

## **The necessity for a balanced diet in children: physical, mental and intellectual development**

H Salome Kruger

School of Physiology, Nutrition and Consumer Sciences, North-West University (Potchefstroom Campus)

A holistic approach is necessary to address the child's overall development, including physical, mental, emotional and behavioural development. Many factors impact on growth and development, but malnutrition impairs both physical, mental and intellectual development. Childhood nutrition determines the risk for immediate health problems for example iron deficiency associated with poor school performance, eating disorders, obesity, under nutrition and dental caries. Nutritional status has long-term health implications as well, namely obesity, coronary heart disease and osteoporosis.

### **Nutritional status of South African children**

Studies indicate a wide range of percentages of children under any given anthropometrical cut-point for under nutrition, with pockets of malnutrition, especially in rural areas. There is a low prevalence of wasting or acute malnutrition, but stunting (low height-for-age) occurs in 20% and relative overweight in 17% of children. Critical periods of intense growth are during infancy, during adolescence. High nutritional demands during these periods make children particularly vulnerable to deficiency.

According to the SA V Aea results, 33% of children have marginal vitamin A status in 6 months to 6 year old children, with iron-deficiency anaemia ( $\text{Hb} < 11 \text{ g/dl}$ ) in 21 % of children and low red blood cell folate concentration in some groups. Multiple micro-nutrient deficiencies were described in rural black children, namely indications of vitamin A, iron and folate deficiencies. Dietary intakes of SA children indicate mostly adequate energy and protein intakes, but low calcium, iron and zinc intakes. A wide range of vitamin A, C and folate intakes were found in studies.

### **Energy and nutrients for growth and development of children**

Illness and competitive sport may increase nutritional requirements and decrease food intake of children. Children with allergies have low intakes of important food groups, for example milk may be excluded. Peer pressure has an effect on eating of snack foods. Self-imposed dieting by adolescents often leads to low intakes of nutrients.

Iron is required for optimal growth, skeletal development, cellular immunity and cognitive function. Zinc is necessary for normal growth, skeletal development and neuropsychological function. Calcium requirements of children are high due to high velocity of bone growth during infancy and adolescence, whereas iodine is necessary for normal growth and intellectual development. Iron deficiency is associated with loss of appetite, higher morbidity and growth retardation. Iron-deficient children tend to be shorter and lighter, but growth improved after iron supplementation. The mechanism for improved growth may be improved appetite and food intake, or improved cellular immunity and decreased morbidity. Iron-deficient children also have poor cognitive function and educational achievement and are less attentive and playful. The mechanism for these may be associated with the role of iron in nerve myelination or on the level of brain neurotransmitters.

Zinc plays a role in growth, via protein synthesis processes. Short stature is associated with zinc deficiency and an increase in height and food intake occurs after zinc supplementation. The mechanism for these is probably an increase in insulin-like growth factor-I after zinc supplementation. Children have high calcium requirements during growth spurt periods. About 25% of peak bone mass depends on calcium intake and physical activity during childhood, which decreases risk of osteoporosis later in life.

Lower calcium intakes are due to exclusion of milk, for example in fad diets. The teenage period is associated with its growth spurt and high demand for calcium. Milk in the diet is associated with higher calcium intakes and higher levels of insulin-like growth factor (IGF-I). High milk intakes have no detrimental effect on iron status. The intake of low-fat milk products is recommended for dieting teenagers.

Children from iodine sufficient regions have higher IQ scores than children from iodine poor regions. Children born more than 3.5 years after implementation of an iodine supplementation programme had significantly higher IQ scores (12-17 IQ points) than children born before the implementation of the programme. Iodine status plays a crucial role in the intellectual development of children. In SA iodine has been added to table salt since 1995.

High calcium intakes may interfere with iron absorption. In a supplementation trial 1500mg Ca/day was still associated with favourable serum ferritin and haemoglobin levels (Ilich-Ernst *et al.* Am J Clin Nutr 1998;68:880-877). High zinc intakes may interfere with iron absorption, but such interactions are only likely to be important at levels of intake achieved by the use of supplements. The recommendation is to take supplements between meals (Fairweather-Tait. Proc Nutr Soc 1995;54:465-473).

