Summary

The studies described in this thesis evaluate the nutritional status of asylum seekers’ children living in The Netherlands; dietary intake, biochemical and anthropometrical aspects are examined. The number of asylum seekers in The Netherlands increased at the end of the twentieth century. It is likely that nutritional habits of asylum seekers are influenced by the altered living conditions dependent on their own cultural background, knowledge of local food and guidelines, and the price of food. It has remained unclear if the nutritional habits of the asylum seekers cause a risk for adequate nutrition and growth of their children. Chapter 1 introduces the subject and gives an outline of the study. The assessment methods for dietary intake, growth monitoring, and biochemical evaluation of iron and vitamin D status and of the bone density are described.

Chapter 2 describes the dietary intake of 116 asylum seekers’ children aged 2-12 year from Africa, Central Asia and Eastern Europe estimated by a dietary interview (24hr recall). The dietary intake was compared with the Dutch nutritional guidelines. Micronutrient intake was considered marginal if below 80% of the Dutch Recommended daily allowance (RDA). Twenty-four percent of all children had a fat intake above the maximal recommended amount of 40En %. Of the total energy intake the fat percentage of the African children (33En %) was below that of the children of Central Asia (37En %) and Eastern Europe (38En %). A saturated fat intake above the 10En% tolerable upper level was found in 70% of the children above 4 years of age. Children of Eastern Europe had the most unfavourable fat and disaccharide intake. The micronutrient intake was marginal for calcium in 42%, for iron in 49%, for vitamin A in 45% and for vitamin D in 80% of the children. The youngest children had the lowest intake of iron and vitamin D. With an increasing age more children with inadequate calcium intake were found. The high percentages of children with a dietary inadequacy indicate the need to implement strategies to improve the dietary intake of asylum seekers’ children in The Netherlands.

In Chapter 3 the growth of children of asylum seekers during their stay in The Netherlands was monitored with the use of the Dutch reference curves. The 135 participating children were a representative sample of the more than 12,000 children staying at Dutch asylum centres, with regards to age, gender, and length of stay and region of origin. At arrival 13% of the children were small for age (below -2SD of the Dutch height for age reference). This percentage reduced to 5% during the follow-up of about 3 years. At the same time the mean height for age remained between the ±3 cm (boys) or ±4 cm (girls) of the Dutch reference height. African children were slightly taller than their peers of Eastern Europe or central
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Asia. The proportion of children crossing the BMI cut-off values for overweight and obesity increased from 15% at arrival to 21% at follow-up. The increase of overweight and obesity was the highest among the children from Eastern Europe whereas the African children had the highest waist-hip-ratio. This study shows that using Dutch reference curves can meaningfully monitor growth and nutritional condition of asylum seekers’ children. Prevention strategies to reduce the development of overweight and obesity among these children seem warranting.

Chapter 4 reports the iron status of a representative sample of 123 asylum seekers children in The Netherlands age 2 to 12 year by haematologic screening (haemoglobin and plasma ferritin). Iron deficiency (ID) was defined as plasma ferritin below 15 µg/L. Anemia was defined as haemoglobin (Hb) below 6.8mmol/l (11 g/L) for children under 6 years and Hb below 7.1mmol/l (11.5 g/L) for children between 6 and 12 years. Based on specific criteria thalassemia was examined in a group of children by Hb electrophoresis or DNA-analysis. The prevalence of thalassemia, iron deficiency anemia (IDA) and of ID without anemia among asylum seeker’s children in The Netherlands was 6%, 4% and 16%, respectively. Thalassemia was not associated with different plasma ferritin levels. Plasma ferritin levels below 15µg/L (ID) were more frequent found among children below 6 years of age and in children originating from Africa. Although approximately 50% of the children below 6 years of age had been born in The Netherlands, this was not associated with presence or absence of ID. Children with a relatively higher body weight (Higher BMI-Z scores) appeared to have more often an adequate iron status. The iron intake was marginal (below 80% of the recommended daily allowances) in 49% of the children. Adequate or marginal dietary iron intake was not significantly related to the presence of ID. Our results indicate that systematic biochemical screening on ID in asylum seekers children in The Netherlands because of the known long-term effects on psychomotor development is warranted.

