The Role of Trace Elements: Diet and Behaviour

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Presentation Outline

- Chemical substances and human behaviour
- ADHD in children
- Trace elements and anti-social behaviour

Chemical Substances and Human Behaviour

- **human behaviour is a complex interplay of factors**
- **can be associated with chemical substances through diet or environmental exposure**
- Evidence:

  * alcohol, non-medical drugs, hallucinogenic agents, therapeutic drugs, chemical solvents
  * inorganic cations (Li^+), dietary deficiency (Mg, Cu, Zn, Fe)

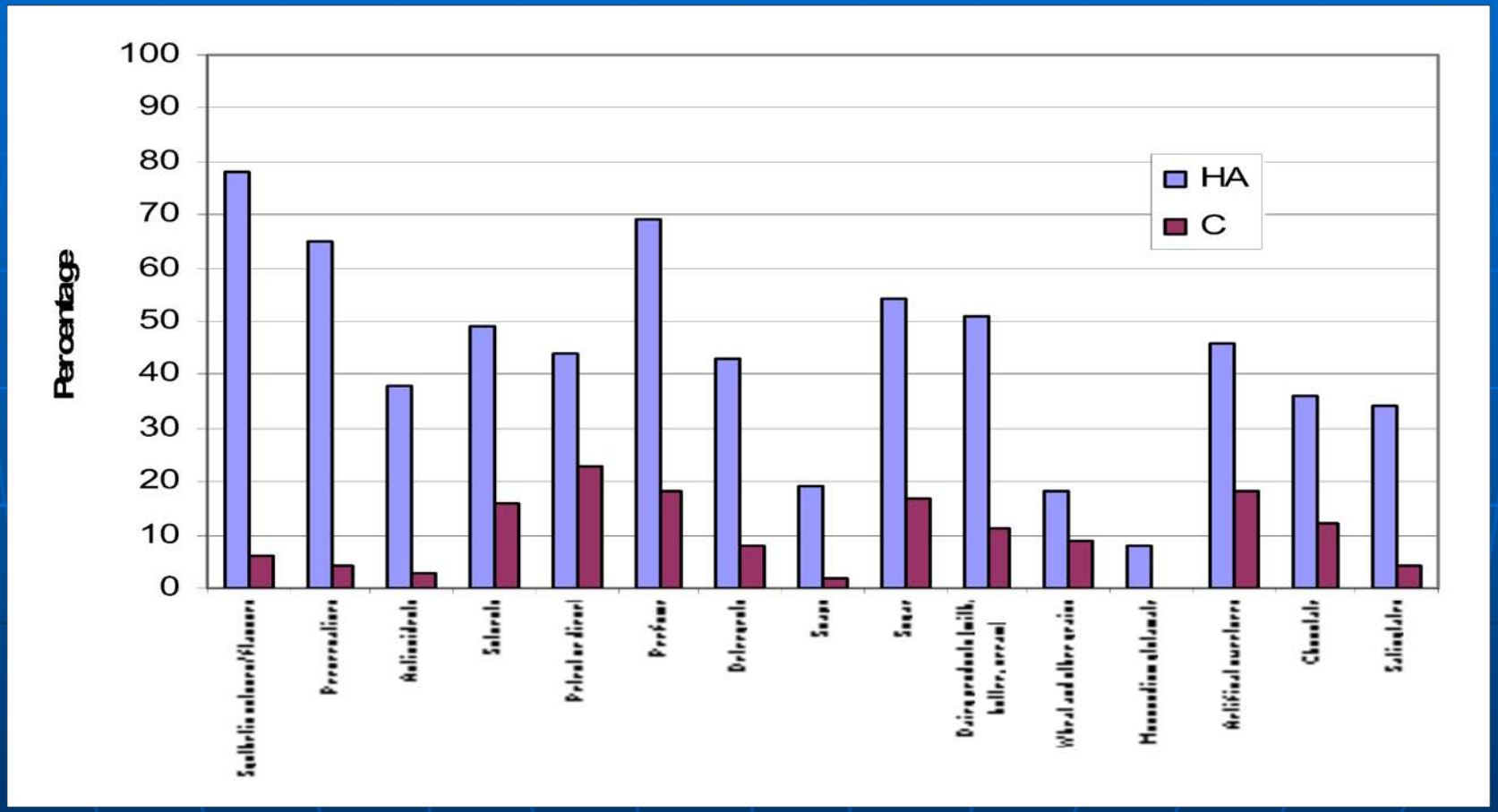
Trace Elements and ADHD

REFERENCES:

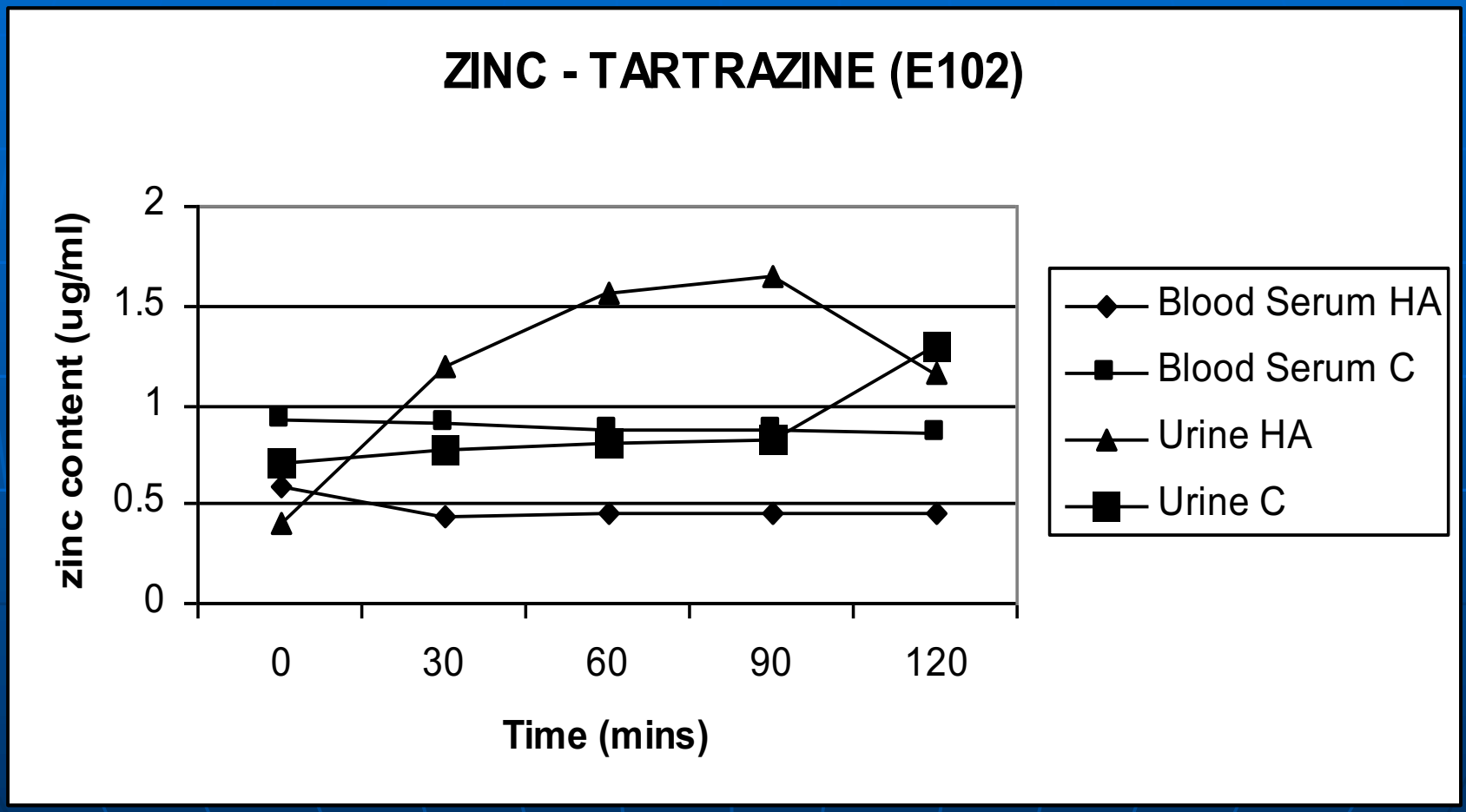
- Ward *et al.*,1990, J. Nutr. Med 1, 51-7.
- Ward N.I., 1997, J. Nutr. Environ. Med. 7, 333-42.
- Ward N.I., 2000, The Nutrition Practitioner 2.2, 43-45.
- Ward N. I., 2001, The Potential Role of Trace Elements in Child Hyperkinetic Disorders, Food Allergy and Intolerance, 2E: Cptr 50, Section D Central Nervous System, Challacombe, D., Brostoff, J. (eds), Harcourt Publishers, London, pp101-116

