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The role of beverages in childhood nutrition

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A satellite symposium looking at the role of beverages in childhood nutrition was held at the 20th International Congress of Nutrition (ICN) on 16 September 2013 in the Granada Conference and Exhibition centre. The sponsored meeting, chaired by Professor Ferdinand Haschke, Head of the Nestlé Nutrition Institute brought together three eminent speakers to examine different aspects of the role of beverages in children's diets.

Hydration status in schoolchildren after breakfast

The first presentation was about a series of studies to measure hydration status in schoolchildren. Adequate hydration is a concern in children as they are more vulnerable to dehydration than adults (Benelam & Wyness 2010). Professor Gérard Friedlander, from the Inserm Research Centre in Paris, presented the results of a study that examined the osmolality (concentration of solutes in urine, expressed in milliosmoles per kg of water, hereafter mOsm) of urine from a large group of schoolchildren (n = 1495) aged 9–11 years in France, Italy and the United Kingdom (UK). These monocentric, cross-sectional and observational studies were performed successively in each of the three countries (Assael *et al*. 2012; Barker *et al*. 2012; Bonnet *et al*. 2012). The aim of these studies was to measure the incidence of elevated morning urinary osmolality and the secondary goals were to understand the determinants of osmolality and any relationship to body mass index (BMI) status and to gender. Elevated urine osmolality was defined as urine with a concentration of more than 800 mOsm, and by this measure, 63% of the children studied had elevated urine osmolality. Mean urinary osmolality of the third quartile was 1003 mOsm, indicating that a substantial number of children may have experienced a water deficit even after having breakfast. Furthermore, there was a significant difference of mean urine osmolality between the different BMI classes (International Obesity Task Force classification), which may be explained by differences in total water intake from both food and fluids. However, the difference is less striking after adjustment for country of residence and gender. Mean urinary osmolality is significantly higher in obese children than in normal weight children, but not significantly different between normal weight and overweight children. There was a trend of difference between normal weight and underweight children. Reporting on the findings by gender, Professor Friedlander explained that mean urinary osmolality was significantly higher in boys than in girls: urinary osmolality exceeding 800 mOsm was observed in 71% of boys and 56% of girls. In conclusion, hydration status in schoolchildren in the morning, as reflected by urinary osmolality after breakfast, is highly dependent on water and fluid intake.

During the question time, attention focused on the availability of water for children to drink while at school and the practicalities of managing this with young children. There was also a mention that the US Institute of Medicine (IOM) recommendation for daily total fluid intake is 1.3 l for children aged 1–3 years (IOM 2005). In Europe, the European Food Safety Authority's (EFSA) recommendation for adequate intake for children aged 2–3 years for fluid (from food and drinks) is also 1.3 l per day (EFSA 2010). For more information, a practical guide examining the issue of hydration in schoolchildren and advice on improving hydration in children has recently been published in this journal (Gibson-Moore 2013).

Milk consumption in children's growth and development

Professor Lindsay Allen from the Nutrition Department of the University of California gave a summary of the health benefits of milk in the diets of children, with a focus on the usefulness of milk in the diet when children are undernourished. Professor Allen, a world expert in micronutrients, reviewed the global evidence for the influence of milk on the nutritional status and develop-

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ment of children. Dairy products are well recognised as being an excellent source of many of the macro- and micronutrients required for optimal growth and development of children. However, milk intake of children is falling in industrialised countries and availability is poor in developing countries. Furthermore, research is ongoing into the health properties of the milk fat globule membrane, with hypocholesterolemic and anticarcinogenic properties being suggested.

