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Nutritional assessment of asylum seekers' children in The Netherlands

Annette Agnes Maria Stellinga-Boelen

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Studies described in this thesis were performed together with the Community health Services for Asylum Seekers (Medische Opvang Asielzoekers Noord Nederland), Pediatric Gastroenterology, University Medical Centre Groningen, University of Groningen department of Clinical Chemistry, KCL, Medical Centre Leeuwarden, and the department of Health Science, University Medical Centre Groningenn, University of Groningen.

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Daniël Pieter Stellinga

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We zijn vijf maanden bij mijn oma in huis geweest. Er waren veel granaataanvallen en luchtalarmen. Heel veel gebouwen zijn afgebrand en elk huis is door minstens een granaat geraakt.

Mak en ik sliepen op de grond, mijn moeder en vader op een bank. We hadden bijna niets te eten. Een beetje rijst, spaghetti en soms bonen.Andere groente was er niet, alleen een tomaat die we in stukjes sneden voor Mak, Deni en mij...

We zijn allemaal magerder geworden, behalve Asja. Zij Krijgt geen voedselhulp, maar ze eet met ons mee. Arm dier, ze wordt nooit uitgelaten. Toch heeft ze meer Geluk dan andere honden die hun baasje hebben Verloren.

- Lana, 8 jaar, uit Sarajevo

Overgenomen uit: Ik droom over vrede
Tekeningen en teksten door kinderen uit het voormalige Joegoslavie.
Unicef 1994

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Annette Agnes Maria Stellinga-Boelen

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te Beverwijk

Promotor:	Prof. Dr. H.J. Verkade
Copromotor:	Dr. C.M.A. Bijleveld
Beoordelingscommissie :	Prof. Dr. A.F. Bos Prof. Dr. H.S. Heymans Prof. Dr. M.J.H. Slooff

Voor

Amina, Abdella, Gina, Ajla, Badmah,Mazen, Sadiq, Satenik, Aliaa, Faduma, Shirkhan, Erfan, Mucharbiek, Jasin, Tazi, Ali, Mohammed, Omid, Lena, Mariana, Tamerlan, Orchan, Dimitri, Baschar, Zhora, Ramin, Bellal, Dunya, Francisca, Senahid, Harutyun, Selsela, Liliana, Walodja, Narine, Faris, Aram, Nadiesda, Jamilla, Veysu, Yusuf, Elbeson, Wannis, Edgar, Miguel, Francesco, Andrea, Meryem, Ketura, Melton, Meggie, Mustafa ....., ..., ..., ...,

alle kinderen die al jaren in asielzoekerscentra wonen

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CHAPTER 1

General introduction and outline of this thesis

Chapter 1

1 Introduction

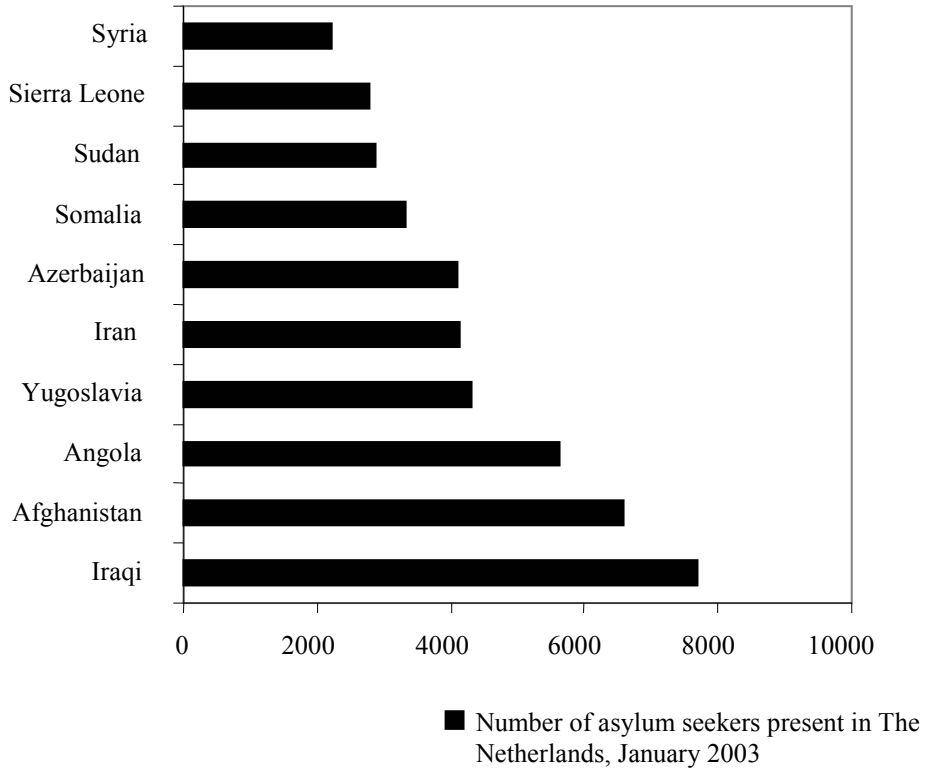
The growth and nutritional status of children is influenced by genetic and environmental factors. Children of migrants are exposed to changing environmental factors. Nutritional practise among migrants is correlated with their traditional and cultural habits, socio-economic status, the availability and affordability of food products and their integration status.[1-3] In the last decennia in Western Europe the number of new migrants has increased of which many were asylum seekers. The nutritional status and growth of asylum seekers' children may be influenced by the altered living conditions. It has remained unclear to what extent the growth and nutritional status of asylum seekers' children are at risk. The studies described in this thesis aim to evaluate the growth and nutritional status of asylum seekers' children living in The Netherlands. First, this introductory chapter describes the background of the asylum seekers, the asylum procedure in The Netherlands and the health risks of asylum seekers' children. Second, a short introduction is provided on adequate nutrition and on monitoring techniques of the nutritional status. Finally, the scope of this thesis is described.

2 Asylum seekers in The Netherlands

Millions of people worldwide migrate from their home countries because of war, armed conflicts, famine, human rights violations and natural disasters or to escape from poverty. Thousands of those people from all over of the world are requesting asylum in The Netherlands.[4] An individual who has left his or her country of origin and has requested asylum, but for whom it has not yet been established whether he or she qualifies for an asylum residence permit is called “asylum seeker”. An asylum seeker who has qualified for an asylum residence permit is called a “refugee”. According the covenant of Geneva (1951) the criteria for a person to be considered a “refugee” are a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular social group or political opinion. Is outside the country of his or her nationality and is unable, or owing to such fear, is unwilling to avail himself or herself to the protection of that country; or who, not having a nationality and being outside the country of his formal habitual residence as a results of such events, is unable or, owing to such a fear, is unwilling to return to it. (www.UNHCR.org) Refugees are mainly accommodated in their geographic region of origin, but, on request of the United Nation High Commissioner for Refugees (UNHCR), some groups are accepted in other countries. The Netherlands accept annually 500-700 of these refugees. (www.ind.nl) Apart from these accepted refugees the number of asylum seekers requesting a residence permit in The Netherlands increased at the end of last Millennium up to almost 40.000 on annual bases. Since that period parallel to more restrictive alterations in the asylum procedure in 2001 the number of asylum seekers has decreased.

In The Netherlands since 1994 the Ministry of Justice has been responsible by law for the service provided to asylum seekers. The Central Organisation of Asylum seekers (COA) provides accommodation and coordinates facilities such as education for children less than 18 year of age and leisure activities. In March 2003 more than 12.000 children aged 2-12 years were living in a reception center for Asylum seekers in The Netherlands. (www.coa.nl) Asylum seekers accommodated by the COA predominantly originate from Iraq, Afghanistan, Angola, Somalia, Azerbaijan, former Yugoslavia and Iran. (Fig 1)

Figure 1



In 2002 more than a thousand babies were born to asylum seeker parents in The Netherlands Altogether a third of the asylum seekers were under 19 year of age.

2.1 Asylum procedure

Every foreign national has the right to apply for asylum; "asylum" is considered a form of protection. When somebody applies for asylum the Immigration and Naturalisation Service (IND) investigates whether orf not he or she qualifies for an asylum residence permit. People who are refused asylum in The Netherlands must leave the country as quickly as possible. The IND assesses asylum requests based on the Alien Act. (www.justitie.nl) In general, an alien qualifies for an asylum residence permit:

- if he or she fears persecution because of his or her race, religion, nationality, political convictions;

- if he or she belongs to a specific social group in his country of origin;
- if he of she runs the risk of being subjected to inhumane treatment (such as torture) in his or her country of origin;
- if he or she suffers specific, traumatic experiences in his or her country of origin and/or
- if the Minister for Alien Affairs and Integration considers the situation in a persons' country of origin not safe enough for him or her to be repatriated.

A person has no right to asylum:
- if another country is responsible for processing the asylum application (Dublin procedure regulation of the European Council EU 3432003) and/or
- if a previous asylum request in The Netherlands has been rejected and no new evidence has been produced or new circumstances have arisen that would justify reversing that decision.

The Dublin procedure means that an asylum application cannot be dealt with in The Netherlands in case the asylum seeker has entered the European Union through a third country that has issued the asylum seeker a visa, or the partner of child of the asylum seeker has already been granted official refugee status in that country. (www.europa.eu.int) An asylum request will also be rejected under The Netherlands Alien act if the IND has clear indication that the asylum seekers have committed a public order offence in The Netherlands or some third country (by committing a crime for example). Article 1F of the 1951 Geneva Convention on Refugees states that people who have committed war crimes or are a terrorist is not entitled to asylum protection.

An asylum application in The Netherlands has to be submitted at an application center (AC) The AC procedure starts with an interview; investigating an asylum seeker's identity, nationality and travel itinerary. After the first interview the IND decides whether the asylum application can be processed further at the AC or whether more time is needed for investigation. If the application merits further processing the asylum seeker will be interviewed further at the AC. During the subsequent interviewing a counsellor (legal assistance) may be present at the interview. If an asylum seeker applies together with his or her wife/husband or partner they will be interviewed separately by an officer of the IND. Children 15 year of age or older who are accompanied by their parent(s) are also interviewed separately. The procedure in the AC takes a maximum of 48 (office)-hours, spread over a number of working days. In general this means asylum seekers stay in the AC for four to six working days. If, after the first interview, more time is needed to decide on an asylum request, the asylum seeker will be referred to a reception center that is organized and controlled by the Central Reception Organisation for Asylum Seekers (COA) and travel from there to the IND screening office for appointments. (www.immigratiedienst.nl)

An independent legal assistance counsellor [usually someone who works for the Asylum Seekers' Legal Aid Foundation (SRA)] helps asylum seekers to prepare for further detailed interview. Asylum seekers do not have to pay for this form of legal assistance. After the detailed interview has been completed the asylum seeker returns to the reception center to wait for the decision on his or her application. Asylum seekers receive a report of their detailed interview. If they do not meet the criteria in the Aliens Act they will be given written notification of the intended decision to reject their asylum application. The written notification states the reason for rejection. Asylum seekers are given time to read the report and the intended decision with their legal assistance counsellor. Subsequently they may submit their responses (views) on the intended decision. Based on this response the IND decides whether the intended decision should remain in effect or whether the asylum procedure has to be continued by the screening office. If, based on, the detailed interview the IND concludes that further investigation is needed the asylum seeker will receive a written report, but will not be informed about the intended decision. This means that the asylum application has to be processed further by the screening office. In general, a decision on an asylum request must be made within six months after the application has been submitted. In some cases however more time may be required. The Minister for Alien Affairs and Integration may also invoke a statutory provision for postponement of the decision for certain categories of asylum seekers because of a "specific general" safety situation in their country of origin, or because of a large number of asylum applications having been received from a particular country or region. A statutory provision for postponement is not related to a specified period of time when it covers groups of asylum seekers. The asylum procedure has two possible outcomes: 1. The asylum application will be granted. If the application has been granted asylum seekers may stay in The Netherlands for the time being. In principle an asylum residence permit is always issued for a fixed period. After this period an application may be submitted for conversion into a permanent permit of residence. In some cases this will not be granted, for example when someone constitutes a danger to public order. If this is the case the asylum seeker must leave The Netherlands. 2. The asylum application has been rejected. If the application has been rejected asylum seekers have the right to appeal against the decision. Asylum seekers may not stay in The Netherlands while their appeals are being processed, except when they request the court for an interim provision. They may usually stay in The Netherlands while such an interim provision is being considered. If the court rejects the appeal all legal remedies are exhausted and they must leave The Netherlands within the period of time stated in the written decision and return to their country of origin. If they do not leave independently within the stipulated period they may be deported or repatriated under supervision. By law the IND is not entitled to inform the authorities of a person's country

of origin that they have applied for asylum in The Netherlands. For assistance with repatriation rejected asylum seekers may turn to the international Organisation for Migration (IOM). The IOM will inform them about financial and other support to which they might be entitled on returning to their country of origin. (www.iom.int)

2.2 Health of asylum seekers

To study the health of the increasing number of people who migrate from their home countries because of war, armed conflicts, famine, human rights violations, natural disasters or poverty and request asylum in a foreign country is of public health interest. Many asylum seekers in The Netherlands come from countries where infectious diseases such as AIDS, tuberculosis and hepatitis B are endemic. Epidemiological studies show that asylum seekers, refugees and other displaced people are prone for health problems such as mental health problems, drugs use, positive HIV status and nutritional problems.[5-13] These health risks usually stem from exposures or experiences in their country of origin and during their migration, which can influence their health and well-being. Beside these experiences the length of stay in a reception center, the uncertainty and the prospect of perhaps being sent back to the situation they have been forced or decided to flee from, also affects their health and well-being. Some asylum seekers have been traumatized by these experiences. Several European publications reported about those specific health problems of asylum seekers including female mutilation, post traumatic stress syndrome (PTSS).[14-19] Information on the health problems of asylum seekers in The Netherlands has focussed on the health care use of asylum seekers in this country, on age screening with bone or teeth development, on psychological problems, on infection diseases such as parasites and tuberculosis and on causes of mortality.[20-30] Studies specific among refugee and asylum seekers' children show growth and nutritional disorders such as caries, iron deficiency, bowel parasites, stunting and obesity among them.[31-33] Children of migrants in general show to be vulnerable for several nutrient deficiencies.[34-38] Nutritional deficiencies occur when people do not have access to micronutrient rich food such as vegetables, fruits, animal products and fortified foods, usually because they are not affordable or locally not available. Asylum seekers, who's financial means are based on regulations of the Ministry of Justice, have a limited budget. Until the end of 2004 the food allowance for asylum seekers who had to organize their own food was stipulated at €7.26 per week for a child below 11 year of age. Since 2004 these allowances are being increased, to reach the minimum necessary food allowance estimated by the Dutch budget institute in 2009. Whether the nutritional status of asylum seekers' children in The Netherlands is threatened or not is unknown. Information on the nutritional practice and dietary (in)adequacy of asylum seekers' children in The

Netherlands is not available. In practice the nutritional status of asylum seekers' children in The Netherlands is monitored with a physical examination after arrival and follow-up of the anthropometrical parameters according the Dutch preventive Youth Health programme. The value of the follow up of growth of asylum seekers' children of many different nationalities with the use of the Dutch national references growth–curves has not been evaluated. Specific dietary assessment will not be performed and information on the micronutrient status of asylum seekers' children in The Netherlands is not available. With the studies described in this thesis nutritional aspect of health of asylum seekers' children are investigated.

3 Nutrition

Food provides the energy and nutrients needed for activity, growth and development of children. The quantity and composition of the dietary intake is important to meet the various requirements of the body. Adequate nutrition contributes to the well-being of children and their potential learning ability. Nutrition in childhood needs to be taken seriously in order to improve health and optimise neurodevelopment outcome.[39] In recent years many studies showed that an unfavourable nutritional practice can be correlated with illnesses such as obesity, arteriosclerosis, rachitis and caries or even preventable chronic diseases.[40-42] To prevent those nutritional disorders nutritional education that informs people about the hazards of food habits is important. Guidelines on good nutritional practice in The Netherlands are based on the dietary reference intake formulated by the Dutch Health Council (Gezondheidsraad). The Dutch Health Council formulates dietary reference intakes for infants, children and adults; the recommended daily allowances for children are shown in table 2. [43,44] The term "dietary reference intake" is a collective term for the estimated average requirement, recommended dietary allowance, adequate intake and tolerable upper intake level. The requirement for a nutrient is the intake that prevents symptoms of deficiency and keeps the risk of chronic diseases as small as possible. Given a requirement with a normal distribution, the estimated average requirement is the level of intake that is adequate for half of the population. The recommended dietary allowance is calculated as the estimated average requirement plus twice the standard deviation of the requirement. This intake is adequate for virtually all of the individuals in this group. Where the estimated average requirement is unknown the determined sufficient level of intake for the entire population is called 'adequate intake' and the tolerable upper intake level specifies the level above which there is a chance that adverse effect will occur.

