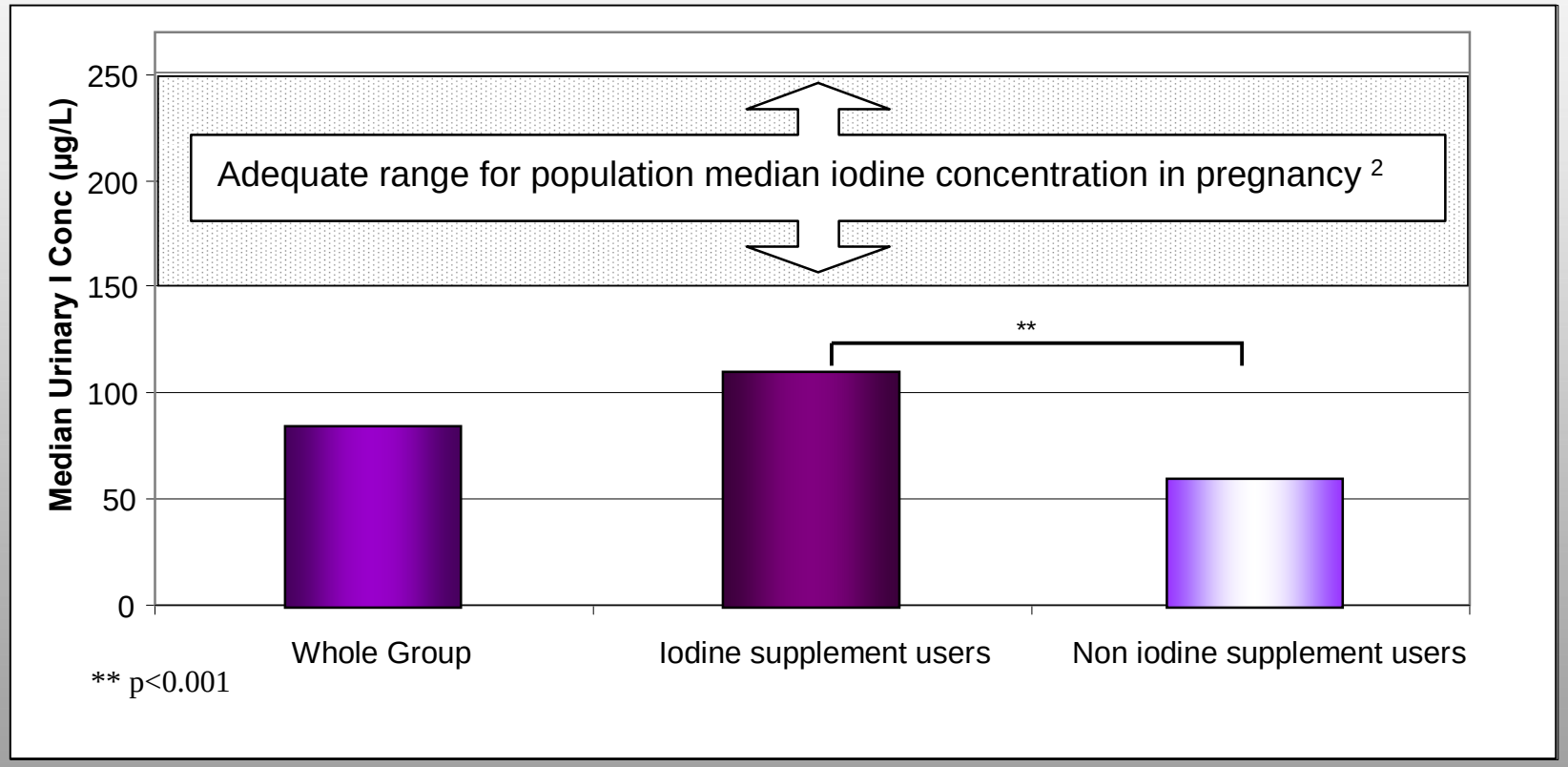


Pregnant Women

- 3.5% had iodine deficiency and 40% were borderline deficient in North East England[3]
- 40% of pregnant women in Tayside, Scotland, had intakes less than half of recommended levels[4]

1.Henderson *et al.* 2003; 2. Bates *et al.* 2009 FSA 3. Kibirige *et al. Arch Dis Child Fetal Neonatal Ed* 2004; 4. Barnett *et al. J Endocrinol. Invest.*2002

Iodine status of pregnant women in Surrey[1]