* ADHD have low blood serum and hair/nail Fe, Cr, (Mg), Se, Zn
* ADHD have raised blood serum and hair/nail Pb, Cd and Al

Percentage Hyperactive and Control Children - positive response to chemicals in foods & beverages



Zinc and ADHD - Food Colours



Zinc and ADHD - Food Colours – Behaviour Changes

Behaviour	Control	Tartrazine	Sunset yellow	Amaranth
Number of cases	15	23	12	12
Overactive	0	18	8	6
Agressive	1	16	3	8
Violent	0	4	1	0
Poor speech	0	2	1	0
Poor coordination	1	12	1	1
Asthma and /or eczema	1	8	4	1

Zinc and ADHD - Food Colours

- ingestion of specific food colours can raise hyperactive responses
- azo dyes could be acting as chelating agents that bind available blood zinc
- azo dyes inhibit trypsin/amalyse activity (low proteolytic enzyme activity would induce inadequate digestion)

Zinc and ADHD - Food Colours

- mode of action not known
  azo dyes are linked to HA behavioural changes
- elimination diet of azo dye
  beverages and ‘sweets’ can have a dramatic effect on some HA or ADHD children

Trace Elements and ADHD

- aggressive behaviour in ADHD linked to reduced melatonin and serotonin (5HT):
  - Zn regulates melatonin biosynthesis
  - reduced Zn absorption/metabolism limits pineal gland to synthesize melatonin

Zinc and ADHD

- low Zn - increased susceptibility to infection and impaired cell-mediated immunity
- low Zn - gut permeability (HA may have a more leaky gut)
- Zn deficiency linked to gastrointestinal changes in enterocytes and microvilli

ADHD and Drug Treatment

- Ritalin (methylphenidate):
  - * **is a stimulant (pharmacological resemblance to amphetamines)**
  - * **USDEA – almost the same properties as cocaine**
  - * **increased use by 600 fold in 1990s**
  - * **USEDA- certain US schools ~20% children taking drug**

Terrass (2000), Nutritional Practitioner, 2.2, 24-27.

ADHD and Drug Treatment

- Reported Side Effects of Ritalin:

* inherently habit-forming
* difficult to assess benefit vs risk
* lack of understanding of therapeutic mechanism of action in ADD or ADHD
* side effects: irritability, mood swings, nausea and stomach pain, appetite loss, skin rash, insomnia, depression, delayed growth……

ADHD Treatment – Nutritional/Dietary Intervention

- Food intolerance: elimination diet

  * sugar, food additives, dairy products, wheat, eggs, chocolate, yeast, citrus, corn, soy, salicylate-rich foods (cherries, apples, berries, grapes, oranges, tea, tomato)
- Trace element, vitamin, EFAs: Fe, Cr, Se, Zn

Trace Elements and Anti-social Behaviour - Al

Moon and Marlow (1986) Biol. Trace Elem. Res. 11, 5-12.

'hair-aluminium concentrations and children's classroom behaviour'

- Al competes for the binding sites of biochemical receptors of other metal ions (Fe and Zn)
- suboptimal dietary intake of Zn and/or Fe may explain the uptake of Al

REFERENCES - Wenk and Stemmer (1983) Brain Res 288, 393-401.
Birchell and Chappell (1988) Lancet 1, 1008.

Trace Elements and Anti-social Behaviour - Pb

- the neurological effects of lead relate to acetylcholine, catecholamines, dopamine and GABA transmitters
- lead acts as an anti-nutrient hindering the utilisation of Mg, Zn, vit B_1
- high Pb linked to reduction in IQ, negative ratings by teachers (classroom behaviour), juvenile delinquency, increased violent behaviour, etc.

Trace Elements and Anti-social Behaviour - Pb

REFERENCES:

Needleman *et al.* 1990, New Engl. J. Med. 322, 83-8.
Needleman *et al.* 1996, JAMA 275, 363-69.
Needleman *et al.*, 2002, Neurotoxic Teratology 24, 711-17.