Table 1 Dutch Recommended daily allowances

Age (years)	**Gender**	**Nutrients**								
		Energy (KJ)	Protein (EN%)	Fat (EN%)	Saturated fat (En%)	Carbohydrates (En%)	Calcium (g)	Iron (mg)	Retinol (µg)	Calciferol (µg)*
1-3	M	4500 - 5000	20	25-40	15	45	0.5	7	400	5.0
	F	4200 - 4700	20	25-40	15	45	0.5	7	400	5.0
4-8	M	6200 - 7200	25	20-35	10	45	0.7	7	500	2.5
	F	5700 - 6500	25	20-35	10	45	0.7	7	500	2.5
9-13	M	9400 -10600	25	20-35	10	45	1.2	10	700	2.5
	F	8600 - 9500	25	20-35	10	45	1.1	11	700	2.5

*RDA needs to be doubled by no exposure to sun or dark pigmented skin

M=male, F=female allowances for protein and saturated fat are upper limit.

3.1 Macronutrients

The macronutrients fat, protein and digestible carbohydrates are the compounds in the diet that provide energy for which the body has a physiological requirement for proper growth and development. Whether the proportion of fat, protein and carbohydrates of the total energy intake makes a different for growth and health of the body has been the topic of several studies.[45-47] No simple direct forward conclusion can be made however the fat percentage of the total energy intake and the composition of the fat intake is in general considered the most important nutrition health indicator for children.[48] The Dutch dietary guidelines recommend a moderate fat diet consisting of < 30% energy from total fat and <10% from saturated for every one over the age of 2 year. In order to prevent overweight and undesirable weight gains the daily composition of a recommended diet is assigned for individuals to a calorie level based upon their gender, age and the physical activity level. A high dietary fat intake is associated with the serum levels of high-density lipoprotein, cholesterol and triglycerides. High serum levels of blood lipids are correlated with abdominal fat distribution, systolic blood pressure and left ventricle mass.[49] Elevated blood

lipids in childhood predict a continuing high level of lipids in adulthood.[50,51] Beside appropriate fat intake sufficient intake of complex carbohydrates, for example through whole-wheat and other whole-grain cereals, fruits and vegetables, has been emphasized to reduce the risk on colic cancer, diabetes and cardiovascular diseases related to arteriosclerosis.[52] A varied selection of vegetables, legumes, meat and diary products usually suffices to meet all protein needs while increasing complex carbohydrate consumption and reducing fat intake.[53]

3.2 Micronutrients

Micronutrients are needed only in small amounts; these substances enable the body to synthesize and/or activate enzymes, hormones and transport proteins essential for proper growth and development. Despite the small amounts needed the consequences of insufficient availability can be serious. Micronutrients can be classified according to the response in children to their deficiencies. Type I nutrients manifest their deficiency by alterations in specific biomarkers and by relatively early clinical signs and symptoms. Anthropometrics may contribute little to the recognition of theses deficiencies. The administration of the deficient nutrient may correct all or most of the alterations, underlining reversibility. All water-soluble and all lipid soluble vitamins and several minerals among which iron and calcium are classified type I.[54] Type II nutrient deficiencies lack specific biomarkers for identification remain unrecognised until they are severe or growth falters. Micronutrient deficiencies in general may not result in readily identifiable clinical symptoms at a functionally important level.[55,56] Micronutrient deficiencies, particularly involving iron, zinc, vitamin A-B11-B12-D, remain a major problem for children in many countries. Nutritional intervention programs like food fortification, supplementary feeding and nutritional education have shown to be of great value to reduce micronutrient deficiencies among children.

4 Monitoring nutritional status

The goal of nutritional monitoring in childhood is to prevent nutritional disorders and to minimize associated morbidity and mortality. Nutritional assessment is the quantitative evaluation of nutritional status. A comprehensive nutritional assessment has three components: dietary assessment, growth monitoring including physical examination, anthropometrical measurements and laboratory investigations

4.1 Dietary assessment

Dietary assessment aims to determine the quantity and quality of the food that is consumed by the infant or child and the eating behaviours of the family. The thus obtained information on nutrient intake is compared to age-specific recommended intake to assess the likelihood of either under nutrition or overeating. Short- and long-term assessment methods are available to estimate the dietary intake in children. Short-term dietary assessment methods collect dietary information on current intake. They vary from recalling the intake from the previous day to keeping a record of the intake of food and drinks over one or more days (dietary record). Long-term dietary assessment methods collect information on food intake over previous months (dietary history or food frequency questionnaires). Each method has its own strengths and weakness and there is no single ideal method. To assess the average intake of a group or population a single 24hr recall has been advised.[57,58] Disadvantage of the method is that the size of the nutritional portion is difficult to estimate accurately. To overcome this, a picture book including country specific dishes with additional household measures and other relevant measurements has been recommended.[59] A single 24h recall does not represent the usual individual intake due to intra-individual variability but characterizes the intake of a group fairly well. The 24h recall which is applicable for broad populations of different ethnicity, does not require literacy and the "burden" for the respondent is relatively small. The 24h recall can be used with acceptable internal and external validity in children who are 10 years or older. Among children below 10 ears, the help of parents or guardians is necessary to obtain an accuracy of reporting that is comparable to that found in adults.[60] The investigator asks the respondent to enumerate the foods and beverages consumed in the preceding full day, including their quantity. The reliability of the interview depends on the skills of the interviewer to get detailed and complete answers and to control the accuracy of data.

4.2 Growth monitoring

Growth measurements are important components of the nutritional assessment of children by which clinicians assess the health and well-being of children. Height and weight are in the primary health clinic the most regularly used anthropometrical measurements. To increase the accuracy of the anthropometrical measurements a protocol is necessary to minimize the chances of technical mistakes. More recently the calculated body mass index (BMI) is added. The BMI is calculated by the height in centimetres divided through the quadrate of the weight in kg. These measurements are useful only if the clinician is able to correctly interpret them by converting absolute values to relative standards for the

appropriate reference population.[61] For the BMI international references have been developed to identify individual children or populations at risk for overweight and obesity.[62] The international criteria for overweight and obesity based on the BMI strongly correlate with the amount of body fat.[63] The estimation of the body fat content can be accomplished by anthropometrical measurements such as mid-upper-arm circumference (MUAC), triceps skin fold thickness (TSFT), waist circumference (WC), hip circumference (HC) and the waist-hip ratio (WHR). The measurements of skin fold thickness are widely used because the techniques are non-invasive, inexpensive and easy to perform in clinical settings.[64-67] Measurements of skin fold thickness are often less accurate than measurement of height and weight. However, skin fold thickness may be useful in prospective estimation of body fat content, for example in obese children.[68] Overweight and obesity correlate with an increased risk of cardiovascular disease in children like in adults.[69-75] Growth in general is considered the best indicator for general health of children. Monitoring growth and nutritional status can be useful to provide tailored nutritional education that can limit the hazards of nutritional inadequacy.

4.3 Laboratorial investigations

Dietary history has shown to be insufficiently sensitive to detect micronutrient deficiencies.[76] Instead, biochemical tests on plasma or serum samples have been proven useful for assessment of micronutrient status.

4.3.1 Iron

Iron is an essential nutrient in humans. Heam-bound iron is important for the transport of oxygen in red blood cells and in mitochondria of nucleated cells. During childhood the body iron stores are primarily determined by dietary iron intake. Common factors leading to an imbalance in iron metabolism include: insufficient iron intake, decreased absorption due to poor dietary sources of iron or increased iron loss (usually by blood loss). The first grade of iron deficiency is called latent iron deficiency, in which low iron intake is compensated by enhanced absorption efficacy without depletion of the storage. More enhanced iron deficiency implies a depletion of the iron stores and a reduced ferritin level in the serum (grade 2). Finally, in the third grade the heam content in the red blood cells is reduced and a microcytair anemie develops.[77] Only third grade iron deficiency gives clinical symptoms such as paleness, tiredness, growth reduction, anorexia and sensibility for infections starts) to develop.

The cornerstone of the biochemical identification of Iron Deficiency (ID) is a low serum ferritin concentration.[78] However, ferritin is an acute-phase reactant and may be elevated during infectious of inflammatory illnesses, independent of ID. To account for "false positive" elevation of serum ferritin levels because of inflammation, determination of complement reactive protein (CRP) concentration in plasma is needed. Prevention or early detection and treatment of ID are of great importance since ID adversely affects the cognitive performance behaviour and growth of infants, pre-and school aged children.[79-84] In the United States the prevalence, of Iron deficiency anemie (IDA) in children, has been declining due to improved iron supplementation.[85,86]

4.3.2 Vitamin D

Vitamin D is important for calcium absorption bone accretion and growth. Calcium is a major component of the skeleton and plays important metabolic, cellular and organ functions. Calcium is essential in chemical signalling within cells, promoting transmission of nerve impulses, inducing muscle contraction, initiating blood-clotting participating as a cofactor for many enzymes and hormones regulating cellular proliferation and maturation. Vitamin D and calcium are required for bone health. [87] The intake of both calcium and vitamin D, throughout all stages of life, likely affects the risk of osteoporosis and bone fractures in later life.[88] The fat-soluble vitamin D is absorbed from the small intestine and incorporated into chylomicrons. Nutritional sources of vitamin D (cholecalciferol) are limited and endogenous non-enzymatic biosynthesis in the skin from 7-dehydrocholesterol under the influence of ultraviolet radiation of sunlight constitutes a major source of the vitamin. In the liver calciferol is metabolised to hydroxycholecalciferol (25-OH D). Parathormone stimulates the formation of the metabolically active compound, 1.25 dihydroxy vitamin D from 25-OH D in the kidney, 1.25 OHD enhances the absorption of calcium from the diet in the intestine. A mildly compromised vitamin D status may increase the susceptibility for infections, dental caries and autoimmune disorders such as diabetes.[89-91] Early signs of inadequate bone mineralization are growth reduction, pain, bone shape disturbance, muscle weakness. Symptoms of inadequate bone mineralization are strongly age dependent. Children at a young age can develop crania tabes, extremely round legs and chicken breast. At school age, children may complain of pain on the knees, hand or ankles. Rickets is a late and severe grade of vitamin D deficiency. Biochemical Vitamin D deficiency (VDD) is defined as serum 25 hydroxycholecalciferol [s25(OH)D] below 30 nmol/L and hypovitaminosis D as s- 25(OH)D below 50 nmol/L. The use of vitamin D supplements has shown to be effective to prevent vitamin D deficiency.

4.4 Bone mineral density

Bone mineral density (BMD) increases during childhood until the peak bone mass is achieved, around the age of 18 to 20 years.[92-96] During growth the accretion of bone is called bone modelling. Bone modelling is achieved both through appositional growth along periostal surfaces and through calcification of cartilage in the growth plate.[97] The mineral content of the bone can be estimated with a dual X ray absorptiometry (DEXA). DEXA is a non-invasive method to measure the hydroxyapatite of the bone. DEXA is the method of choice to measure the BMD because it uses a low dose gamma radiation (<0.05SVI) and offers profound accuracy and is suitable for children.[98-100] The BMD (g/cm^2) reflects an area density derived from the bone mineral content (g) divided by the protected bone image (area, cm^2) of the region. The correction for areas removes some, but not all, of the dependency on bone size. Given a fixed volumetric density, large vertebrae have greater BMD values than small vertebrae.[101] To interpret the DEXA measurement appropriate reference data are needed. Dutch paediatric lumbar spine BMD (LSBMD g/cm^2) reference values have been determined.[102] To correct for bone size, volumetric bone mineral apparent density can be calculated according to several models.[103] The Dutch reference uses a validated cylindrical model using the formula lumbar spine bone mineral apparent density (LSBMAD) (g/cm^3).

$$LSBMAD=BMD\times[4/\pi \times \text{width}] \text{ with width = mean width of } L_2-L_4.$$

However, this model has been validated on a previous version of the Hologic scanner. Recently UK reference values were published using the current Hologic 4500 DXA scanners: the lumbar spine BMAD is calculated as

$$BMAD\ (g/cm^3) = \frac{BMC1+BMC2+BMC3+BMC4}{V1+V2+V3+V4}$$

In which V is the volume of the single lumbar vertebra and BMC the Bone Mineral Content of each individual vertebra body.

This equation allows calculating individual standard deviation scores:

$$Z = \frac{(y/M)^2 - 1}{L\times S}$$

In which Lambda represents the skewness, Sigma the variation coefficient, Mu the median curve derivate from the reference centile curve and Z the calculation of the individual standard deviation score of the LSBMAD for age.[104] Early detection of children at risk for impaired bone mineralization seems to be of great value because the peak bone mass provides optimal reserve for later life.[105]

5 Scope of the thesis

The overall aim of the studies reported in this thesis was to monitor the growth and nutritional status of asylum seekers' children in The Netherlands, to evaluate the determinants used to monitor growth and health of asylum seekers' children and to identify potential nutritional risks in this unique group of children. It is of public health interest to determine the health risks of specific populations, for example those living in uncommon socio-economic circumstances. As described above, several health threats can theoretically be expected for children of asylum seekers who live in asylum seekers centres for a long-standing period. The background, cultural habits, limited budget, unfamiliarity with Dutch food guidelines or supplement advices and the extra-ordinary circumstances can make them vulnerable for negative influences on their growth and nutritional status. Although growth and development of asylum seekers' children is regularly monitored, the influence of the different backgrounds or nutritional habits on their health while resident in an asylum center in The Netherlands has never been evaluated. To provide quality care and to optimize the health care service for asylum seekers' in The Netherlands scientific research and epidemiological data are necessary to clarify the health threats and needs. These studies could provide tools for the development of guidelines, standards and protocols to recognize nutritional vulnerability and to improve tailored education, support and treatments. The general objective is approached by separate projects, including:

- Estimation of quality of the dietary intake of asylum seekers' children in The Netherlands in relation to age, gender and origin of the children (chapter 2);
- Evaluation of the Dutch growth reference to monitor the growth and nutritional status of asylum seekers' children in The Netherlands (chapter 3);
- Determination of the prevalence of Iron Deficiency in asylum seekers' children in The Netherlands and describing the iron status in relation to demographic variables and dietary intake of iron (chapter 4);
- Determining the vitamin D status of Asylum seekers' children in The Netherlands in relation to the season and supplement use and to describe the vitamin D status of asylum seekers' children in relation to demographic variables and dietary intake of vitamin D and calcium (chapter 5);
- Measuring the effect of VDD on the bone density of the spine in relation to the calcium intake (chapter 6).

Reference

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CHAPTER 2

Dietary intake in asylum seekers' children in The Netherlands, strongly related to age and origin

Annette A.M. Stellinga-Boelen[1], P. Auke Wiegersma[2], Charles M.A. Bijleveld[3]

1. Community health Service for Asylum Seekers (Medische Opvang Asielzoekers Noord Nederland) P.O. Box 584 9700 AN Groningen, The Netherlands
2. Department of Health Sciences, University Medical Center Groningen University of Groningen, P.O. Box 30.001 9700 RB Groningen, The Netherlands
3. Pediatric Gastroenterology University Medical Center Groningen University of Groningen, P.O. Box 30.001 9700 RB Groningen, The Netherlands

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Chapter 2

Abstract

Objective: To monitor the dietary intake of energy, macro- and micronutrients in asylum seeker children.

Design and setting: Cross sectional study in three asylum seeker centres in The Netherlands.

Subjects: Hundred and sixteen children 2-12 years old (86% of the study cohort) provided a dietary history.

Method: The dietary intake was estimated by 24h recall, and the origin of the children was classified in three geographic regions; African (n=45), Central Asia (n=34) or Eastern Europe (n=37)**.**

Results: The total energy intake from fat was in 24% of the children above 40En%. Seventy per cent of the children above 4 year of age had a saturated fat intake above 10En%. The children from Eastern Europe had a higher intake of fat and disaccharides than the children from the other regions. Among the children an intake less than 80% of the recommended daily allowances (RDA) of micronutrients was found for calcium (42%), iron (49%) vitamin A (45%), and vitamin D (80%). An inadequate dietary intake of iron and vitamin D was significantly more seen among the youngest children, whereas an inadequate intake of calcium and vitamin A was found more among the elder children**.**

Conclusions: The dietary intake of a prominent proportion of these children contains too much fat and insufficient amounts of calcium, iron, vitamin A and vitamin D. The low micronutrient intake of the asylum seeker children can be considered as a nutritional risk. Nutritional education and strategies to improve the macro- and micronutrient intake of asylum seeker children is indicated.