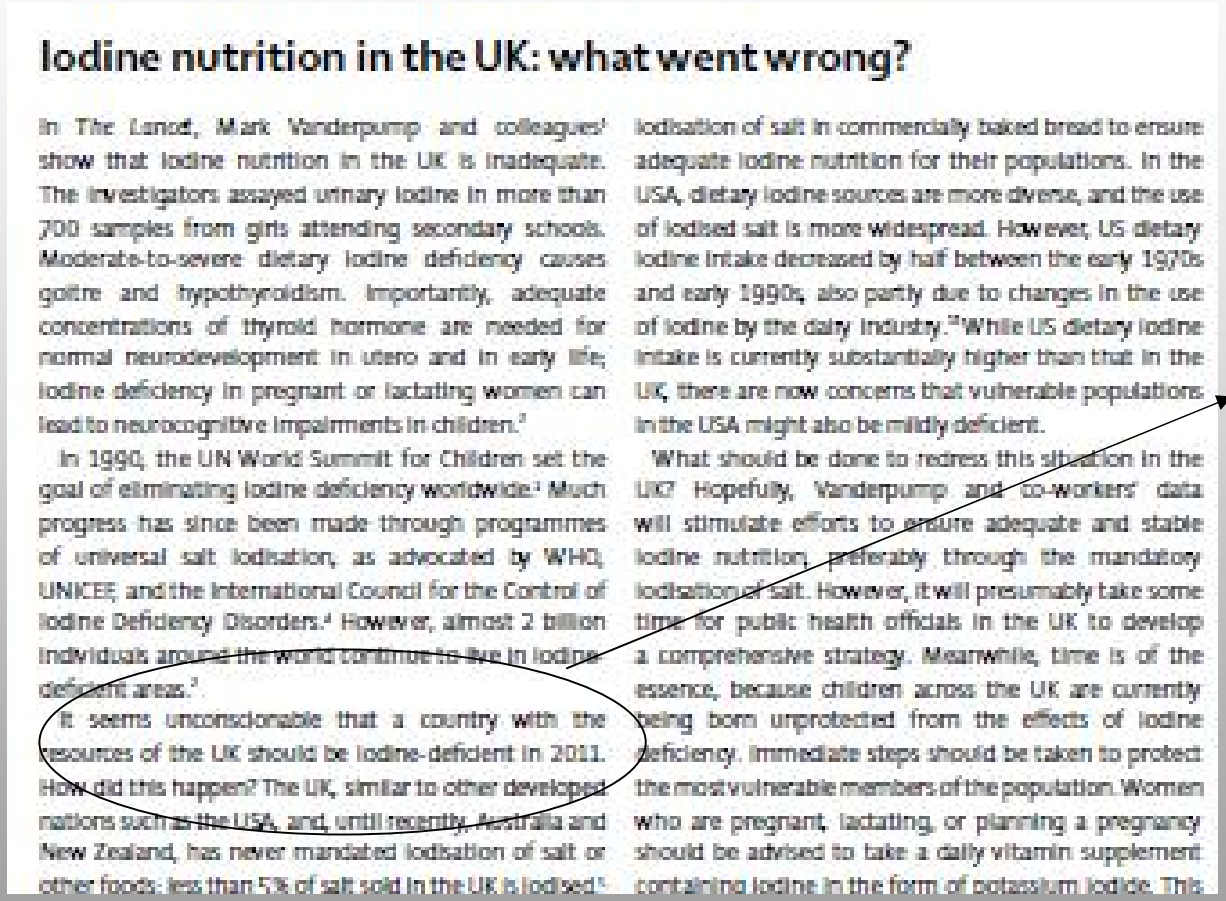
1. Bath *et al.* Proc Nutr Soc 2010; 2. Andersson *et al. Public Health Nutr* 2007

Iodine status of UK schoolgirls*

- Urinary iodine concentration measured in 737 adolescent girls aged 14-15 years
- Nine centres across the UK
- Iodine excretion indicated mild deficiency in the cohort
- Greatest risk of iodine deficiency in Belfast
- Concern that iodine deficiency may be widespread in the UK

*Vanderpump *et al. Lancet* 2011; **377,** pp 2007-2012

Wake-up call for the UK*



Iodine nutrition in the UK: what went wrong?