Canfield *et al.*, 2003

'there cannot be defined a safe level of lead in children – even lower than 3 mcg/dl Pb effects can be expected'

Water - Dehydration

- human brain is more than 75% water, and it is very sensitive to the amount of water available to it
- a 2% drop in body water can trigger fuzzy short-term memory, trouble with basic math, and difficulty focusing on the computer screen or on a printed page
- mild dehydration will slow down one's metabolism as much as 3%

Dehydration - Effects on the Body (Symptoms)

Mild

- kidneys -urine becomes concentrated
- dry skin, mucous membranes, and lips - thirst, often extreme

Moderate

- "doughy" skin that doesn't bounce back when pinched
- dizziness / vertigo / lightheadedness
- headache - problems concentrating, drowsiness
- impatience and extreme irritability

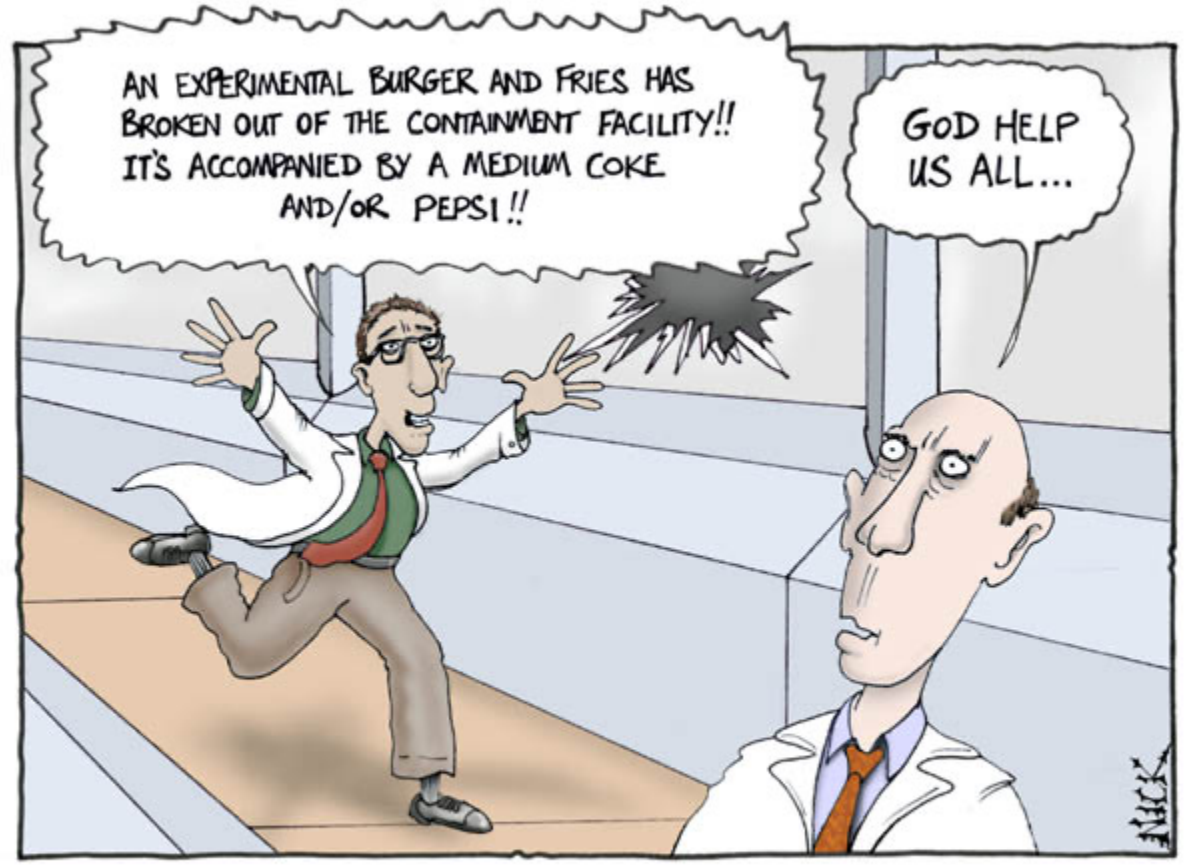
Dehydration is 'a real threat' to kids

"SOFT drinks giant Coca-Cola has warned ministers that schoolchildren risk becoming "dehydrated" if all of their products are banned from Scottish schools"

"youngsters will flock to local shops to buy fizzy drinks if school canteens are restricted to selling water and fruit juice"

http://news.scotsman.com/health

The Future – Obesity and Behaviour



1964, the height of the cold war. In an average community surrounding a little-known biological warfare institute, the obesity epidemic is quietly unleashed.

SUMMARY

- strong evidence of a link between trace element status and human behaviour
- Trace elements – diet, environment
- many of the mechanisms yet unknown
- elimination produces positive improvements
- more data and case studies required.