Keywords: asylum seeker children, dietary intake, micronutrients

Introduction

Monitoring the nutritional status of children is widely used to assess their health. Adequate dietary intake and subsequently good nutritional status is important for the physical and mental growth and development of children. Nutritional problems among children of migrants in The Netherlands are reported.[1,2] The post-migration nutritional situation of children is influenced by many factors, including dietary acculturation, cultural beliefs, knowledge of food composition, food prices, and lifestyle. These factors may contribute to the risk of malnutrition among asylum seeker children.[3]

Little is known about the nutritional status of asylum seeker children in The Netherlands. A number of them might have been exposed to nutritional risks prior to migration as nutritional deficiencies are widely prevalent in the world.[4] Asylum seekers emigrate from countries with unstable social circumstances owing to political, economic and demographic factors. These social, economic and demographic factors have been proven to be associated with the nutritional status of children, and asylum seeker children frequently live in poor circumstances with unemployed parents unable to purchase or prepare a competent diet for their children.[5,6]

In the last decennia many asylum seekers have entered The Netherlands. During 2002 more than 83.000 people were registered as asylum seeker of whom more than 30% was below 18 year of age.[7] During the process to acquire a permanent residence permit most asylum seekers stay in asylum centres with shared cooking facilities. The Dutch government provides them with a small budget for daily living. The aim of this study was to monitor the dietary intake of young children of asylum seekers in order to assess the dietary competence. The presented study is part of a broader initiative of the Medical Organisation Asylum Seekers North Netherlands to explore the health and nutrition status of asylum seeker children.

Design

To monitor the dietary intake and estimated the macro- and micronutrients of the food consumed by 2- to 12-year-old children living in asylum seekers' centres in The North of The Netherlands, a cross-sectional study was performed in 2003. The study was approved by the Ethical Committee of the Medical Centre Leeuwarden. The children with their parents were invited to participate in the study by an information letter translated into their native languages. During the first visit, the procedure was orally explained with the use of an independent interpreter and formal permission was obtained from the caregiver for each child participating in the survey.

Subjects

We invited the children from three asylum seeker centre who were at least 1 year in The Netherlands, (n=168). In total 135 children participated (80%); 33 children did not participate, relating to moving to another asylum centre out of the region (n=6), refusal to participate (n=9) or none responding on their invitation (n=18). Non-response analyses showed that these children did not differ by gender, age, origin or length of stay in The Netherlands compared with the study cohort (data not shown). As well we confirmed by statistical analyses that the cohort children constituted a representative sample of the more than 12.000 children aged 2-12 years, remaining in Dutch asylum centres for at least 1 year, with regards to age, gender and region of origin.

Table 1 General characteristics of the children

Origin	**Age** (years)	**Gender**		**Length of stay** (years)		**Underweight**	**Overweight**	**Obese**
		F	M	1-3	>3			
Africa, n = 45	2-3, n = 11	6	5	8	3	0	1	1
	4-8, n = 20	8	12	11	9	1	3	2
	9-12, n = 14	5	9	12	2	0	2	1
Central Asia, n = 34	2-3, n = 9	7	2	9	0	1	1	0
	4-8, n = 16	4	12	9	7	0	2	0
	9-12, n = 9	3	6	5	4	2	0	0
Eastern Europe, n = 37	2-3, n = 7	2	5	4	3	0	2	0
	4-8, n = 17	7	10	8	9	0	3	1
	9-12, n = 13	6	7	3	10	0	1	1
Total, n = 116		48	68	69	47	4	15	6

Number of children studied to origin, gender, age group and length of stay in The Netherlands. Underweight defined as BMI<-2sd of the Dutch reference curves of BMI for age and gender (Fredriks et al. 2000)
Overweight and obesity defined according the international cutoff values of BMI for age and gender. (Cole et al. 2000)
Africa origin in detail: Angola n=19, Somalia n=17, Sudan n= 8, and other n=1
Central Asia origin in detail: Afghanistan n=16, Iraq n=10, Iran n= 6, and others n=2
Eastern Europe origin in detail: Azerbaijan n=13, Yugoslavia n=10, Russia n=12 and others n=2

A dietary history was taken of 116 (86%) of the study cohort for comparative analyses the geographical origin of the children was categorized into three regions: Africa n=45, Central Asia n=34 and Eastern Europe n=37. The average length of stay in The Netherlands was 3 years. Table 1 shows the general characteristics of the study population.

Method

The dietary assessment was carried out by one experienced qualified dietician to minimize inter-individual bias among different professionals. The dietary assessment was based on a 24-h recall method with language interpreters to minimise misunderstandings. In addition, pictures developed for dietary assessment of other migration populations and materials to demonstrate standardised samples were used to estimate the size of the portions eaten. No dietary information was given which could interfere with the collected data from the dietary assessment. Food quantities were estimated using BECEL a nutritional software package developed by the Unilever B.V. (Vlaardingen The Netherlands). The data were compared to the Dutch list of recommended daily allowance (RDA) for gender and age.[8]
The intake of micronutrients was graded as "marginal" when estimated below 80% of the RDA.[9]. Overweight and obesity were defined according the Dutch guidelines based on the international body mass index (BMI) cutoff values for age and gender[10] and underweight was defined as BMI below the -2 s.d. on the Dutch BMI for age and gender curve.[11]
Data were analysed, using the SPSS statistical software package (SPSS 11.5 2003). The non-parametric Mann-Witney test was used to compare the intake of micro- and macronutrients between the children of different groups according age or origin. χ^2 tests were used to check for associations between prevalence of unfavourable fat intake with other variables such as origin, gender, age group, or length of stay. A *P*-value of 0.05 was taken as threshold for statistical significance.

Results

To monitor the energy, macro- and micronutrient intake of asylum seekers' children, we estimated the nutrient intake of healthy children living at asylum centres in The Netherlands. The dietary intake of the children showed that total the energy intake in children of different origin was the same. Table 2 shows the median intake of energy and macronutrients in En% by origin and age group.

Table 2 Dietary intake of macronutrients and energy to origin and age group

Total	**Africa**, n = 45	**Central Asia**, n = 34	**Eastern Europe**, n = 37
Energy (Kcal)	1470 (652-3276)	1491 (408-2443)	1490 (580-2701)
Total fat (En %)	33 (21-48)[a,b]	37 (17-59)[a]	38 (19-52)[b]
• SF (En %)	13 (6-18)[a]	13 (7-26)	14 (6-30)[a]
• MUFA (En %)	10 (6-19)[a]	11 (4-17)[a]	10 (5-17)
• PUFA (En %)	8 (3-17)	8 (2-12)	7 (2-11)
Protein (En %)	16 (10-27)[c,d]	14 (9-22)[c]	15 (4-22)[d]
Carbohydrates (En %)	48 (39-64)	48 (26-72)	47 (26-77)
• Disaccharides (En %)	24 (14-42)	23 (5-47)[a]	27 (8-61)[a]
• Complex (En %)	25 (13-41)[c]	25 (12-40)[d]	20 (13-30)[c,d]
2-3 year	**Africa,** n = 11	**Central Asia,** n = 9	**Eastern Europe,** n = 7
Energy (Kcal)	1238 (948-2323)	1199 (613-1880)	1054 (580-1922)
Total fat (En %)	38 (28-48)	37 (17-47)	38 (31-52)
• SF (En %)	13 (8-18)	13 (7-19)	13 (9-23)
• MUFA (En %)	10 (8-19)	10 (4-17)	11 (9-13)
• PUFA (En %)	9 (4-12	8 (4-11)	9 (4-10)
Protein (En %)	18 (10-24)	15 (11-19)	17 (11-22)
Carbohydrates (En %)	46 (39-54)	47 (37-72)	47 (26-52)
• Disaccharides (En %)	25 (21-30)	23 (19-47)	23 (8-33)
• Complex (En %)	20 (13-27)	23 (16-31)	19 (15-29)
4-8 year	**Africa,** n = 20	**Central Asia,** n = 16	**Eastern Europe,** n = 17
Energy (Kcal)	1425 (652-3022)	1543 (408-2443)	1655 (872-2526)
Total fat (En %)	33 (24-45)	36 (22-53)	37 (20-48)
• SF (En %)	13 (6-17)	14 (7-21)	14 (7-30)
• MUFA (En %)	10 (6-15)	11 (6-16)	9 (6-17)
• PUFA (En %)	7 (3-17)	7 (2-10)	6 (3-11)
Protein (En %)	16 (13-27)[a]	14 (9-22)	14 (10-20)[a]
Carbohydrates (En %)	51 (42-59)	50 (36-63)	48 (39-66)
• Disaccharides (En %)	26 (14-42)	23 (10-41)[a]	29 (17-50)[a]
• Complex (En %)	25 (15-41)[a]	25 (12-40)[c]	22 (13-27)[a,c]

9-12 year	**Africa,** n = 14	**Central Asia,** n = 9	**Eastern Europe,** n = 13
Energy (Kcal)	2143 (1257-3276)[a,b]	1583 (703-2190)[a]	1490 (786-2701)[b]
Total fat (En %)	33 (21-42)[a,c]	38 (34-59)[c]	38 (19-46)[a]
• SF (En %)	12 (7-16)[a]	13 (11-26)	15 (6-30)[a]
• MUFA (En %)	10 (6-11) [a]	11 (9-16)[a]	11 (5-16)
• PUFA (En %)	8 (4-11)	9 (7-12)[c]	7 (2-10)[c]
Protein (En %)	17 (13-24)[a]	13 (10-21)	15 (4-18)[a]
Carbohydrates (En %)	50 (41-64)	46 (26-54)	47 (36-77)
• Disaccharides (En %)	22 (16-32)	21 (5-26)[a]	23 (20-61)[a]
• Complex (En %)	29 (21-37)[c]	24 (20-35)	23 (14-30)[c]

Abbreviations: MUFA=monounsaturated fatty acids; PUFA =polyunsaturated fatty acids; SF=saturated fatty acids,
Values are median (range) intake
Analyses: Kruskal Wallis followed by Mann-Whitney test
Significant differences between origins by identical letters: [a,b] *P<0.05;* [c,d] *P<0.01*

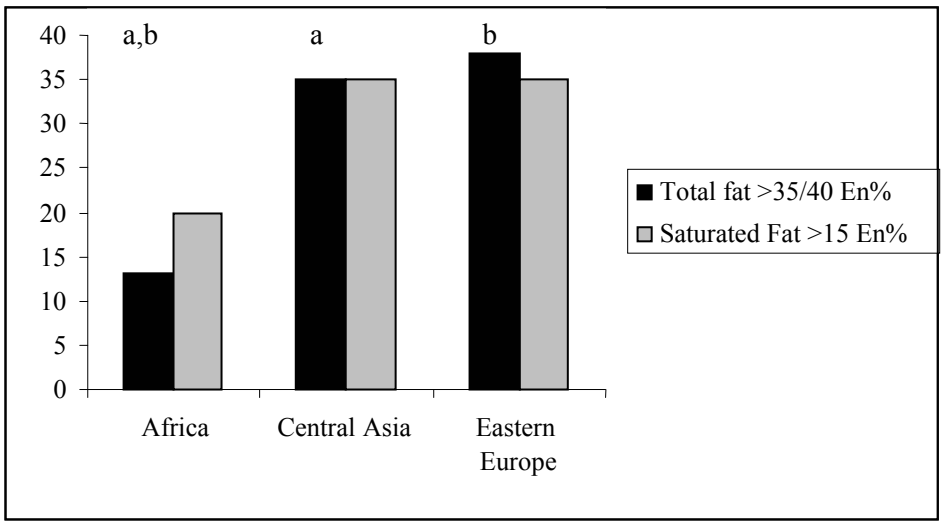
The lowest intake of fat was found in children from Africa (fat En% intake 33%) compared to children from Central Asia (37%) or Eastern Europe (38%, both p<0.05). Saturated fatty acids represented the largest fraction of the total ingested fat. The intake of saturated fats was lower in African children than in children form Eastern Europe (p <0.05). The protein intake of all children was adequate, between 5-6 En% and 25En % as recommended.[12] The protein intake of African children was higher than that of children from the other regions (p<0.01). Two third of the children met the Dutch recommended allowances of total carbohydrate intake of 45 En%. Children from Eastern Europe had a lower in take of complex carbohydrates than the children from both other regions (both p <0.01) and a higher intake of disaccharides than the children from Central Asia (p<0.05).
Differences in macronutrient intake according to the children's origin were especially prominent in the eldest age groups.
The macronutrient intake did not significantly differ between the children from the three age groups independently of origin, except for a higher saturated fat intake among the youngest children. The length of stay in The Netherlands was not associated with the energy intake or the composition of macronutrients among the children (NS). Male gender was associated with a higher median total energy (p<0.05).

A dietary fat intake above 40 En% was found in 24% of the children. A dietary intake of a maximum 40 En% fat is recommended for children up to 4 year and for elder children as long as they are not overweight or do not gain undesirable weight. The fat intake of the children with an elevated BMI was not higher than among the other children. A third of the children with an elevated BMI had a fat intake above the 35En%. The proportion of the children with a total fat intake above 40 En% was significantly smaller in the children from Africa (fig.1)

An intake of saturated fatty acids above the recommended tolerable upper level (15 En% up to 4 year of age and 10 En% for the elder children) was found in 30% of the children less than 4 year of age and in 70% of the children 4-12 year ($p<0.01$). The recommended 12 En% intake of polyunsaturated fatty acids (PUFA) was met by only 1 % of the children.

The intake of micronutrients showed several differences between the children to age group. Table 3 shows the estimated intake of selected nutrients by age group and origin. The differences in micronutrient intake between children to origin are found especially among the eldest children, with a significant higher intake of calcium and iron among the African children.

Figure 1 fat intake to origin



Y-axis: Values are percentage within origin
Differences between regions by χ^2 Tests
a,b= P<0.05

Figure 2 shows the intake of calcium, iron, vitamin A and vitamin D in percentage of the RDA between the children to age group independent of origin. The iron and vitamin D intake of the youngest children was significant lower than the intake of the other children ($p<0.01$). On the other hand, the vitamin A and calcium intake of the eldest children was significant lower than the intake of the other children ($p<0.05$, and $p<0.01$; respectively).
A marginal intake (below 80% of the RDA) was found in 45% of the children for vitamin A, in 80% for vitamin D, in 42% for calcium, and in 49% for iron. The proportion of children with a marginal intake was not significantly influenced by their length of stay in The Netherlands or to their origin (data not shown). Among the increasing age groups, the number of children with a marginal intake of calcium increased; 18% of the children below 4 year, 36% of the children 4-8 year and 69% of the children 9-12 year ($p <0.01$). The number of children with a marginal intake of iron to age group was 61% of the children below 4 year, 30% of the children 4-8 year and 59% of the children 9-12 year.