In The Lancet, Mark Vanderpump and colleagues[1] show that iodine nutrition in the UK is inadequate. The investigators assayed urinary iodine in more than 700 samples from girls attending secondary schools. Moderate-to-severe dietary iodine deficiency causes goitre and hypothyroidism. Importantly, adequate concentrations of thyroid hormone are needed for normal neurodevelopment in utero and in early life; iodine deficiency in pregnant or lactating women can lead to neurocognitive impairments in children.[2]

In 1990, the UN World Summit for Children set the goal of eliminating iodine deficiency worldwide.[3] Much progress has since been made through programmes of universal salt iodisation, as advocated by WHO, UNICEF, and the International Council for the Control of Iodine Deficiency Disorders.[4] However, almost 2 billion individuals around the world continue to live in iodine-deficient areas.[2]

It seems unconscionable that a country with the resources of the UK should be iodine-deficient in 2011. How did this happen? The UK, similar to other developed nations such as the USA, and, until recently, Australia and New Zealand, has never mandated iodisation of salt or other foods; less than 5% of salt sold in the UK is iodised.[5] Iodisation of salt in commercially baked bread to ensure adequate iodine nutrition for their populations. In the USA, dietary iodine sources are more diverse, and the use of iodised salt is more widespread. However, US dietary iodine intake decreased by half between the early 1970s and early 1990s, also partly due to changes in the use of iodine by the dairy industry.[6] While US dietary iodine intake is currently substantially higher than that in the UK, there are now concerns that vulnerable populations in the USA might also be mildly deficient.

What should be done to redress this situation in the UK? Hopefully, Vanderpump and co-workers' data will stimulate efforts to ensure adequate and stable iodine nutrition, preferably through the mandatory iodisation of salt. However, it will presumably take some time for public health officials in the UK to develop a comprehensive strategy. Meanwhile, time is of the essence, because children across the UK are currently being born unprotected from the effects of iodine deficiency. Immediate steps should be taken to protect the most vulnerable members of the population. Women who are pregnant, lactating, or planning a pregnancy should be advised to take a daily vitamin supplement containing iodine in the form of potassium iodide. This

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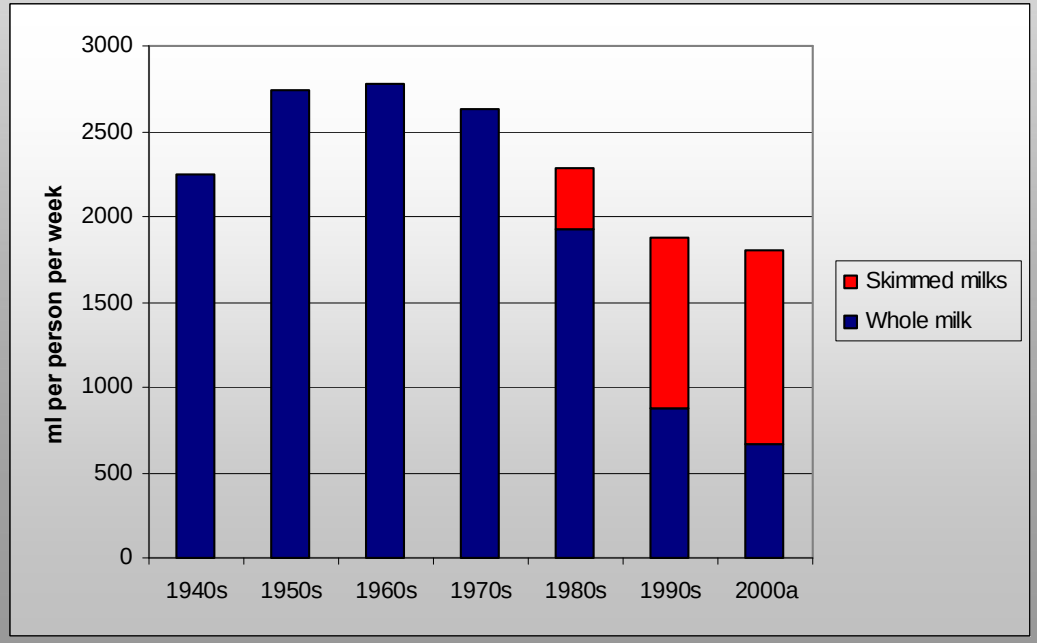
*Pearce, *Lancet* 2011 **377** pp 1979-1980

The Current UK Situation: Role of milk

- Milk and dairy products are the principal source of iodine in UK diet
- They contribute up to 40% of iodine intake[1]
- Low milk consumption is linked to a higher risk of low iodine status[2]
- However, milk consumption has decreased in recent years[3]



1. Henderson *et al.* 2003; 2. Vanderpump *et al. Lancet* 2011; 3. National Food Survey 2000

The UK Organic Milk Industry

- Liquid organic milk accounts for 3.2% of total market sales*
- Ten years of growth in organic milk market
- Milk is entry point for organic market

* OMSCo 2010

Iodine concentration of organic *vs.* conventional milk

- Pairs of supermarket own-brand organic and conventional milk
- Five supermarkets (total market share 80%)
- 16 counties (SE and SW UK)
- Major brands of organic milk
- Total 92 organic and 80 conventional milk samples