Key vitamins for child development include vitamin A for normal growth, eyesight and immunity, and folate for growth and development of new cells. B-vitamins are involved in behavioural and cognitive outcomes. Vitamin A is essential for growth, eyesight, bone development, immunity and healthy epithelial tissue. The mechanism for growth regulation is through regulation of nocturnal growth hormone secretion or by reduction of infection, thereby allowing optimal growth. Folate is essential for cell division and development. There is an increased demand during the growth spurt periods. Folate deficiency is associated with megaloblastic anaemia, an increased risk of cardiovascular disease and an increased risk of babies born with neural tube defects. Other B-vitamins are linked to a variety of behavioural and cognitive outcomes. Vitamin B6 plays a role in neurotransmitter systems of learning and memory. Most results are from observational studies, with no definite proof of cause and effect (Wachs. J Nutr 1995;125:2245-2254).

Breastfeeding; alcohol and smoking Studies in low-birthweight infants show an advantage of breastfeeding in cognitive function measured by IQ points. These studies are difficult to interpret, because socioeconomic factors confound the association between breastfeeding and cognitive function. Breastmilk has higher concentrations of certain fatty acids than cow's milk, especially docosahexaenoic acid (DHA). Low intakes of omega-3 fatty acids during early child development lead to changes in visual acuity in human infants. Results of studies indicate that overall nutritional status (measured as head circumference) and educational status of the mother have a stronger association with childhood intellectual development than breastfeeding only. Maternal smoking was negatively associated with IQ (Auestad *et al.* Pediatrics 2003;112:e177-183).

The Western Cape farm areas has the highest reported rate of foetal alcohol syndrome (FAS) in the world (65-74 per 1000 children). FAS is associated with poor growth and development and lower

intellectual functioning and negative behaviour outcomes (Viljoen *et al.* J Stud Alcohol 2005;66:593-604). Stunted children had significantly lower intelligence and academic achievement scores than children of normal height (Wheeler *et al.* Arch Pediatr Adolesc Med 2004; t 58:236-43).

### **Eating habits of children**

Childhood offers a unique opportunity to positively influence the adoption of healthful eating and physical activity patterns. Adolescents as a group have poor eating habits that do not meet dietary recommendations. Concerns include unhealthy dieting, skipping meals, high intakes of fast foods and cold drinks, low intake of milk, fruit and vegetables. These are due to social and environmental changes, including growing independence, eating away from home, peer pressure and concern with physical appearance.

The environment changed over the past decades, with more tasty, energy-dense foods generally available and more sedentary lifestyles. Children's eating habits changed:

they eat more high fat foods and drink more cold drinks. The additional kJ intake provided by cold drinks is about 800kJ extra /day, up to an additional 4000kJ/day. Milk consumption among adolescents decreased dramatically. Cold drinks replaced milk in the diet. An increasing body of literature suggests that dairy calcium may play a role in maintaining stable body weight. Overweight children had an increased risk factors, such as increased blood pressure and total serum cholesterol. Long-term low intakes of milk were associated with shorter stature, with more body fat and poor bone health. SA studies showed that children had low intakes of milk, fruit and vegetables and thus low intakes of calcium, vitamin A and C.

### **Recommendations**

Recommendations are to match nutrition intervention strategies with factors that motivate children to select a certain diet and lifestyle. More research is necessary to determine the motivational factors that affect children's food and activity choices. School and community based programmes that promote regular physical activity and healthy eating among children could be the most effective strategy for reducing the burden of chronic diseases associated with sedentary lifestyles and unhealthy eating patterns. Schools can be an environment where healthy lifestyle is reinforced, by encouraging policy to restrict the sale of soft drinks and foods high in fat and sugar in the school environment. Nutrition information can be displayed in school tuck-shops and pricing in tuck-shops can have a strong effect on food choices. Department of Education, teachers, school governing boards and children's representatives should work together to create a more healthy school environment that fosters good eating and physical activity habits. Interventions to improve the mineral and vitamin nutritional status of children have a positive impact on growth and health of children, educational outcomes, productivity as adults and eventually national economies.