Discussion

In the presented study we report a high fat and a low micronutrient intake among asylum seekers' children in The Netherlands. We used the 24 h recall to estimate the dietary intake. The 24 h recall is considered the method of choice for assessing nutrient intake on population base. A single 24 h recall only estimate the average nutrient intake roughly, as the composition of the diet varies substantially day by day. This individual variation have been considered acceptable for group-wise comparisons.[13] Inadequate average intake will lead to inadequate nutrient status. Owing to a broader distribution of intake estimated by 24 h recall the percentage of children with an average intake value below 80% of the RDA will be overestimated. Underestimation due to underreporting was checked by calculating the ratio EI/BMR.[14-16] Children, whose ratio EI/BMR ratio was below 1.1, were equally divided among the different age groups, gender and region and did not influence the statistical analyses of the data obtained by the 24 h recall.
The fat percentage of the total energy intake and the composition of the fat intake is considered the most important nutrition health indicator for children.[17] The high fat intake and the differences in fat and macronutrient intake between the children to origin found in our study might be explained by several factors including dietary risks prior to migration, cultural believes, lack of knowledge of food composition, food price and life style. Earlier nutritional surveys among migrants in The Netherlands report favourable macronutrient intake with a relatively low fat (particular saturated fat) and high carbohydrate content.[18]

Table 3 Intake of selected nutrients to origin and age group

Total % RDA			**Africa,** n = 45	**Central Asia,** n = 34	**Eastern Europe,** n = 37
Fibre			65 (24-182)	61 (12-153)	63 (0-117)
Calcium			103 (19-302)	88 (19-205)	79 (10-271)
Iron			84 (26-217)	81 (23-151)	80 (23-154)
Retinol			93 (23-343)[a]	90 (18-190)	70 (9-231)[a]
Calciferol			18 (0-82)[c,d]	34 (3-133)[c]	36 (2-190)[d]
2-3 year % DRI		**RDA**	**Africa,** n = 11	**Central Asia,** n = 9	**Eastern Europe,** n = 7
Fibre	M	15 g/d	59 (24-182)	74 (25-119)	69 (29-87)
	F	14 g/d			
Calcium		500 mg/d	153 (56-302)	117 (47-205)	139 (38-271)
Iron		7 mg/d	69 (26-166)	81 (39-116)	74 (30-117)
Retinol		0.4 µg/d	115 (27-313)	85 (18-125)	80 (28-231)
Calciferol		5 µg/d*	10 (5-43)	13 (3-30)	21 (5-75)
4-8 year % DRI		**RDA**	**Africa,** n = 20	**Central Asia,** n = 16	**Eastern Europe,** n = 17
Fibre	M	22 g/d	65 (32-170)	68 (12-153)	70 (28-117)
	F	20 g/d			
Calcium		700 mg/d	111 (19-191)	89 (32-189)	97 (50-211)
Iron		7 mg/d	93 (47-214)	94 (23-151)[c]	106 (39-154)[c]
Retinol		0.5 µg/d	98 (23-186)	123 (22-190)	78 (16-175)
Calciferol		2.5 µg/d*	21 (0-80)[a,c]	39 (9-101)[a]	42 (10-89)[c]
9-12 year % DRI		**RDA**	**Africa,** n = 14	**Central Asia,** n = 9	**Eastern Europe,** n = 13
Fibre	M	32 g/d	69 (34-121)[c]	35 (13-64)[c]	54 (0-100)
	F	29 g/d			
Calcium	M	1200 mg/d	80 (29-126)[a, c]	32 (19-87)[c]	57 (10-103)[a]
	F	1100 mg/d			
Iron	M	10 mg/d	91 (54-152)[a,b]	73 (26-87)[a]	67 (23-116)[b]
	F	11 mg/d			
Retinol		0.7 µg/d	84 (28-120)	78 (21-96)	58 (9-212)
Calciferol		2.5 µg/d*	23 (5-82)[a]	85 (9-133)[a]	38 (2-190)

Abbreviation: F, female; M, male; RDA, recommended daily allowance
Values are median (range) intake in percentage of the RDA for age and gender
Analyses Kruskal Wallis followed by Mann-Whitney test
Significant differences between origins by identical letters: $^{a, b}$ *P<0.05;* ^{c,d} *P<0.01*
For African children, because of skin colour the RDA of calciferol is doubled

Brussaard reported on migrants who were not accommodated in an asylum seekers centre and properly less acculturated, as the dietary pattern is an important marker of the description of acculturation. Several nutritional surveys report that former migrants to western countries like in our study adopt dietary patterns with increasing fat and sugar and reducing vegetable, fruits and fibre consumption.[19,20]

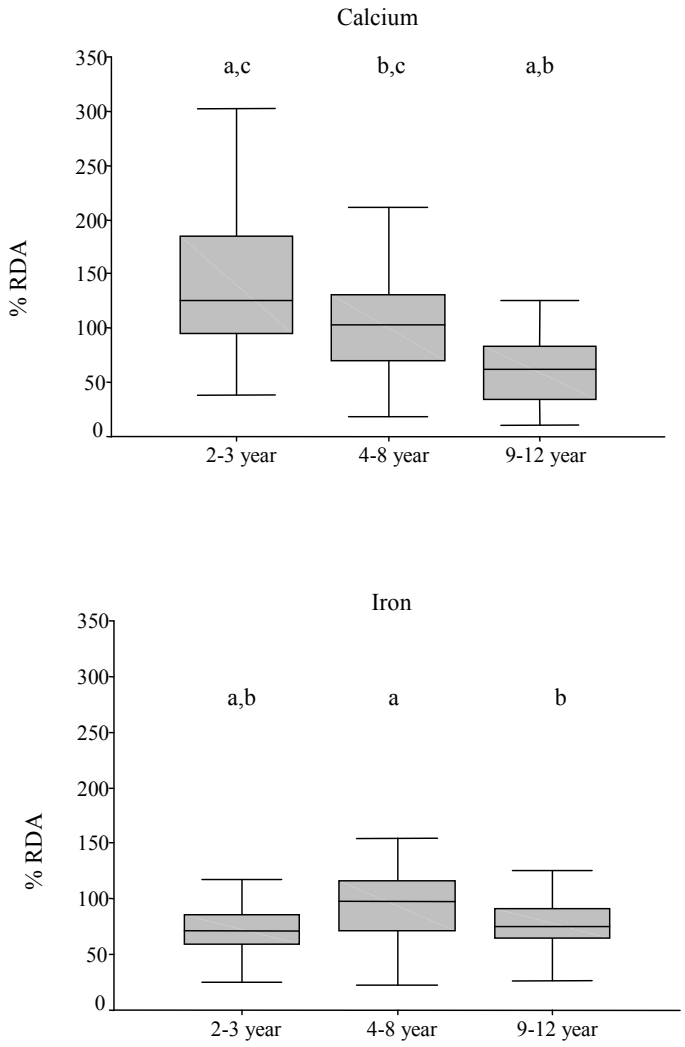
The high fat intake found in our study is a health concern, especially since it is associated with obesity in children and cardio-vascular disease at adult life.[21,22] Thirteen percent of the children in our study were over weighted and 5% had obesity according the international criteria of BMI for age. This is less than in many other populations; however analyses of the growth of these children showed that the mean weight for height had increased during their stay in The Netherlands (Stellinga-Boelen 2004, unpublished data).

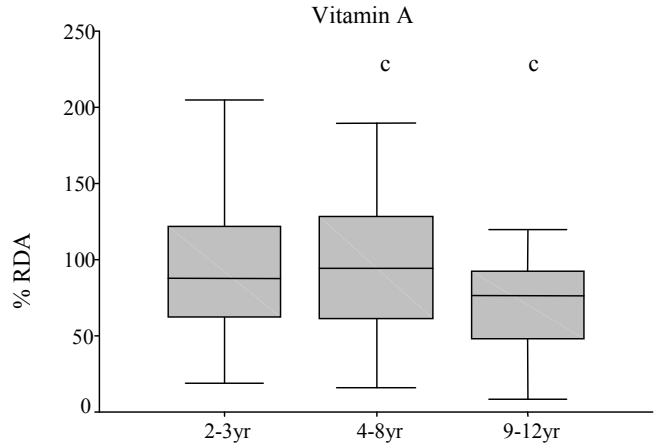
In agreement with other observations, our results indicate that a high fat intake is not protective against micronutrient inadequacy.[23] Dutch nutritional surveys show that native Dutch children from all ages meet the RDA for micronutrients, except for the vitamin D in children less than 4 years of age.[24] In the asylum seekers' children, however, we did not only frequently find a low intake of vitamin D, but also of iron, calcium and vitamin A. The iron intake was less than those reported in other migrant children in The Netherlands.[1,24] The Low intake of calcium and vitamin A might be related to a low intake of diary products.[25]

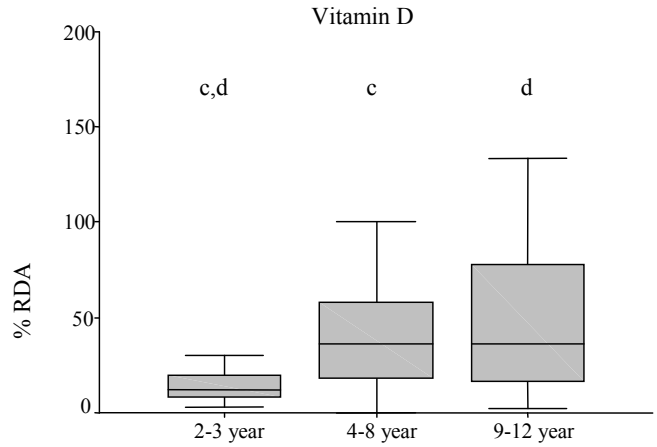
The inadequate micronutrient intake corresponds with the reported tendency that with the demographic transition in Europe, children, are at risk for mineral and vitamin deficiency despite a high caloric intake.[26] Calcium, iron, and vitamin D deficiencies were found among underprivileged populations in several European countries.[27] Adequate nutrition contributes to the well-being of children and their potential learning ability.[28] Monotonous diets induced by socioeconomic circumstances can lead to inadequate intake in both quality and quantity of the nutrients.[29-31] The living circumstances of the asylum seekers, with a small budget, poor cooking facilities and difficulties to adapt to local food products might highly influence the low micronutrient intake estimated among their children. The biochemical effects of the dietary inadequacy observed in our study might need to be confirmed by clinical study. Nevertheless the present data indicate the need to implement strategies to improve the dietary intake of asylum seekers' children, for example by

nutritional education, supplementary school feeding programs or providing of fortificated food to the family to achieve the RDA's of micronutrients. [26,32-36]

Figure 2 Intakes of selected micronutrients by age group







Values are intake in percentage of the RDA
Analyses Kruskal Wallis followed by Mann-Whitney test
Differences between age groups
a,b *P<0.05;* ***c,d*** *P<0.01*

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CHAPTER 3

Obesity in asylum seekers' children in The Netherlands- the use of national reference charts

Annette A.M. Stellinga-Boelen[1], P. Auke Wiegersma[2], Charles M.A. Bijleveld[3], Henkjan J. Verkade[3]

1. Community health Service for Asylum Seekers (Medische Opvang Asielzoekers Noord Nederland) P.O. Box 584 9700 AN Groningen, The Netherlands
2. Department of Health Sciences, University Medical Center Groningen University of Groningen, P.O. Box 30.001 9700 RB Groningen, The Netherlands
3. Pediatric Gastroenterolgy University Medical Center Groningen University of Groningen, P.O. Box 30.001 9700 RB Groningen, The Netherlands

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Chapter 3

Abstract

Background: Growth assessment can be used to monitor health at individual and population level. For asylum seekers' children with different geographic backgrounds, growth reference values are frequently not available. We assessed nutritional condition and growth of asylum seekers' children upon arrival and follow-up in The Netherlands, using national growth charts, and related these parameters to geographic origin.

Methods: Height and weight of 135 children originating from Africa (n=47), Central Asia (n=41), and Eastern Europe (n=47), were assessed longitudinally (median follow-up 3 yr, range 1 - 8 yr). Body-mass-index (BMI) was calculated, and overweight and obesity were defined according the international BMI cut-off values for age and gender.

Results: Upon arrival at a median age of 4.5 yr (range 0-11.5 yr), 13% of the children were small for age (below -2SD of the Dutch height for age reference), which decreased to 5% during follow-up ($p<0.05$). During follow-up, 90% of the height measurements in boys and 85% in girls were within the normal range (+/-2SD) of the Dutch references. The proportion of children with overweight including obesity increased from 15% at arrival to 21% during follow-up ($p<0.05$). Irrespective of age, children originating from African were taller than children from Central Asia or Eastern Europe at follow up ($p<0.05$). Overweight and obesity was most prominent among children of Eastern Europe.

Conclusion: Dutch national reference values allow monitoring growth and the development of overweight or obesity in asylum seekers' children in The Netherlands. Prevention strategies to reduce the development of overweight and obesity among these children seem warranted.

Keywords: asylum seekers' children, growth monitoring, obesity

Introduction

Growth of children is influenced both by the environment, such as the availability of nutrients, physical activity, behaviour and by genetic factors. Despite ethnic differences, growth rates have been considered the best indicator for the health of children at individual and at population level.[1-3] During the last decennia many countries have compiled national growth references and prefer to use these rather than corresponding references from the World Health Organisation.[4-8] In many Western countries a secular trend towards earlier maturity and increasing adult size has recently led to revision of reference growth curves.[9-11] The reference curves used in The Netherlands were revised in 1997, based on the fourth nationwide growth study performed in 1996-1997.[12] Children from ethnic minorities were not included in this reference. Separate reference curves for children grown up in The Netherlands with parents from Turkish or Moroccan origin have recently been published.[13,14]

Asylum seekers' children in The Netherlands originate from many different countries and growth references from these countries are usually not available. Previous studies in the United State indicated that growth and nutritional conditions among asylum seekers' children were suboptimal.[15,16] In the general population, the prevalence of childhood obesity in general has increased strongly during the past two decades.[17-19] It is unclear to what extent this phenomenon has occurred in asylum seekers' children. The use of the BMI to assess the nutritional condition with respect to overweight and obesity is widely accepted.[20,21] Other anthropometrical measurement such as mid-upper-arm circumference, triceps skin fold thickness, waist circumference, hip circumference and the waist-hip ratio are used to assess body fat distribution.[22-24] We determined the growth of asylum seekers' children of different geographic background relative to the Dutch references and assessed the prevalence of overweight and obesity among these children. Additionally the body fat distribution of the children was assessed in relation to the geographic background.

Methods

Growth and nutritional status of were longitudinally determined in pre-adolescent asylum seekers' children from asylum seekers' centres in the North of The Netherlands. The study was approved by the Ethical Committee of the Medical Center Leeuwarden. Parents and children were invited to participate in the study using an informative letter translated into their native languages. The procedure was explained with the use of an independent language interpreter and formal permission to participate in the study was obtained from the parent (caregiver) of each child. 135 children and/or their parents signed consent. In total

33 children did not participate, because of moving to another facility (n=6), refusal to participate (n=9) or non-response (n=18). Non-response analyses showed that these 33 children did not differ by gender, age, origin or length of stay in The Netherlands compared with the study cohort (n=135; data not shown). The anthropometrical measurements for growth and body fat distribution included height, weight, mid upper arm circumference, waist circumference, hip circumference and triceps skin fold thickness. Measuring skin fold thickness at other locations and calculating their sum could have been informative. However, the limitations of the present design included determination of triceps skin fold to be used as the only indicator for skin fold thickness. Measurements were performed following the standard procedures as described in Paediatric Morphometrics using Seca medical precise weight scale (Van Seenus Nederland B.V.) and the standing height with a Seca 208 somatrometre (Van Seenus Nederland B.V.)[25] The triceps skin fold thickness was determined with the Holtain skin fold calliper. All anthropometrical measurements were performed by one trained medical doctor except for the height and weight measurements, retrieved from the medical files in which measurement performed following the same procedures regularly had been recorded since arrival in The Netherlands. All measurements were indexed upon the Dutch reference. Standard deviation scores were calculated for each child using the computer based Growth Analyser Information program (version 2 Dutch growth foundation 2001-2003).

Overweight or obesity was defined according the Dutch guidelines based on the international BMI cut-off values for age and gender.[25] Children who were below 2 year of age were not considered overweight or obese since no cut-off values are available.

The general characteristics of the children are listed in Table 1. Data were analysed, using the SPSS statistical software package (SPSS 11.5 2003). The χ^2 test was used for statistical analysis of the prevalence of small for age children at arrival and at follow-up, and for the relationships between origin and prevalence of overweight and obesity at arrival and at follow-up. The Mann Witney test was used to analyse the mean Z-scores of mid upper arm circumference, triceps skin fold thickness, waist circumference, hip circumference and waist-hip ratio in relation to geographic background. A p-value below 0.05 was considered statistical significant.

Table 1 General characteristics of the study population

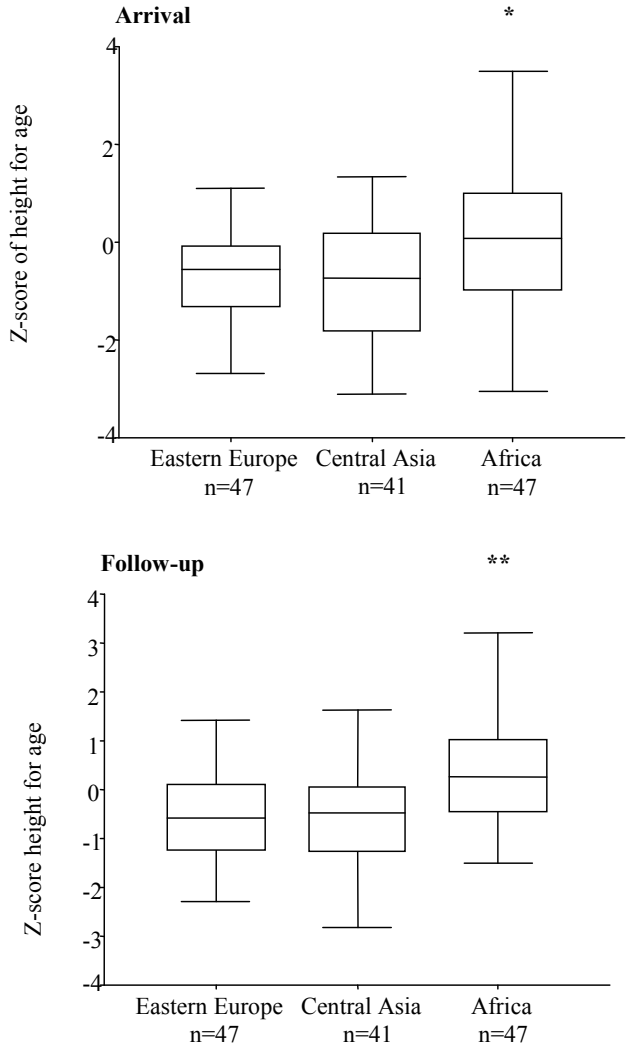
	Africa, n = 47	**Central Asia,** n = 41	**Eastern Europe,** n = 47
Country of origin	Angola 20	Afghanistan 18	Azerbaijan 15
	Somalia 18	Iraq 11	Former Yugoslavia 18
	Sudan 8	Iran 6	Armenia/Russia 12
	Other 1	Other 6	Other 2
Female/male	20/27	20/21	17/30
Age upon arrival (year; median and range)	3.9 (0.9-11.0)	3.7 (0.9-11.5)	5.7 (0.8-10.2)
Follow up in The Netherlands (months; median and range)	35 (12-94)	32 (17-58)	42 (14-65)

Results

Growth

The height for age of the children at arrival was in 85% and during follow-up in 91% within the normal range (+/-2SD) of the Dutch references. The mean height for age for boys in our sample remained between ±3 cm of the Dutch reference and for girls between ±4 cm of the Dutch reference. We did not find a significant difference between the mean height for age of boys and girls in our sample. Upon arrival in The Netherlands, thirteen percent of the children were small for age (height for age below –2SD on the Dutch reference curve). During follow-up (2.5 ± 1.3 yr, mean ± SD) this fraction significantly decreased (5% at follow-up; $p<0.05$). Those children small for age upon arrival, originated from Eastern Europe (n=8), Central Asia (n=7) and Africa (n=3). Independent of age, the height for age of the African children at arrival [median Z-score (range) height for age -0.1 (-3.0, 3.5)] and at the end of follow-up [median Z-score (range) height for age 0.3 (-1.5, 3.2)] was higher than that of the children from Central Asia [-0.7 (-3.1, 1.3) at arrival ($p<0.05$), and -0.5 (-2.8, 1.6)] at follow-up ($p<0.01$) or Eastern Europe [-0.6 (-2.7, 1.9) at arrival and -0.6 (-2.3, 1.4)] at follow-up ($p<0.01$). (Figure 1). At the end of follow-up, 8% of the African children had a height above +2SD of the Dutch reference compared to none of the children from Eastern Europe or Central Asia ($p<0.01$). The height for age upon arrival or during follow-up was not significantly different between children originating from different countries within one continent.