Professor Allen presented a review of 35 studies [observational and randomised controlled trials (RCTs)] related to feeding fortified and unfortified dairy products to children (Dror & Allen 2013). The review concluded that in developed countries, there is either no association or an inverse relationship between milk and dairy consumption and risk of overweight, dental caries, and hypertension (small effect). A cross-sectional analysis of the diets of Canadian children aged 8–10 years (n = 610), showed that a high intake of dairy foods (two or more servings per day) has antihypertensive effects on blood pressure (Yuan *et al*. 2013), while it is well documented that bone health is improved by milk consumption (Cashman 2006). In terms of dental health, Professor Allen explained that all 11 studies on this topic, although observational, showed an inverse relationship between dairy intake and dental caries, especially for individuals with a high sucrose intake. Additionally, an academic review for the Borrow Foundation looked at 11 studies of milk consumption and dental caries risk, but no formal meta-analysis was undertaken. The review concluded that there is an absence of controlled trials, but that studies as a group show a trend towards lower dental caries with milk or dairy consumption. (Rugg-Gunn & Woodward 2011). For undernourished children, milk products can improve linear growth and improve cognitive function. In this regard, Professor Allen gave an example of a school milk programme in the UK, which started in the 1920s. In the 7 months following the start of the programme, children drinking milk had an average height gain of 0.5–0.75 cm more than that of children given an isocaloric drink. Many nutrition programmes provide micronutrient (particularly iron) fortified milk for infants and children for consumption after the period of exclusive breastfeeding, and this has been shown to be efficacious for improving micronutrient status (Daly *et al*. 1996). Professor Allen emphasised the important role that animal products such as milk play in the nourishment of children in low-income countries. Professor Allen concluded that dairy products remain an important dietary source of multiple micronutrients, and also provide children with energy, high-quality protein, and essential and non-essential fatty acids. Professor Allen commented that more RCTs are needed with children of different ages with suitable adjustment for possible confounders. She finished by saying that further work is needed to understand the growth-inducing effects of milk, to evaluate their long-term effects and to make dairy products more available to children in situations where nutrition support is needed.

Beverage nutrient density and childhood obesity

Professor Adam Drewnowski, from the Department of Epidemiology at the University of Washington presented data from US dietary surveys, and compared nutrient density scoring models. In order to set the context and discuss beverages in the diets, Professor Drewnowski outlined that diets associated with childhood obesity tend to be energy-dense but nutrient poor. He explained two possible solutions to addressing increasing obesity, namely to increase nutrient density through the consumption of more nutrient-dense beverages and foods (*i.e*. add nutrients), or to reduce the energy density of the overall diet by, for example, drinking more water in place of sugar-containing soft drinks (*i.e*. remove calories). Water from beverages and foods is the key determinant of the energy density of the diet. Drinking more non-caloric beverages, including plain water, would reduce dietary energy density and improve the dietary nutrients-to-calories ratio. Alternatively, drinking more nutrient-rich beverages (such as milk) would meet the twin objectives of reducing energy density and simultaneously improving the nutrient quality of the diet. To support this, he cited the US National Health and Nutrition Examination Study (NHANES 1999–present) dietary surveys, which show that in diets of 3–19 year-olds, milk and milk products supplies 47% of dietary calcium, but only 13% of energy. Similarly, close examination of the UK Dietary and Nutrition Survey for Infants and Young Children report shows that for approximately 1200 young children aged 12–18 months, all had intakes below the reference nutrient intake for vitamin D. Fortified milks provided 36% of the vitamin D from foods in this age group and 17% of the iron intake, while supplying 10% of energy intake (DH & FSA 2012).

Nutrient profiling such as the nutrient-rich foods (NRF) index developed by EFSA (2008) can help distinguish between energy-dense and NRFs, although Professor Drewnowski showed that a variety of nutrient profiling tools can classify the same food in different ways depending on the parameters built into the tool

[(for example, nutrient profiling models can be based on 'qualifying' nutrients known to be beneficial to health (mostly vitamins and minerals), 'disqualifying' nutrients, (mostly fats, sugars, and sodium), or some combination of both; Drewnowski & Fulgoni 2008]. Water consumption is one way to ensure adequate hydration and to reduce dietary energy density. Commenting on the US situation, Professor Drewnowski highlighted that relatively few studies have examined water consumption patterns among children. He reported the data from a recent study of three cycles of NHANES data (2005–2006, 2007–2008, 2009–2010) to assess water and beverage consumption among 4766 children aged 4–13 years. Beverages were classified into nine different groups:

- water (tap and bottled);
- plain and flavoured milk;
- 100% fruit juice;
- soft drinks (regular and diet);
- fruit drinks;
- sports drinks;
- coffee;
- tea;
- energy drinks.

Total water intakes from plain water, beverages and food were compared with dietary reference intakes (DRIs) for the United States (IOM 2005). Results showed that water and other beverages contributed 70–75% of dietary water, with the remaining 25–30% provided by moisture in foods, depending on participant's age. Plain water, tap and bottled, contributed 25–30% of total dietary water. In general, the ratio of tap to bottled water consumed in the United States was 60:40. Interestingly, Professor Drewnowski explained that tap water consumption compared with bottled water consumption is greater in higher-income households than in lower-income families. Data analysis showed that no group of US children came close to satisfying the DRIs for water. At least 78% of children aged 4–8 years, and 86% of children aged 9–13 years did not meet the DRIs for total water intake, as established by the IOM. Additional studies on consumption of nutrient-dense beverages and water among diverse socio-demographic groups will provide more information on hydration, energy density and nutrient density of children's diets in relation to bodyweight.