Chapter 5 describes the vitamin D status of asylum seekers in relation to season and supplement use. The endogenous synthesis of vitamin D in the skin, stimulated by the ultraviolet radiation of the sun, is limited in The Netherlands between September and April. The prevalence of vitamin D deficiency (VDD) and the mild shortage of vitamin D (hypovitaminosis D) were estimated in 2-12 year old children living in asylum seekers’ centres in the north of The Netherlands. The serum concentrations of 25-Hydroxyvitamin D \([25(\text{OH})\text{D}]\), intact parathyroid hormone (I-PTH) and plasma alkaline phosphatase (ALP) were assessed. Vitamin D deficiency (VDD) and hypovitaminosis D were defined as \(25(\text{OH})\text{D} \) below 30 or 50 nmol/L, respectively. With a part of the children the vitamin D status assessment could be repeated after summer (3 months later) to measure the effect of
the summer months (with likely higher doses of ultraviolet radiation of the sun) on the vitamin D status. All children were advised to expose their skin to the sun for at least 30 minutes daily. Half of the children were randomly assigned to receive a supplement of 400 IU vitamin D daily for three months. None of the children showed classical symptoms of bone deformity due to VDD such as bowed legs, swelling of wrists, rickets rosary or muscle weakness. Mid-spring, (April-may) 13% of the children had Vitamin D deficiency, and 42% had hypovitaminosis D. The prevalence of VDD was significantly higher in African children, compared to children from Central Asia or Eastern Europe. Serum 25(OH)D levels were profoundly lower in African children above 6 years than in African children below 6 year or Eastern European children above 6 year. After the summer median 25(OH)D increased with 42% in children without supplementation and with 85% in children with supplementation. The effect of supplementation was most prominent among African children. Although serum 25(OH)D levels increase in African children during Dutch summer month, this does not completely correct the compromised vitamin D status found in spring. Our data indicate that children from African origin would benefit most effectively from vitamin D supplementation.

In **Chapter 6** we describe the bone mineral density measured by a dual X-ray absorptiometry (DEXA-scan) of a group of 13 asylum seekers’ children with VDD in relation to the dietary calcium intake. The bone mineral density of the spine was expressed as Z-score for gender and age. The median lumbar spine bone mineral density (LSBMD g/cm²) was Z-score –1.84 (range –2.99, -0.47) of the Dutch reference. The lumbar spine bone mineral apparent density was positively related to the estimated calcium intake of the children. (r=0.59, p=0.03) These results indicate that adequate calcium intake can reduce the negative effects of low serum levels of vitamin D. The preventable character underlines the importance of adequate nutritional education with respect to vitamin D and calcium intake for asylum seekers' children in The Netherlands.

In **chapter 7** the findings as presented in the preceding chapters are combined and discussed. The presented studies have clearly demonstrated that asylum seekers' children of different background are vulnerable for unfavourable dietary habits that can affect their growth and development. It appears likely that unfavourable high fat intake and low micronutrient intake is influenced by the negative relationships that exist between energy density and food price. Those unfavourable diet habits are most likely related to the observed increase of overweight and obesity among the asylum seekers' children. The prevalence of Iron deficiency observed among the asylum seekers' children appeared to be related to the children’s origin; there was only a very limited influence of the current
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dietary iron intake. Based on this observation systematic screening, followed by evaluation and intervention of children with a low iron status appears most beneficial. Many asylum seekers’ children have a compromised vitamin D status in spring, which inadequately improves during summer. Together with the marginal calcium intake this threatens the bonemineralization that is ultimately important for a strong skeleton in further life. A multifaceted strategy including early detection, preventive nutritional education and provision of supplementation seems justified.

P.S. Based on the results presented in the thesis the indication of free vitamin D supplements is reconsidered, nutritional education is explicitly implemented in the health-education-program for asylum seekers’ children, the used nutritional education material for asylum seekers’ children in all regions of The Netherlands is updated. The financial budget for asylum seekers children has increased to the advised budget of the Dutch Budget Institute (NIBUD)