Figure 1 Z-scores of Height to age according Dutch references of preadolescent asylum seekers' children from different geographical origin upon arrival and follow up in The Netherlands.



Box plot represent first and third quartiles of Z-scores of height for age plus 3rd and 97th centiles.

Difference of Height to age of African children to children of both other origin analysed by Mann-Whitney U test; P<0.05, ** P<0.01*

The weight for height of the children at arrival was in 87% and during follow-up in 89% within the normal range (+/-2SD) of the Dutch references. Upon arrival in The Netherlands, five percent of the children had a weight for height below -2SD on the Dutch reference curve, and this fraction did not significantly change during follow-up (4%, NS). The weight for height at arrival of the children did not significantly differ according to their origin. During follow-up the median Z-score (range) of the weight for height of the children from Central Asia [-0.4 (-3.3, 2.5)] was below those of Africa [0.3 (-1.6, 4.7)] ($p<0.05$), and of Eastern Europe [0.0 (-2.1, 3.6)].
Between children of different countries within one continent no significant difference in the weight for height upon arrival or during follow-up was seen.

Overweight and obesity

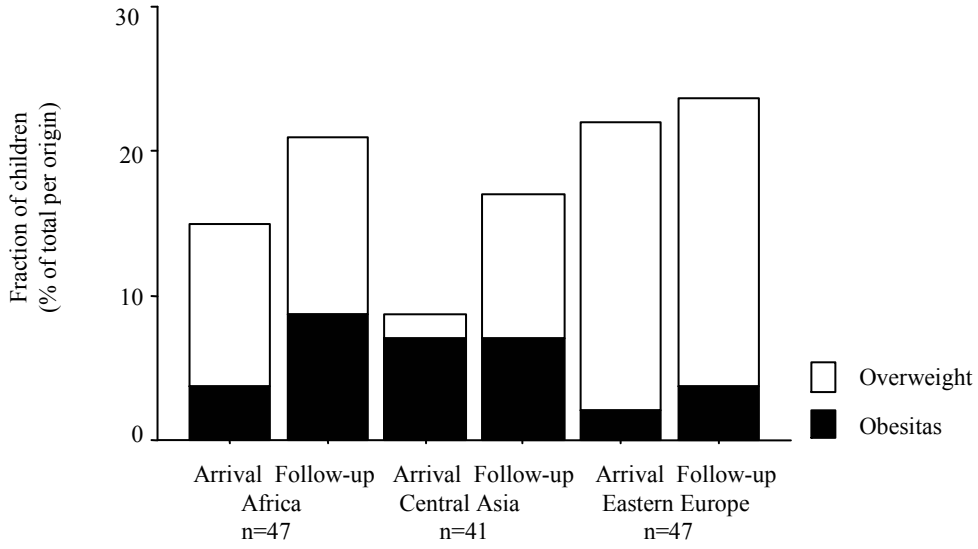
The number of children crossing the international cut-off values of the BMI for overweight and obesity increased from 15% at arrival to 21% at follow-up. The prevalence of overweight and obesity was higher among children from Eastern Europe than among children from Africa or Central Asia (Odds Ratio 1.6 vs 0.9 and 0.6; resp.). Fifteen children had overweight upon arrival in The Netherlands, which increased to 19 at follow-up. The number of obese children increased from 6 at arrival to 9 during follow-up. Figure 2 shows the increase of children with overweight and obesity during follow-up to geographic background.

Fat distribution

Compared to the age and gender specific Dutch Z-scores, we found 13% of the children with a mid upper arm circumference above +2SD and 5% below -2SD during follow up. For triceps skin fold thickness similar values were found: 15% of the measurements above +2SD and none below -2SD. None of the children had a mid upper arm circumference less than the 13 cm as used by WHO as a cut-off-value to indicate malnutrition. During follow-up the median Z-score (range) of the mid upper arm circumference of the children from Central Asia [-0.9 (-3.1, 3.1)] was significantly lower than in children from Africa [-0.7 (-2.2, 6.2); $p<0.05$] or Eastern Europe [0.2 (-1.7, 7.3), $p<0.01$], respectively. The median Z-score (range) of the triceps skin fold thickness of the children from Central Asia [0.5 (-1.4, 4.0)] was similar to that of children from Africa [0.8 (-0.8, 4.5), NS], and lower than that of children from Eastern Europe [1.0 (-0.6, 4.9), $p<0.05$], respectively. Except for two boys from Eastern Europe with severe obesity, all our measurements of waist circumference, hip circumference and the waist-hip ratio were within the +2SD and –2SD of the recently published gender and age specific Dutch references.[26] We found 17 (13%) children with a waist circumference above the 1.3SD and another 8 (6%) with a waist circumference above

+2.3SD, which are the suggested cut-off values to screen on abdominal fat. The median waist-hip ratio of the African children (0.96) was higher than that in children from Asia (0.94; $p<0.05$) or Eastern Europe (0.93; $p<0.01$). Our data did not show a high risk for children small for age or with a low weight on arrival to develop overweight obesity, or an increased waist-hip ratio during follow-up.

Figure 2 Prevalence of overweight and obesity in preadolescent asylum seekers' children from different geographical origin upon their arrival and subsequent follow up in The Netherlands



Discussion

This study shows that growth and nutritional condition of asylum seekers' children can meaningfully be monitored by using Dutch reference curves. Height for age and weight for height of the pre-adolescent asylum seekers' children did not significantly differ from the Dutch reference. Our results correspond with the conclusions of the Multi-centre Growth reference Study by WHO that stated that all children have the same growth potential, provided that they are exposed to an optimal nutritional environment.[28] Although our

sample size was small and the age range wide we observed an increase of the prevalence of overweight and obesity among the asylum seekers' children during the average 2.5 year period of follow-up, which appears to follow the trend reported in urban areas of The Netherlands. Differences in weight for height between urban and non-urban populations are well known, however, the responsible mechanism has not been elucidated, apart from epidemiological associations.[29]

In the present study we observed a slight difference in height for age according to origin of the asylum seekers' children, with the height for age of the African children to be higher than these of children of Central Asia and Eastern Europe. This difference corresponded with earlier reports on ethnic differences in height for age among minorities in Europe. Chinn described that African children were taller (0.6 SD) and Asian children were shorter (0.5 SD), compared to the UK reference of 1990.[27] The ethnic differences we found appeared to be smaller than reported data of children from Morocco in The Netherlands whose final height was estimated to be 10cm less that of their Dutch peers.[13] These height variations among ethnic minorities may be influenced by a generation effect, the social status and intermarriage. The use of national reference therefore is preferable independent the child ethnic background.[9] The statistically not significant differences in the height for age between boys and girls in our study is surprising but might be related to the pre-pubertal stage of the present study group.

We assessed the prevalence and subsequent development of overweight and obesity in the asylum seekers' children using international cut- off values of the BMI. We found a high prevalence of overweight and obesity compared to the national Dutch reference of 1997 based on the fourth growth study. The present data shows the prevalence of overweight among girls at arrival (12%) corresponds with the prevalence among girls of the same age in an urban population in The Netherlands (11 %) and the prevalence among girls at follow-up (17%), corresponds with the prevalence among girls of the same age in other regions in The Netherlands (17%) at time of the fourth growth study.

The prevalence of obesity among girls at arrival and at follow-up (7%) in our study was much higher than reported in the fourth growth study (3% urban and 1.4% other regions). For boys the prevalence of overweight (12%) at arrival and follow-up did not vary much from the prevalence among Dutch boys of the same age (13% urban and 9% other regions). The prevalence of obesity in our study among boys 3% at arrival and 6% during follow-up was higher than the prevalence reported in boys of the same age (1.6% urban and 1.4% other regions).[12]

The prevalence of overweight and obesity among other minorities in The Netherlands such as Turkish and Moroccan children at the time of the fourth growth study was higher than those found in our study among the asylum seekers' children.[31] We reported an increase of

the prevalence of overweight and obesity among asylum seekers' children during follow-up. In the general Dutch population the prevalence of overweight and obesity since the fourth growth study has almost doubled.[32]

Too much body fat at young age is related with cardiovascular diseases, diabetes mellitus and respiratory compromise and therefore with deterioration of health.[33,34] Monitoring trends in overweight and obesity with BMI alone will fail to identify variation in body fat distribution. A high waist circumference is related to abdominal fat and an increase of risk on cardiovascular diseases in adulthood. Age-sex and ethnicity-specific waist circumference percentiles have been made available to monitor body fat distribution for The Netherlands. We found a high prevalence of an increased waist circumference particularly among African children. The present analysis does not allow, however, identifying underlying causes for the observed differences according to origins. Almost irrespective of the origin of asylum seekers' children, our data indicate that their exposure to a Western society rapidly increases the prevalence of overweight and obesity. Recently, we reported that asylum seekers' children in The Netherlands frequently consume diets that are energy-rich and micronutrient-poor.[35] This diet composition is considered to carry a high risk on the development of overweight and obesity.[36] It would be interesting to delineate the relationship between the previous nutritional condition and the risk on developing overweight or obesity while exposed to a western society. Our present data do not indicate that a relative low weight upon arrival predisposes to overweight or obesity during follow up. Yet, previous exposure to poor nutrition or traumatizing experiences could have influenced the nutritional status at arrival. Specific information on these individual circumstances of the children was not available and, theoretically, we cannot exclude that variation of these parameters over the different groups confounds the results to some extent. Notwithstanding, our results support strategies for this vulnerable group of children to prevent development of overweight and obesity, including nutritional, physical and environmental approaches.

Key-points

- Growth is considered to be the best indicator for the health of children at an individual and population level, Dutch national growth references can be used for meaningful monitoring the nutritional status and growth of asylum seekers' children.
- Growth of children is influenced by the availability of nutrients and genetic factors. However, ethnic and gender differences in growth of pre-adolescent asylum seeker children are relatively small.
- The prevalence of overweight and obesity increases rapidly among asylum seekers' children in The Netherlands
- Prevention of overweight and obesity should include strategies aimed at this specific group of children upon their exposure to a Western society.

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CHAPTER 4

Iron deficiency Among Children of Asylum Seekers in The Netherlands

Annette A.M. Stellinga-Boelen[1], Huib Storm[2], P. Auke Wiegersma[3], Charles M.A. Bijleveld[4], Henkjan J. Verkade[4]

1. Community health Service for Asylum Seekers
(Medische Opvang Asielzoekers Noord Nederland) P.O. Box 584
9700 AN Groningen, The Netherlands
2. Department of Clinical Chemistry, KCL, Medical Center Leeuwarden,
P.O. Box 888, 8901 BR Leeuwarden, The Netherlands
3. Department of Health Sciences, University Medical Center Groningen
University of Groningen, P.O. Box 30.001 9700 RB Groningen,
The Netherlands
4. Pediatric Gastroenterolgy, University Medical Center Groningen
University of Groningen, P.O. Box 30.001 9700 RB Groningen,
The Netherlands

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Chapter 4

Abstract

Objectives: To investigate in asylum seekers' children in The Netherlands, biochemical iron status and the prevalence of iron deficiency (ID) and anemia in relation to age, region of origin, length of stay in The Netherlands, body mass index (BMI), and dietary iron intake.

Patients and Methods: Heamoglobin (Hb) and plasma ferritin concentrations were determined in 122 asylum seekers' children (median age, 7.1 years; range, 2-12y),. ID was defined by plasma ferritin <15 μg/L. Anemia was defined as Hb levels < 6.8 mmol/l (*11 g/dL*) for children <6 years of age and Hb levels < 7.1 mmol/L (*11.5 g/dL*) for children between 6 and 12 years of age. Nutritional status of the children was assessed by BMI and dietary intake of iron was estimated by 24-hour recall.

Results: Twenty percent of the children had compromised iron status (16% with ID, 4% with ID anemia, [IDA]). Another 6% of the children had anemia caused by thalassemia. ID was significantly more prevalent in children <6 years of age and in children of African origin. The iron status was not significantly correlated with the length of stay in The Netherlands (r=0.6, P=0.48). Higher BMI-Z scores were positively correlated with iron status. Adequate or marginal dietary iron intake was not significantly related to the presence of ID (r= 0.02, P=0.9) or anemia (IDA and thalassemia) (r=0.15, P=0.9).

Conclusions: Iron deficiency is highly prevalent among the children of asylum seekers in The Netherlands. Our data indicate that systematic biochemical screening for ID is warranted in asylum seekers' children.

Keywords: Anemia, Asylum seekers, Biochemical screening, Iron deficiency

Introduction

Iron deficiency (ID) is one of the most common nutritional deficiencies in childhood. ID is highly prevalent in developing countries, but in European countries it is still considered one of the main nutritional disorders.[1,2] Iron requirements for growth and development are relatively high, which renders children vulnerable to ID.[3] Clinical symptoms of ID are rather a specific (e.g. tiredness, anorexia, poor concentration) and often remain unrecognized until ID is severe.[4,5] ID, even in the absence of anemia, has been associated with an increased risk for permanently impaired psychomotor development.[6-8] We recently demonstrated that asylum seekers' children in The Netherlands frequently have low dietary iron intake.[9] However, it has remained unclear to what extent iron status of asylum seekers' children is compromised during their stay in The Netherlands. Hematologic screening of anemia and iron status of asylum seekers' children entering The Netherlands has not been systematically done despite theoretical vulnerability because of previously exposure to nutritional risks, socio-economic situations and ethnic background[10-12] In asylum seekers' children in The Netherlands, we investigated the prevalence of ID and anemia, in relation to age, country of origin, and length of stay in The Netherlands, body mass index (BMI) and dietary iron intake.