Summing up

Although diverse in approach, the three presentations made for a very interesting examination of the importance of beverages to children both for hydration and nutrition, and encouraging an increase in beverage intake as a potential strategy to improve the nutrient density of children's diets. Professor Haschke invited questions and comments from the audience, thanked the speakers and brought this very informative session to a close.

Overall, there was a huge array of choices of sessions to attend at this very busy congress; the final number of delegates was over 4000. From my perspective, as someone who works in infant nutrition, it was valuable to get a glimpse of the emerging science and debates in other areas of scientific interest in the field of nutrition.

Nestlé Nutrition Institute

The *Nestlé Nutrition Institute* shares leading science-based information and education with health professionals, scientists, and nutrition communities and stakeholders, in an interactive way (www.nestlenutrition-institute.org).

Conflict of interest

This was a sponsored satellite symposium presented by the Nestlé Nutrition Institute during the 20th ICN, Granada, Spain, September, 2013. Anne Sidnell is an employee of Nestlé Nutrition, UK.

References

Assael B, Cipolli M, Meneghelli I *et al*. (2012) Italian children go to school with a hydration deficit. *Journal of Nutritional Disorders & Therapy* **2**: 1–6.

Barker M, Benefer M, Russell J *et al*. (2012) Hydration deficit after breakfast intake among British schoolchildren. *The FASEB Journal* **26** (Suppl.): lb395.

Benelam B & Wyness L (2010) Hydration and health: a review. *Nutrition Bulletin* **35**: 3–25.

Bonnet F, Lepicard E, Cathrin L *et al*. (2012) French children start their school day with a hydration deficit. *Annals of Nutrition & Metabolism* **60**: 257–63.

Cashman K (2006) Milk minerals (including trace elements) and bone health. *International Dairy Journal* **16**: 1389–98.

Daly A, MacDonald A, Aukett A *et al*. (1996) Prevention of anaemia in inner city toddlers by an iron supplemented cows' milk formula. *Archives of Disease in Childhood* **75**: 9–16.

DH & FSA (Department of Health and Food Standards Agency) (2012) *Diet and Nutrition Survey of Infants and Young Children, 2011*. Edited by Lennox A, Sommerville J, Ong K *et al*. Available at: http://transparency.dh.gov.uk/2013/03/13/dnsiyc-2011/ (accessed 25 November 2013).

Drewnowski A & Fulgoni VL 3rd (2008) Nutrient profiling of foods: creating a nutrient-rich food index. *Nutrition Reviews* **66**: 23–39.

Dror DK & Allen LH (2013) Dairy product intake in children and adolescents in developed countries: trends, nutritional contribution, and a review of association with health outcomes. *Nutrition Reviews*. doi: 10.1111/nure.12078.

EFSA (European Food Safety Authority) (2008) *Nutrient Profiling For Foods Bearing Nutrition and Health Claims Summary Report*. EFSA Scientific Colloquium 9, 11–12 October 2007 – Parma, Italy. Available at: http://www.efsa.europa.eu/en/supporting/pub/119e.htm (accessed 25 November 2013).

EFSA (European Food Safety Authority) (2010) Scientific opinion on dietary reference values for water. *EFSA Journal* **8**: 1459. [48 pp.]. Available at: http://www.efsa.europa.eu/en/efsajournal/pub/1459.htm (accessed 25 November 2013).

Gibson-Moore H (2013) Improving hydration in children: a sensible guide. *Nutrition Bulletin* **38**: 236–42.

IOM (Institute of Medicine) (2005) Panel on Dietary Reference Intakes for Electrolytes and Water, Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. *Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate*. The National Academies Press: Washington DC. Available at: http://www.nap.edu (accessed 25 November 2013).

NHANES (National Health and Nutrition Examination Survey) (1999–present) *Survey Results and Products from the National Health and Nutrition Examination Survey*. Available at: http://www.cdc.gov/nchs/nhanes/nhanes_products.htm (accessed 25 November 2013).

Rugg-Gunn A & Woodward M (2011) Milk and oral health. Available at: http://www.borrowfoundation.org/assets/uploads/milk-and-oral-health.pdf (accessed 25 November 2013).

Yuan WL, Kakinami L, Gray-Donald K *et al*. (2013) Influence of dairy product consumption on children's blood pressure: results from the QUALITY cohort. *Journal of the Academy of Nutrition and Dietetics* **113**: 936–41.