Bath, Button & Rayman, *Br J Nutr* 2011

The Current UK Situation: Organic Milk

Our Results	Organic	Conventional
Median iodine concentration (ng/g)	144.5	249.5
Iodine content per 200 g milk serving (µg)	29	50

- Organic milk was 42.1% lower in iodine content than conventional milk
- Possibly due to feeding restrictions organic farms
- Higher clover content of organic feed may also block delivery of iodine to milk

Bath, Button & Rayman, *Br J Nutr* 2011

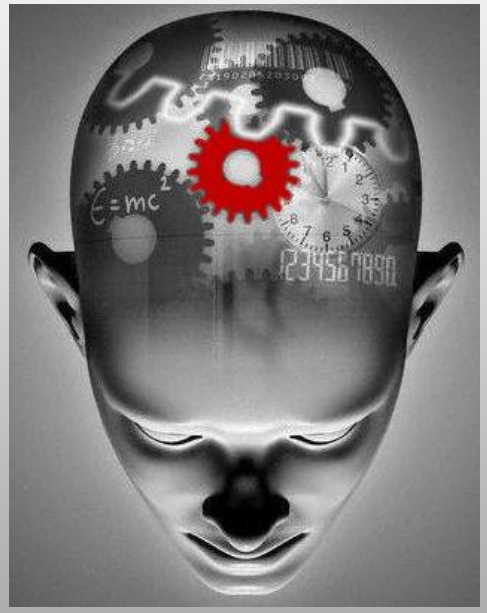
Current UK Situation: Iodised salt availability

Universal salt iodisation is used in most countries

- However, in the UK, our research has shown that*
- Iodised salt has a 0.6% volume share of the table-salt market
- Iodised salt is available to less than 20% of supermarket shoppers
- Iodised salt is six times more expensive
- 96% of the UK pregnant women we surveyed rarely consumed iodised salt

*Bath, Button and Rayman, *Proc Nutr Soc* 2011

Does iodine deficiency in the UK matter?



Bath, Steer, Golding, Emmett, Rayman, *Proc Nut Soc* 2012, Abstract in press

Methods: Participants*

Our current study investigated 1000 ALSPAC women

The women were selected on the basis of:

- availability of a urine sample at during pregnancy

And

- their children having a measure of intelligence quotient (IQ) at age eight years

*Bath, Steer, Golding, Emmett, Rayman, *Proc Nut Soc* 2012, Abstract in press

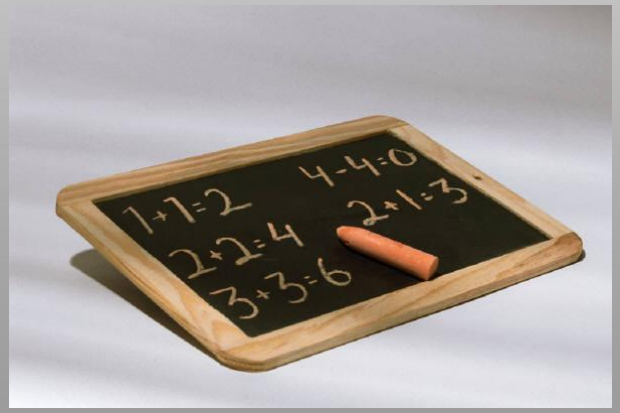
Results: Iodine status[1]

- This cohort of pregnant women were classified as mildly-to-moderately iodine deficient[2,3]
- 61% of the women were iodine deficient (< 150 µg/g) when using creatinine-adjusted values

1.Bath, Steer, Golding, Emmett, Rayman, *Proc Nut Soc* 2012 Abstract in press; 2. Andersson et al. *Public Health Nutr* 2007; 10: 1606-1611; 3. Zimmermann. *Thyroid* 2007; 17: 829-835.

Results: Cognitive outcomes*

- Statistical analysis was adjusted for 24 confounders
  - e.g. maternal education, breastfeeding
- Compared to children of women who were iodine sufficient, children born to women who were iodine deficient during pregnancy were:
  - ☹ **58%** more likely to have total IQ scores in the lowest quartile
  - ☹ **83%** more likely to have a reading score in the bottom quartile
  - ☹ **66%** more likely to be in the lowest quartile of Key Stage 2 maths scores



*Bath, Steer, Golding, Emmett, Rayman, *Proc Nut Soc* 2012 Abstract in press

Conclusions

- Food sources of iodine in UK are haphazard
- Iodine deficiency has been demonstrated in UK women of childbearing age and pregnant women
- Results from ALSPAC suggest this is negatively impacting on child cognition
- UK needs to review population iodine status and policy on fortification

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