Patients and Methods

Iron status was estimated in a cross-sectional study among children ages 2-12 years living in an asylum seekers' center in the northern part of The Netherlands. The study was approved by the Ethical Committee of the Medical Center Leeuwarden. Parents and children were invited to participate in the study using an informative letter translated into their native languages. The procedure was explained with the use of an independent language interpreter and formal permission to participate in the study was obtained from the parent (or caregiver) of each child. The study subjects (n=135) were healthy children who had been in The Netherlands ≥1year. The mean length of stay in The Netherlands of the children participating in the study was 3 years. Nineteen percent of the children had been born in The Netherlands. With regard to age, sex, and region of origin, the studied children constituted a representative sample of the ≥12.000 children ages 2 to 12 years remaining in Dutch asylum centers for ≥1 year.[13] A total of 122 children (90%) allowed blood withdrawal and a dietary history was taken of 116 children. For comparative analyses, the geographical origin of the children was categorized into 3 regions: Africa, n=44 (Angola n=18, Somalia n=18, Sudan n= 7), central Asia, n=36 (Afghanistan n=17, Iraq n=9, Iran n= 6, and others n=4) and, eastern Europe, n=42 (Azerbaijan n=13, former Yugoslavia n=14,

Russia n=13 and others n=2). Blood samples were collected at the laboratory ward of the hospital facility. In nonfasting venous blood samples, haemoglobin (Hb) and erythrocyte indices were measured using a CellDyn4000 automated hematology analyzer (Abbott laboratories, Hoofddorp, The Netherlands), and plasma ferritin was determined using a sandwich enzyme-linked immunosorbenr assay (Sandwich ECLIA, Roche, Almere, The Netherlands). Anemia was defined by an Hb level < 6.8 mmol/L (*11 g/Ll*) for children < 6 years of age, or <7.1 mmol/L (*11.5 g/dL*) for children 6 to 12 years of age, in accordance with Centers for Diseaese Control and Prevention criteria.[14] ID was defined by a plasma ferritin level <15 μg/L, in accordance with previous studies.[15,16] To aid in the interpretation of ferritin levels complement reactive protein (CRP) was measured to determine an acute phase response. ID anemia (IDA) was defined as ID and anemia with a cutoff value for the mean corpuscular volume (MCV) of ≤75 fL for children <6 years of age and ≤80 fL for children 6 to 12 years of age.[17] Samples in which the MCV divided by the erythrocyte count was <13, were analyzed for hemoglobinopathy and thalassemia by Hb electrophoresis and DNA polymerase chain reaction analysis for the major α-thalassemia deletions (ie, 3.7kB, 4.2kB, SEA,MED). Anthropometrical measurements were performed following the standard procedures as described in Paediatric Morphometrics using a Seca medical precise weight scale and the standing height with a Seca 208 stadiometer (RvS Nederland, Almere, The Netherlands).[17] All anthropometric measurements were collected by one trained medical doctor and indexed on the Dutch growth reference of 1997. Standard deviation scores were calculated for each child using the computer based Growth Analyser Information program (version 2 Dutch Growth Foundation 2001-2003). The dietary assessment was based on a 24-hour recall with language interpreters to minimize misunderstandings. All of the dietary histories were taken by 1 experienced dietitian. In addition, pictures developed for dietary assessment of other migration populations and standardized samples were used to estimate the size of the portions eaten. From the dietary assessments, food quantities were estimated using BECEL, a nutritional software package developed by Unilever (Vlaardingen, The Netherlands). The data were compared to the Dutch list of recommended daily allowance (RDA) for sex and age(18;19). Iron intake <80% of the RDA was graded as marginal.[20].

Data were analyzed, with the SPSS statistical software package (version 11.5:SPSS, Chicago, IL). P=0.05 was taken as threshold for statistical significance.

Results

To investigate iron status and anemia among the children,they were initially examined for corresponding clinical signs. None of the children reported or exhibited classical symptoms of anemia such as pale mucosa, tiredness, or anorexia. Table 1 shows the prevalence of ID and IDA in relation to age group, origin, sex, and length of stay in The Netherlands. A total of 16% of the children had ID and 10% had anemia. The 10% incidence of anemia could be attributed to IDA (4%) and previously undiagnosed thalassemia (6%). The prevalence of ID was 20% higher in children <6 years of age compared with older children ($P<0.05$). Approximately 50% of the children <6 years of age were born in The Netherlands, but this was not associated with presence or absence of ID ($P=0.12$). Independent of age, the prevalence of ID was higher in children who has come from Africa than in children from central Asia or Eastern Europe (each $P<0.05$). The length of stay in The Netherlands of children from Eastern Europe was slightly longer than that od African children ($P<0.05$). Neither length of stay in The Netherlands nor sex of the children was significantly related to the prevalence of ID or IDA.

Table 1 Demographic parameters of children with ID or IDA

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Demographic category	No. of patients	**ID** (n)	**IDA** (n)	**Total of ID, IDA** (%)
Origin				
Africa	n = 41	10	4	34[a,b]
Central Asia	n = 32	3	1	12[a]
Eastern Europe	n = 42	6	0	14[b]
Gender				
Female	n = 49	9	3	23
Male	n = 66	10	2	16
Age (years)				
2 – 6	n = 44	11	2	35[c]
6 – 12	n = 71	8	3	15[c]
Length of stay in The Netherlands (years)				
1 – 3	n = 60	11	4	24
> 3	n = 55	8	1	16
Total	n = 115*	19	5	21

** Seven children with thalassemia excluded*

Anemia: Hb<6.8 mmol/L children less than 6y, Hb<7.1 mmol/L children aged 6-12y

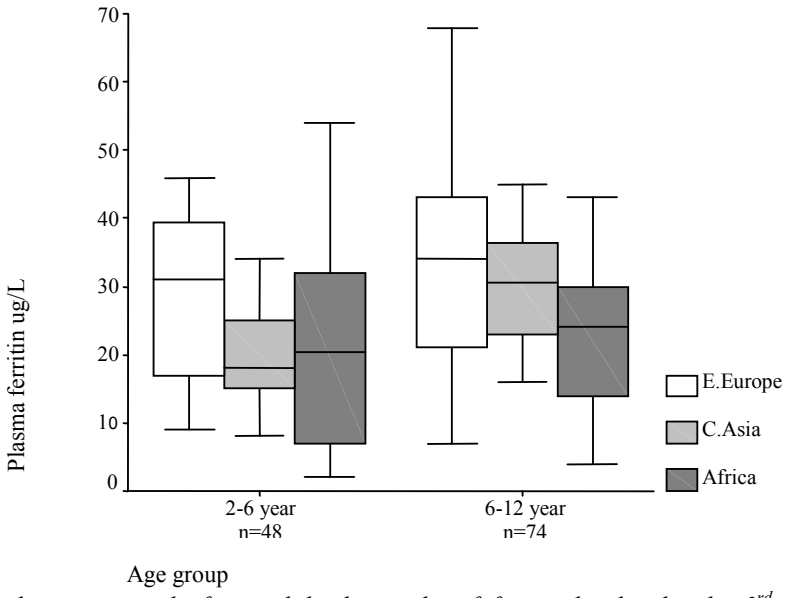
ID: iron deficiency; plasma ferritin<15 μg/L

IDA: iron deficiency anemia (ID + Anemia)

Differences in prevalence of ID and IDA to origin and age: χ^2 test a-c significance $P<0.05$

Four of the 7 children found with thalassemia, originated central Asia and 3 originated from Africa. Mean Hb levels of these children (5.8±0.3 mmol/L) and MCV (59±4 fl) were significantly lower than those of the children without thalassemia (Hb: 7.6±0.5 mmol/L; MCV: 81±4; respectively; each P<0.01*).* Thalassemia was not associated with different plasma ferritin levels. Excluding the children with thalassemia, the Hb levels of the African children were slightly lower (7.4±0.5 mmol/L) than those in children from eastern Europe (7.7±0.5 mmol/L; P<0.05) or central Asia (7.7±0.4 mmol/L; P<0.05). Independent of origin, children <6 years of age had lower Hb levels and MCV (Hb, 7.4±0.5 mmol/L; MCV, 79±4 fL, respectively) than older children (Hb, 7.7±0.5 mmol/L, P<0.01; MCV, 82±4 fL, P<0.01).

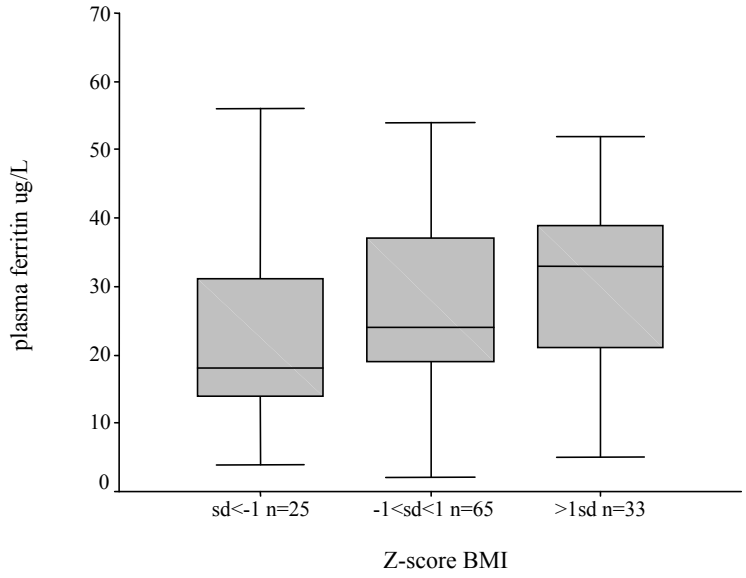
Figure 1 Ferritin levels related to age and geographic origin



Box plot represens the first and third quartiles of ferritin levels plus the 3rd and 97th centiles
Analysis was done by the Mann-Whitney test
Differences in ferritin among age groups among Asian children were significant at P*<0.01 Differences in ferritin levels within the elder age group between eastern European and African children were significant at P<0.05*

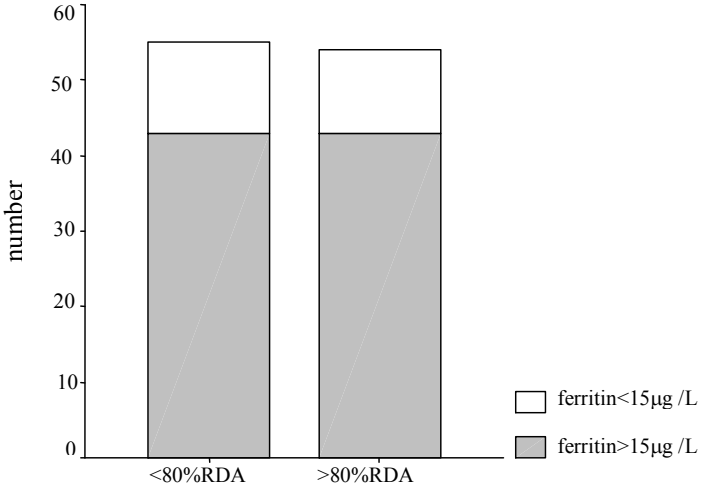
Figure 1 shows the relation between plasma ferritin levels of the children in relation to age and origin. The CRP level of 97.5% of the children was <10mg/L; 4 children with a CRP level >10mg/L (11,12,17,19mg/L respectively) did not have high ferritin levels (.11,42,39,24µg/ L respectively). The mean plasma ferritin level of the young children were less than those of the older children (24± 15µg/L vs. 30±15µg/L, respectively; P=0.005). Among the children from central Asia, the plasma ferritin levels of children <6 years of age were significantly lower than those of children >6 years of age (21± 9µg/L vs 31±9µg/L, P=0.001). In the groups >6 years of age, African children had lower plasma ferritin levels than eastern European children (26±18 vs 33±14 µg/lL P=0.03). We did not find a significant relationship between the weight for height and the plasma ferritin levels (r=0.2, P=0.07). However, independent of age or origin, plasma ferritin levels of the children were positively related to higher BMI-Z scores (fig 2).
The dietary iron intake was estimated adequate in approximately 50% of the children. However an estimated adequate dietary iron intake was not related to the prevalence of ID (r=0.02, P=0.9) or anemia (r=0.15, P=0.9; fig 3).

Figure 2 Ferritin levels related to the sex- and age specific BMI Z-score



Box plot represenst first and third quartiles of ferritin levels plus the 3rd and 97th centiles
Analysis was done by the Mann-Whitney test
Differencesin ferritin levels between <-1 and >1standard deviation score were significant at P<0.05

Figure 3 Number of children with ID related to dietary iron intake in percentage of RDA



Discussion

The prevalence of ID (16%) and IDA (4%) among 2- to 12-year-old asylum seekers' in The Netherlands as reported in this study is much higher than among children who presented at an outpatient clinic of a Dutch hospital (incidence of anemia 0.8-2.6%), and similar to observations among 1-to 11-year-old children in besieged Sarajevo who were receiving food rations of the United Nations.[21,22] Other studies among asylum seekers' children reporting in Switzerland a prevalence of 2% IDA, and a prevalence as high as 67% in displaced and refugee children in Lebanon.[23-27] We used 15µg/L as cutoff value for serum ferritin for all children >2 years of age in our laboratory. Serum ferritin reference values depend on the analytic method used. Serum ferritin levels <12µg/L have also been suggested to diagnose ID in children.[28-30] Reducing the cutof value to <12µg/L rather than <15 µg/L reduces the prevalence of ID from 16% to 10% in our total study population.
Corresponding to other reports, anthropometric measurements, clinical symptoms, and dietary assessment were not of great value to identify children at risk for ID in our study.[4] The present demographic risk factors for ID among asylum seekers' children in The Netherlands who are <6 years of age and of African descent corresponds with the high

prevalence of ID in their countries of origin.[31,32] Together with the lack of relation between the iron status of the children and the length of stay in The Netherlands this suggest that solely improving demographic factors and food availability is insufficient to recover from ID.

World-wide, the high prevalence of ID among refugee children (according to reports on behalf of the United Nations) have led to improvement of the micronutrient content of ration food and supplements provided in refugee camps.[33,34] However, in The Netherlands, asylum seekers are not provided with food rations but with a small budget to prepare their own food.

Because ID, (ie, depletion of iron stores without anemia) adversely affects the cognitive performance (eg. poor attention, memory, verbal performance), behaviour, and growth of infants, pre-school and school aged children, the high prevalence of ID and anemia in young asylum seekers' children imposes a serious concern.[35-37] Prevention or early detection and treatment is of great importance, especially because ID in pre-school children may cause prolonged neurological effects confounding the interpretation of iron supplementation in later childhood.[38,39] Guidelines for screening and treatment of ID in pregnancy and among adopted children are being developed in The Netherlands.[40,41] Hematological screening with the biochemical marker ferritin is reported to be corner stone to identify ID in early stage of compromised iron status.[42] Hematological screening of asylum seekers' children could be of great value to identify children for whom iron supplements (2-4 mg/kg, day for 2-5 months) are justified.[43] Additionally it should be realized that verification of hemoglobinopathy is important among the anemic children of asylum seekers. In summary, our data indicate that asylum seekers' children in The Netherlands frequently have compromised iron status, particularly children <6 years of age and those originating from Africa, which may threaten an adequate psychomotor development. The present study indicates that with a relatively simple screening a high number of children with thalassemia, ID or IDA can be identified. The high percentage of children with inadequate dietary iron intake underlines the importance of adequate nutritional education and support of those children, in addition to haematological screening..

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CHAPTER 6

Bone mineral density of asylum seekers' children in The Netherlands

Annette A.M. Stellinga-Boelen[1], Huib Storm[2], Henkjan J. Verkade[3]

1. *Community health Service for Asylum Seekers (Medische Opvang Asielzoekers Noord Nederland) P.O. Box 584 9700 AN Groningen, The Netherlands*
2. Department of Clinical Chemistry, KCL, Medical Center Leeuwarden, P.O. Box 888, 8901 BR Leeuwarden, The Netherlands
3. Pediatric Gastroenterolgy, University Medical Center Groningen, University of Groningen, P.O. Box 30.001, 9700 RB Groningen, The Netherlands

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Submitted

Chapter 6

Abstract

Asylum seekers' children in The Netherlands can have seasonal low serum 25hydroxycholecalciferol (s-25(OH)D) levels combined with inadequate dietary calcium intake. In this study we determined in 13 asylum seekers' children (age 6-12 year) with s-25(OH)D levels below 30nmol/L the bone mineral density (BMD) by dual X-ray absorptiometry and related those to the dietary calcium intake. The lumbar spine BMD was below the Dutch and slightly below the U.K. references. The calcium intake was associated with the BMD (r= 0. 59 p=0.03). Our data indicate that low s-25(OH)D levels particular reduce the BMD in asylum seekers' children with inadequate calcium intake.

Key words: Asylum seekers' children, bone mineral density, vitamin D deficiency, dietary calcium intake

Bonedensity

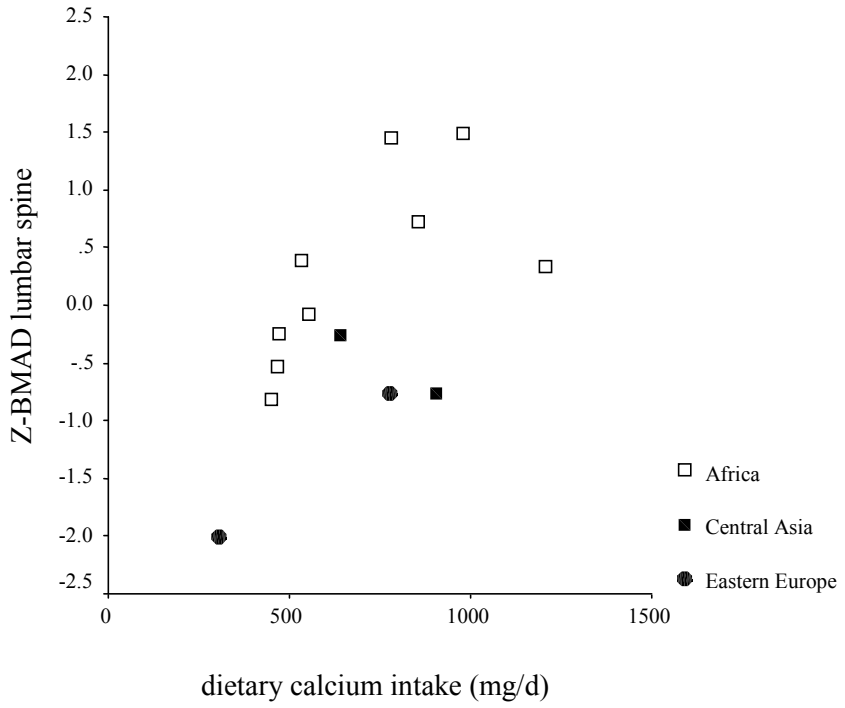
Bone continuously undergoes synthesis, remodelling, and resorption. Bone mineralization at the lumbar spine area is hardly influenced by ethnicity of children.[1-3] Recently we demonstrated that asylum seekers' children in The Netherlands have low serum 25hydroxycholecalciferol (s-25(OH)D) levels in mid-spring, i.e. after the winter season. Low s-25(OH)D concentrations were frequently combined with low dietary intake of calcium.[4,5] It has remained unclear however, to what extent these biochemical and nutritional parameters are actually associated with the bone mineralization. In the present study we determined the lumbar spine bone mineralization in asylum seekers' children with low s-25(OH)D levels (below 30nmol/L) by dual X-ray absorptiometry (DEXA-scan, Hologic QDR 4500.[6] The results were related to the biochemical parameters and to dietary calcium intake.

We studied thirteen children, aged 6 to 12 year (median 9.9), who stayed in The Netherlands for 32 months (median, range16-56). Nine of the 13 children were from African origin. The estimated dietary calcium intake was based on 24 h recall and calculated with the use of a nutritional software package (Unilever B.V., Vlaardingen, The Netherlands).

Analysis using the Mølgaard model, indicated that six children had 'small bones' (Z-scores height for age between -2.2 and -1.1) or 'narrow bones' (Z-score bone area for height between -2.43 and -1.46) and four other children had 'under-mineralized,' bones (Z-score bone mineral content for area between -3.24 and -1.20).[7] The lumbar spine bone mineral density (LSBMD; g/cm^2) was below the Dutch age and gender specific Z-scores (Median -1.84, range -2.99 and -0.47) and the lumbar spine bone mineral apparent density (LSBMAD; g/cm^3) was slightly below the UK references (median Z-score -0.19, range -2.02;+1.49).[8,9] The bone mineral density did not correlate with the biochemical parameters of the vitamin D status, except for a negative relation between Z-LSBMAD and serum phosphate (r=-0.58 p=0.02).

The estimated dietary calcium intake that varied between 300 and 1300 mg, did neither correlate with the s-25(OH)D levels (r =0.34, p = 0.25) nor with African origin (r=-0.04, p=0.89). The dietary calcium intake however was positive related to the Z-LSBMAD (g/cm^3) (r= 0.59, p=0.03; Figure 1). Our data indicate that the low vitamin D levels particularly reduce the bone mineralization in asylum seekers' children with inadequate calcium intake. 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.

Figure 1 Relationship between dietary calcium intake and Bone Mineral Density in vitamin D-deficient asylum seekers' children in The Netherlands.



Relationship between dietary calcium intake and the age and gender specific Z-scores of the lumbar spine Bone Mineral apparent Density measured by DEXA-scan in vitamin D-deficient asylum seekers' children in The Netherlands.
Vitamin D deficiency was defined as a s-25OHcholecalciferol <30nmol/L
Lumbar spine bone mineral apparent density (g/cm^3) measured by DEXA-scan, Hologic QDR 4500 and Z-score calculated of the U.K. reference.

The linear correlation between dietary calcium intake and Z-LSBMAD could be characterised by the following equation: [Z-LSBMAD] = 0.0017x [dietary calcium intake] – 2.20. (Spearman correlation coefficient r = 0.59; p=0.03).

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Chapter 6

CHAPTER 7

General Discussion

Chapter 7

In this thesis we studied nutritional and health aspects of asylum seekers children in The Netherlands. We hypothesized that nutrition and growth of asylum seekers' children were influenced by the living conditions. Asylum seekers' children of different background are exposed to changing environmental factors that can influence the nutritional habits and the availability and affordability of food products. Socio-economic aspects, such as the availability and affordability of food products, cultural and nutritional habits, family relationships and the coping mechanisms in a new environment, influence the dietary intake of migrants.[1,2] Many migrant families often have a low socio-economic status with a low family income which might cause food insecurity which has shown to be strongly related to unfavourable dietary habits.[3,4] Last decennia nutritional research has tried to find evidence for the importance of adequate dietary intake at childhood to optimize health and to prevent chronic diseases in adulthood.[5,6]

In **Chapter 2** we estimated the quality of the dietary intake of asylum seekers children in The Netherlands in relation to age, gender and origin of the children. We found that the dietary fat intake was high and consisted of mostly saturated fatty acids in a substantial fraction of the asylum seekers' children. The fat percentage of the total energy intake and the composition of the fat intake are considered to be the most important nutrition health indicator for children.[7] The high intake of unfavourable fat in asylum seekers' children was most prominent in children originating from Eastern Europe. Neither gender nor length of stay in The Netherlands correlated with the quality of fat intake. Possibly, this observation could be explained by the negative relationship existing between energy density and price, in which high energy dense diets are those that include more fast foods, snacks and desserts, whereas diets lower in energy density are those higher in (mostly expensive) vegetables and fruits as shown in several studies.[8] High fat diets are of great concern because they are considered to carry an increased risk on development of overweight and obesity.[9] The high saturated fat intake found in our study is in contrast with studies among migrant children form Turkey and Morocco in The Netherlands. Those study showed a particular low intake of saturated fat and a higher intake of carbohydrate with a better ratio between polysaccharides and mono/disaccharides than the conventional Dutch diet.[10] Such differences in dietary fat intake have been described between traditional diets of people from Northern and Southern European countries with the most beneficial fat composition in the so called Mediterranean diet with high percentage of unsaturated fatty acids.[11] With migration, a mixture of dietary habits often develops together with an increase of fast food consumption, causing an higher saturated fat intake which might induce unfavourable lipid and insulin levels that are associated with increased cardiovascular disease risks.[12,13]

Micronutrients enable the body to synthesize and/or activate enzymes, hormones and transport proteins essential for proper growth and development. Despite the small amounts needed, the consequences of insufficient availability can be serious. In our dietary study we found a compromised dietary intake of several micronutrients. The intake of iron, calcium and vitamin D was strongly related with the age of the children. Gender or length of stay in The Netherlands did not show a relation with micronutrient intake. Low micronutrient intakes are not seen in the national nutritional survey's in The Netherlands, which report that the diet of Dutch children between 2-12 years is mainly micronutrient adequate.[14] Situations where the intake may be less adequate are either a disease state, which profoundly affects the demand, or reduces intake, or absorption, or food insecure environmental circumstances. Such food insecure circumstances might have been the case for asylum seekers' children prior to their stay in The Netherlands. However, world wide even in emergency situations such as war inadequate intake is mostly found in infants and adolescents, as the demand for growth is then higher than during the primary school

age.[15,16] In several European studies inadequate micronutrient intake clearly correlate with socio-economical circumstances.[17,18] To prevent micronutrient inadequacies a dietary intake with five portions of fruit and vegetables daily is advised in the nutritional guidelines. Fresh fruit and vegetables are rather costly, indicating again that poverty could play an important role in our observations. Improvement of the socio-economical circumstances might contribute to more adequate dietary intake.

The most common nutritional deficiency, iron deficiency, is also strongly related to socio-economic conditions.[19,20] Asylum seekers' children might be vulnerable for iron deficiency because of their socio-economic situation and possibly also because exposure to nutritional risks prior to their stay in The Netherlands.[21-23] In **Chapter 4** we investigated the prevalence of Iron Deficiency (ID) and anaemia in asylum seekers' children in The Netherlands in relation to demographic variables and dietary intake of iron. We found a prevalence of ID 10-16% of ID (depending on the definition cut of value of ferritin) and 4% IDA. The prevalence was the highest in children originating from Africa and in children below 6 years of age. The prevalence that we observed was similar to that described in refugee children in more disadvantageous situations.[24-26] This observation suggests that the situation prior to migration influences the iron status more than the current dietary intake. In accordance with this interpretation the iron status was not related with the current dietary iron intake. The high prevalence of ID among asylum seekers' children is of great concern. Iron is an essential nutrient important for the transport of oxygen in red blood cells and in mitochondria of nucleated cells. Iron deficiency adversely affects the cognitive performance behaviour and growth of infants, pre- and school aged children.[27-32] Because of long-term neurological effects early detection, treatment and/or prevention of ID is of importance.[33] The American Nutritional Surveillance System 2000 aimed to reduce the prevalence of iron deficiency to less than 3% among children of 1-14 years of age. Upon nation-wide interventions the prevalence of ID has profoundly decreased. Such nationwide interventions are not indicated in The Netherlands whereas the prevalence of ID among the general Dutch population is estimated 2.6% in children between 2 and 9 years of age and 0.8% in children at 9-15 years of age.[34] In general, the prevalence of ID is related to infant age, breast-feeding, recent infections and inadequate dietary iron intake.[35,36] We might expect in line with other European studies that prevalence of ID in asylum seekers' infants and adolescents in The Netherlands is higher than those reported in our study.[37-39] WHO recommends screening on ID and subsequently treatment in areas where the prevalence is high, to reduce the prevalence to less than 3% among children aged 1-4 years. Our data show a high prevalence of ID in asylum seekers' children. Also, our results indicate that dietary intake of iron is an unreliable parameter to screen on ID in this group. Rather, appropriate biochemical investigations are necessary. A single finger prick method

could be an effective and useful tool to screen for ID and haemoglobinopathy among asylum seekers' children. Interventions such as supplementation seem to be justified given the confirmed beneficial effects of supplementation.[40]

In the Netherlands vitamin D is the only micronutrient for which nutritional guidelines advise supplementation. Asylum seekers' children in The Netherlands are theoretically susceptible for inadequate vitamin D levels because of their often dark pigmented or covered skin, unfamiliarity with supplement use and marginal dietary intake. We determined the vitamin D status [s-25(OH)D levels] of Asylum seekers' children in The Netherlands mid spring in relation to demographic variables and the dietary intake of vitamin D and calcium (**Chapter 5**). In a subgroup we reassessed the vitamin D status after the summer, during which the children had been assigned at random to remain un-supplemented or to receive vitamin D supplements. In mid-spring 13% of the asylum seekers' children had Vitamin D deficiency (VDD) [s-25(OH)D ≤30nmol/L] and 42% hypovitaminosis D [s-25(OH)D ≤50nmol/L]. The compromised vitamin D status could be attributed to a marginal dietary vitamin D intake, geographic origin (skin pigmentation), seasonal variation and a lack of supplement use. This high prevalence is remarkable since vitamin D deficiency is rare among the general Dutch population. Our present results accord with recent concerns about a compromised vitamin D status among migrants in The Netherlands,[41-43] in the United kingdom and in several Northern European countries.[44-48] Adequate vitamin D levels are important for the calcium homeostasis in the body and for the development and maintenance of a healthy skeleton. Early detection of children at risk for impaired bone mineralization seems warranted to guarantee optimal reserve for later life.[49]

In **Chapter 6** we describe the results of the bone mineralization of asylum seekers' children with seasonal low s-25(OH)D concentrations in relation to the dietary calcium intake. Our data indicate that seasonal low vitamin D levels particularly reduce the mineralization in asylum seekers' children with inadequate calcium intake. Adequate dietary intake of calcium could easily be obtained with a regular Dutch diet that normally includes diary products. However, to reach adequate vitamin D levels dietary intake will be insufficient and with reduced endogenous synthesis of vitamin D because of a dark pigmented skin, supplementation is necessary.[50] To further delineate the observed relationship between the dietary intakes of calcium, vitamin D status and bone mineralization, it would be interesting to apply more detailed dietary nutrient intake methods. Detailed information on the nutritional habits of asylum seekers' children could be of value for nutritional education and for development of strategies to prevent nutritional inadequacies. Strategies to recognize in an early stage, those children who are

more vulnerable for reduced bone mineralization, will be very helpful to develop further intervention. Recognition of these children may be complicated by the fact that bone is an active tissue that is constantly being remodelled. Analysis of the bone density with different paediatric DEXA software shows discrepancies. The discrepancies and the lack of multi-ethnic references may limit the value of our findings. However, the importance of optimal bone health at young age justifies recommendations to develop strategies to improve the vitamin D status of asylum seekers' children.

In addition to biochemical aspects of nutrition, growth parameters are also important to assess the nutritional condition of children. We evaluated the use of the Dutch growth references to monitor the growth and nutritional status of asylum seekers' children in The Netherlands. (**Chapter 3.**) Our results indicated that the growth of pre-pubertal asylum seekers' children could be reliably monitored with the use of the Dutch growth reference charts. Our results correspond with the conclusions of the Multi-centre Growth reference Study by WHO that stated that all children have the same growth potential, provided that they are exposed to the same nutritional environment.[51] Interestingly, the prevalence of overweight and obesity increased from 15% to 21% of asylum seekers' children during their stay in The Netherlands. Since the potential growth of asylum seekers' children is similar to that of the general Dutch population the high and increasing prevalence of overweight and obesity among the asylum seekers' children in The Netherlands is alarming. In the general population in The Netherlands the prevalence of overweight and obesity has also increased to almost 10%, but among some migrant groups the values amount up to 15-30%, including our present data.[2] The increased prevalence of overweight and obesity has occurred in many industrialising countries and urbanised areas of developing countries during the past decades.[53-56] The rate and the extended of this increase assumes that the growth in overweight and obesity is caused largely by environmental factors.[57,58] From the many environmental factors which are suggested to be partly responsible for this increase, including socio-economic situation, food insecurity, limited physical activities, television watching and low education level, it can be concluded that asylum seekers' children are in a vulnerable position.[59,60] Because of the adverse health effects later in life, prevention of overweight and obesity should have priority in asylum seekers' child health care.

The diet of children aged 2-12 years strongly depends on their environment, in particular their parent(s) or caregiver. The possibility for the caregiver to provide an energy-adequate diet with sufficient amounts of micronutrients depends on knowledge of healthy diets, affordability of food products and cultural and religious habits.[61] In our study we only

measured the current dietary intake and did not investigate dietary knowledge, cultural or religious habits or affordability of food products. We can speculate that the variability in education level and limited knowledge of the Dutch language, might have influenced the dietary habits of the caregiver. The influence of cultural and religious habits seems limited, as macro- and micronutrient contents of an optimal diet can be achieved with most traditional diets. The affordability of food product might exert a greater influence, because the daily allowance for an asylum seekers' child is limited and an optimal diet high in fruits and vegetables is costly. Improvement of the dietary intake of asylum seekers' children is therefore only likely to be achieved with a multifaceted strategy in which knowledge, availability and affordability are the key factors. Such a strategy should include appropriate investigation of the iron status of the asylum seekers' child shortly after arrival in The Netherlands. We could ethically not justify investigating the iron status at arrival and at follow-up without treating ID. The fact that we did not find a low prevalence of ID among children who had been in the Netherlands for a prolonged period indicates that efficient spontaneous recovery of ID does not easily occur.

The studies reported in this thesis were aimed to monitor the growth and nutritional status of asylum seekers' children in The Netherlands, to evaluate the determinants used to monitor growth and health of asylum seekers' children and to identify potential nutritional risks in this unique group of children. The studies were supported by an unrestricted grant of the Community health Service for Asylum Seekers (Medische Organisatie Asielzoekers Noord Nederland) to provide scientific data for the development of guidelines, standards and protocols to optimize the health care service for asylum seekers' children in The Netherlands. Shortly after publication of the data on the dietary intake of the asylum seekers' children the food allowance for asylum seekers were increased to the minimum necessary food allowance estimated by the Dutch Budget Institute (NIBUD). Vitamin D supplements are considered self medication (no-prescription) however the national board of the Community health Service for Asylum Seekers has implemented free access to vitamin D supplements for asylum seekers' children below 4 years of age in the Netherlands. Based on present data on the vitamin D status and seasonal vitamin D deficiency the national board has decided to reconsider the indication for providing free vitamin D supplements. In the study area food information markets were organised and leaflets with information on adequate children's nutrition were developed and translated in the main languages the interest for both of the asylum seekers' parents was high. After publication of our data the national board has decided to explicit the need of nutritional education in their youth program and to update the used nutritional education material for asylum seekers in all regions of The Netherlands.

Chapter 7

In conclusion, the present studies have delineated the growth and nutritional status of asylum seekers' children in The Netherlands. Asylum seekers' children are vulnerable for both macro- and micronutrient inadequacies. The energy-dense dietary composition might be one of the factors related to the increase of overweight and obesity among the asylum seekers' children. The consequences of inadequate intake for iron and vitamin D intake were confirmed in high prevalence of anaemia and compromised bone mineralization, respectively. A multifaceted strategy seems justified to develop preventive nutritional and education programs such as nutritional education, free provision of micronutrient fortification of commonly used foods and/or supplementation of iron and cholecalciferol.

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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

Asia. The proportion of children crossing the BMI cut-of values for overweight and obesity increased form 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 haematological screening (haemoglobin and plasma ferritin). Iron deficiency (ID) was defined as plasma ferritin below 15 µg/L. Anemie 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 15ug/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(OH)D], intact parathyroid hormone (I-PTH) and plasma alkaline phosphatase (ALP) were assessed. Vitamin D deficiency (VDD) and hypovitaminosis D were defined as 25(OH)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/cm^2) 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

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)

Samenvatting

De studies beschreven in dit proefschrift evalueren de voedingsstatus van asielzoekers kinderen in Nederland; dietaire, biochemische en anthropometrische aspecten worden beoordeeld. Het aantal asielzoekers in Nederland is aan het einde van de twintigste eeuw sterk toegenomen. Het is aannemelijk dat asielzoekers hun voedingsgewoonte veranderen afhankelijk van eigen culturele achtergrond, bekendheid met lokale voedingsproducten en richtlijnen, en de prijs van voedingsmiddelen. Het is onbekend of de voedingsgewoonten van asielzoekers in Nederland een risico betekenen voor adequate voeding en groei van hun kinderen. ***Hoofdstuk 1*** introduceert het onderwerp en geeft een beschrijving van de studie vraagstellingen. De onderzoekmethodes, dieetanamnese, groei-monitoring en de biochemische evaluatie van de ijzer- en vitamine D-status en de botdichtheidmeeting worden beschreven.

Hoofdstuk 2 beschrijft de voedingsinname van 116 asielzoekers kinderen in de leeftijd van 2-12 jaar afkomstig uit Afrika, Centraal Azië en Oost Europa berekent uit de zogenaamde "24-uur recall" dieetanamnese. De voedingsinname wordt vergeleken met de Nederlandse voedingsadviezen. Een micronutriënt inname minder dan 80% van de aanbevolen dagelijkse hoeveelheid (ADH) wordt geclassificeerd als "marginaal". Vierentwintig procent van de kinderen had een vetinname hoger dan de maximaal aanbevolen norm (40En %). De fractie van de totale energie inname die in de vorm van vet werd geconsumeerd was bij Afrikaanse kinderen (33En %) iets lager dan bij kinderen uit Centraal Azië (37En %) of uit Oost Europa (38En %). Te hoge inname van verzadigd vetzuur (d.w.z. boven de 10En%) werd gevonden bij 70% procent van de kinderen ouder dan 4 jaar. Kinderen uit Oost Europa hadden de meest ongunstige vet en koolhydraten inname. De micronutriënt inname was vaak marginaal: voor calcium bij 42% van de kinderen, voor ijzer bij 49%, voor vitamine A bij 45% en voor vitamine D zelfs bij 80%. De jongste kinderen hadden de laagste inname van ijzer en vitamine D. Naarmate kinderen ouder werden werd er vaker een inadequate calciuminname geconstateerd. Het grote aantal kinderen met een inadequate voedingsinname is een indicatie dat strategieën die de voedingsinname van asielzoekerskinderen in Nederland verbeteren noodzakelijk zijn.

In ***Hoofdstuk 3*** wordt de groei van asielzoekerskinderen tijdens hun verblijf in Nederland geëvalueerd aan de hand van Nederlandse referentie groeicurven. De deelnemende 135 kinderen vormden een representatieve steekproef uit de ~12000 kinderen tussen de 2 en 12 jaar die in Nederlandse asielzoekers centra verbleven, met betrekking tot hun leeftijd, geslacht, verblijfsduur en regio van afkomst. Bij aankomst in Nederland had 13% van de

kinderen een zeer kleine lengte voor leeftijd (d.w.z. onder de -2SD). Dit percentage verminderde tot 5% tijdens de follow-up van bijna drie jaar. De gemiddelde lengte naar leeftijd bleef tijdens de follow-up tussen de ±3 cm (jongens)of ±4 cm (meisjes) van de Nederlandse referentie lengte. Afrikaanse kinderen waren gemiddeld iets langer dan de kinderen uit Oost Europa of Centraal Azië. Het aantal kinderen met een BMI boven de afkapwaarde voor overgewicht en obesitas nam toe van 15% bij aankomst tot 21% tijdens follow-up. De toename van overgewicht en obesitas was het grootst onder kinderen uit Oost Europa, terwijl Afrikaanse kinderen de grootste heuptaille ratio hadden. De studie laat zien dat de groei en voedingsstatus van asielzoekerskinderen adequaat geëvalueerd kunnen worden met de Nederlandse referentiecurve. Strategieën om de ontwikkeling van overgewicht en obesitas bij deze kinderen te voorkomen en/of behandelen lijken noodzakelijk.

Hoofdstuk 4 beschrijft de ijzerstatus van een representatieve groep van 123 asielzoekerskinderen in Nederland (leeftijd 2-12 jaar) met behulp van hematologisch onderzoek (hemoglobine- en plasma ferritine gehalte) IJzer deficiëntie (ID) was gedefinieerd als plasma ferritine lager dan 15µg/L. Anemie was gedefinieerd als hemoglobinegehalte (Hb) lager dan 6.8mmol/l (*11 g/L*) voor kinderen jonger dan 6 jaar en lager dan 7.1mmol/l (*11.5 g/L*) voor kinderen tussen 6 en 12 jaar oud. Op grond van specifieke criteria werd bij een aantal kinderen het voorkomen van thalassemie onderzocht door middel van Hb electrophorese of DNA-analyse. De prevalentie van thalassemie, ijzer gebreksanemie en ID zonder anemie onder de asielzoekerskinderen in Nederland was 6%, 4% and 16%, respectievelijk. Plasma ferritine gehalte was niet geassocieerd met het voorkomen van thalassemie. Plasma ferritine gehalte lager dan 15ug/L (ID) werden vaker gevonden bij kinderen onder de 6 jaar en bij kinderen van 2-12 jaar afkomstig uit Afrika. Hoewel ongeveer 50% van de kinderen onder de 6 jaar in Nederland geboren was, bleek dit geen invloed te hebben op de prevalentie van ID. Kinderen met een relatief hoog lichaamsgewicht (hoge Body Mass Index Z score) bleken vaker een adequate ijzerstatus te hebben. De ijzerinname via de voeding was marginaal (lager dan 80% van de aanbevolen dagelijkse hoeveelheid) bij 49% van de kinderen. De aanwezigheid van ID bleek niet significant gecorreleerd met de ijzerinname via de voeding. De resultaten ondersteunen een systematische hematologische screening op ID bij asielzoekerskinderen in Nederland, mede in het licht van de bekende negatieve lange termijn gevolgen van ID op de psychomotorische ontwikkeling van het kind.

Hoofdstuk 5 beschrijft de vitamine D status van asielzoekerskinderen in relatie tot jaargetijde en supplement gebruik. De endogene synthese van vitamine D is, onder invloed

van de ultraviolette straling van de zon, van september tot april in Nederland zeer beperkt. De prevalenties van vitamine D deficiëntie (VDD) en van de mildere vorm van vitamine D tekort, hypovitaminosis D, werden bepaald in 2-12 jarige kinderen in asielzoekerscentra in het noorden van Nederland. De serumconcentraties van 25-hydroxyvitamine D [25(OH)D], intact parathyroid hormoon (I-PTH) en plasma alkalisch fosfatase (ALP) werden bepaald. Vitamine D deficiëntie en hypovitaminosis D waren gedefinieerd als 25(OH)D lager dan 30 of 50 nmol/L, respectievelijk. Een deel van de kinderen werd na de zomer (drie maanden later) opnieuw onderzocht, zodat het effect van de zomermaanden (met aannemelijk een hogere blootstelling aan ultraviolet zonlicht) op de vitamine D status kon worden bepaald. Alle kinderen werd verzocht een deel van de huid minimaal 30 minuten dagelijks aan de zon bloot te stellen. Gerandomiseerd ontving de helft van de kinderen bovendien dagelijks 400 IU vitamine D suppletie gedurende de drie zomermaanden. Geen van de kinderen vertoonde klassieke symptomen van vitamine D deficiëntie zoals O-benen, verbrede polsen, rosaria op de ribben of spierzwakte. Halverwege de lente (april-mei) had 13% van de kinderen vitamine D deficiëntie en 42% hypovitaminosis D. De prevalentie van vitamine D deficiëntie was significant hoger in Afrikaanse kinderen dan in kinderen afkomstig uit Centraal Azië of Oost Europa. Serum 25(OH)D spiegels waren aanzienlijk lager in Afrikaanse kinderen boven de 6 jaar dan in Afrikaanse kinderen beneden de 6 jaar of dan in Oost Europese kinderen boven de 6 jaar. Na de zomer was de gemiddelde 25(OH)D concentratie toegenomen met 42% in de kinderen zonder suppletie en zelfs met 85% in de kinderen die ook nog dagelijkse 400 IU vitamine D hadden ontvangen. Het effect van suppletie was het duidelijkst bij Afrikaanse kinderen. Alhoewel serum 25(OH)D concentraties van de Afrikaanse kinderen gedurende de Nederlandse zomer dus duidelijk gestegen waren, corrigeerde dit toch niet volledig de gecompromitteerde vitamine D status die in de lente was aangetroffen. Onze data geven aan dat Afrikaanse kinderen het meest effectief zouden profiteren van vitamine D suppletie.

In ***Hoofdstuk 6*** wordt de botdichtheid beschreven gemeten met dual X-ray absorptiometrie (DEXA-scan) van 13 asielzoekerskinderen met VDD in relatie tot de calciuminname. De botdichtheid van lumbale wervels (L1-L4) werd uitgedrukt in Z-score voor geslacht en leeftijd. De gemiddelde Z-score van de lumbale wervel botdichtheid (g/cm^2) was -1.84 (range -2.99, -0.47) ten opzichte van de Nederlandse referentiewaarden. De lumbale wervel dichtheid was positief gecorreleerd met de geschatte calciuminname van de kinderen. ($r=0.59$, $p=0.03$). Deze gegevens duiden erop dat een adequate calciuminname de nadelige effecten van te lage vitamine D concentraties op de botdichtheid kunnen voorkomen. Het preventieve karakter onderstreept het belang van adequate voedingsvoorlichting met betrekking tot vitamine D en calcium inname aan asielzoekerskinderen in Nederland.

Samenvatting

In ***Hoofdstuk 7*** worden de bevindingen uit de voorafgaande hoofdstukken gecombineerd en bediscussieerd. De gepresenteerde studies hebben duidelijk gedemonstreerd dat asielzoekerskinderen van verschillende geografische origine kwetsbaar zijn voor ongunstige voedingsgewoontes die hun groei en ontwikkeling kunnen beïnvloeden. Het lijkt aannemelijk dat de ongunstige, hoge vetinname en de lage micronutriënt inname in de hand gewerkt worden door de negatieve relatie tussen de prijs van voedingsmiddelen en de energiedichtheid, in combinatie met de in het algemeen beperkte financiële middelen van asielzoekers. De ongunstige voedingsgewoonten zijn mogelijk ook gerelateerd aan de geobserveerde toename van overgewicht en obesitas onder de asielzoekerskinderen.
De prevalentie van ijzergebrek onder de asielzoekerskinderen bleek variabel naar afkomst en was slechts beperkt geassocieerd met de ijzerinname. Op grond hiervan lijkt systematische screening, gevolgd door gerichte evaluatie en interventie bij kinderen met een gecompromitteerde ijzerstatus het meest voor de hand te liggen. Veel asielzoekerskinderen in Nederland hebben in de lente een verlaagde vitamine D status die onvoldoende verbetert in de zomer. In combinatie met een marginale calciuminname bedreigt dit duidelijk de botaanmaak in een levensfase, die uiterst belangrijk is voor de sterkte van het skelet in het latere leven. Een “meersporenbeleid” met vroegtijdige onderkenning, preventieve voedingsvoorlichting en de (gratis) provisie van supplementen lijkt gerechtvaardigd.

P.S. Op grond van de bevindingen in dit proefschrift wordt de indicatie van vitamine D verstrekking heroverwogen, gaat voedingsvoorlichting een expliciet onderdeel uitmaken van de voorlichting in de jeugdgezondheidszorg aan asielzoekers kinderen en wordt het gebruikte voorlichtingsmateriaal gecontroleerd op bruikbaarheid voor de doelgroep. De financiële toelage voor asielzoekers kinderen is inmiddels verhoogd naar het geschatte noodzakelijke budget in Nederland (NIBUD).

Abbreviations

ALP	:	alkaline phosphatase
AC	:	Application Center
AIDS	:	Acquired immune deficiency syndrome
AZC	:	Asylum seekers Centrum
BMI	:	Body Mass Index
BMR	:	Basic metabolic rate
CDC	:	Communicable Disease center
COA	:	Central Reception Organisation for Asylum Seekers
CRP	:	Complement reactive protein
DEXA	:	Dual energy X-ray absorptiometry
EI	:	Estimates Intake
En%	:	Energy percent
EU	:	European Union
HB	:	Haemoglobin
HC	:	Hip circumference
HIV	:	Human immunity virus
ID	:	Iron Deficiency
IDA	:	Iron Deficiency Anaemia
IU	:	International Units
IND	:	Immigration and naturalisation Service
IOM	:	International Organisation for Migration
I-PTH	:	intact parathyroid hormone
LSBMAD	:	lumbar bone mineral apparent density
MCL	:	Medisch Centrum Leeuwarden
MCV	:	Mean corpuscular volume
MOA	:	Community health Services for Asylum Seekers
MUAC	:	Mid-upper-arm circumference
MUFA	:	Monounsaturated fatty acids
PTSS	:	Post traumatic stress syndrome
PUFA	:	Polyunsaturated fatty acids
RDA	:	Recommended Daily Allowances
RVA	:	Regulations for asylum seekers
SD	:	Standaarddeviationscore
SF	:	Saturated fatty acids
SPSS	:	Statistical Software Package

SRA	:	Asylum Seekers' Legal Aid Foundation
TSFT	:	Triceps skin fold thickness
UN	:	United Nations
UNHCR	:	United Nation High Commissioner for Refugees
VDD	:	Vitamin D deficiency
WC	:	Waist circumference
WHO	:	World health organisation
WHR	:	Waist-hip ratio
25(OH) D	:	25-Hydroxycholecalciferol

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Curriculum Vitae

Annette Agnes Maria Stellinga-Boelen werd op 14 juni 1964 geboren in Beverwijk. Studeerde Geneeskunde aan de Rijks Universiteit Groningen van 1986-1991. Tijdens haar studie was ze elective coördinator van het Netherlands Medical Student International Committee (Nemsic) en voorzitters van het internationale elective committee van de International Federation of Medical Student Associations (IFMSA). Voor haar coschappen verhuisde zij naar het medisch spectrum Twente te Enschede en ronde in 1993 haar studie af met een keuze coschap tropische kindergeneeskunde aan de Airlanga University Soerabaja Indonesië. Aansluitend volgde zij de opleiding tropische geneeskunde waarvoor zij als assistent chirurgie en verloskunde/gynaecologie werkte in het Tjongerschans ziekenhuis te Heerenveen. In dezelfde periode volgde zij de applicatie cursus CB-arts en was voorafgaande aan haar uitzending naar de tropen 3 maanden werkzaam als assistent kindergeneeskunde in het Rijnstate ziekenhuis te Arnhem. Van 1996-2000 werkte zij als arts in het Deborah Retief Memorial (DRM) Hospital in Mochudi Botswana. Vanaf 2001 werkt zij als arts voor de Medische Opvang Asielzoekers Noord Nederland en specialiseerde als arts Maatschappij en Gezondheid / Jeugd gezondheidszorg. Sinds 2006 werkt ze tevens bij de Gemeentelijke Geneeskundige Dienst (GGD) in Drenthe.

Als ik President was,
zouden de tanks speelgoed zijn voor kinderen.
Zakken met snoep zouden uit de lucht vallen.
De mortieren zouden ballonnen afvuren,
en de geweren zouden in volle bloei staan.

Alle kinderen van de wereld
zouden slapen in vrede,
niet opgeschrikt door luchtalarm of beschietingen.

De vluchtelingen zouden teruggaan naar hun dorpen.
En wij zouden op nieuw beginnen

- Roberto, 10 jaar, uit Pula

Overgenomen uit: Ik droom over vrede
Tekeningen en teksten door kinderen uit het voormalige Joegoslavië.
Unicef 1994