THESIS ON NATURAL AND EXACT SCIENCES B51

Nutrition situation of pre-school children in Estonia from 1995 to 2004

TAGLI PITSI

Department of Food Processing
Faculty of Chemical and Material Technology
TALLINN UNIVERSITY OF TECHNOLOGY

The dissertation was accepted for the commencement of the degree of Doctor of Philosophy in Natural Sciences on April 27, 2006.

Supervisor: Prof. Raivo Vokk, Head of the Department of Food Processing, Tallinn University of Technology, Tallinn, Estonia.
Co-supervisor: Dr. Anne-Reet Ilves Annunziata, J. Gerald and R. Dorothy Friedman School of Nutrition Science and Policy, Tufts University, USA

Opponents:
Professor Daina Karklina, Dr. Eng. Sc,. Dean, Faculty of Food Technology, Latvia University of Agriculture
Mai Maser, MD. PhD. The Estonian Society of Nutritional Science

Commencement: June 12, 2006 at Tallinn University of Technology

Declaration: Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any degree or examination

Tagli Pitsi

ISSN 1406-4723
ISBN 9985-59-623-4

ABSTRACT

Pitsi, T. **Nutrition situation of pre-school children in Estonia from 1995 to 2004.** Tallinn University of Technology (2006).

The main objective of this study was to investigate Estonian kindergarten menus over the period of 1995 to 2004, compare them with the recommendations and find out if the possible shortages would be compensated with the food children eat at homes. Several kindergarten menu calculations have been carried out in the Department of Food Processing at Tallinn University of Technology. In addition, help has been provided for making two major Estonian children dietary surveys – Estonian Toddler Health and Nutrition Survey (ETHNS) in 1996 and Estonian Children Health and Nutrition Survey (ECHNS) in 2002.

The energy level from most of the kindergarten menus met the recommendations or exceeded it. Energy levels within the calculated days were extremely varying and energy contribution to different meals did not meet the recommendations. Energy consumption of the children in ETHNS and ECHNS was slightly lower than recommended. Energy derivation from macronutrients depended on the kindergarten. The average intake of fibre in both kindergarten menus and individual level surveys were sufficient. Problems were with vitamin D and C levels from kindergarten menus and the vitamin D deficiency would not be compensated with the food eaten at home. Although the supply with vitamin C has not improved over the years, its densities in kindergarten menus have increased. There was no problem of calcium levels from kindergarten menus, but individual level surveys showed over one fourth of pre-schoolers having shortages in calcium consumption and also that the structure of consumed milk products has changed over the years. There could be some problems with actual iron absorption due to relatively low iron levels and the fact that most of the consumed iron was non-haem and vitamin C levels were too low in some cases. Sodium intake both from menus and individual level surveys were too high and need to be corrected.

All the studied kindergartens received the calculations of their menus with the suggestions of how to correct them and some of them were provided completely new corrected menus. From the surveyed kindergarten menu calculations a compilation of daily menus with recipes (Children's food/Laste toit) has been published for kindergarten kitchens. All surveyed children' parents in ETHNS and ECHNS were also given feedback of their child's health and nutrition situation and recommendations for improving it.

Key words: children, pre-school, kindergarten, Estonia, food, nutrition, nutrient

Tagli Pitsi, Department of Food Processing, Tallinn University of Technology, Ehitajate tee 5, 19086, Tallinn, Estonia

LIST OF PUBLICATIONS

The present dissertation is based on the following papers, which are referred to in the text by their Roman numerals I-V:

I Ilves Annunziata, A-R., Veldre, G., Saluste, L., **Pitsi, T.**, Süvalep, I., Viin, L., Vainu, J. Results of the Estonian Toddler Health and Nutrition Survey: I. nutrition status and family socio-demographics – *Eesti Arst* 2000, vol. 3, p 142-144, 146, 147. (in Estonian)

II Ilves Annunziata, A-R., Veldre, G., Saluste, L., **Pitsi, T.**, Süvalep, I., Viin, L., Vainu, J. Results of the Estonian Toddler Health and Nutrition Survey: II health indicators and growth status. – *Eesti Arst* 2000, vol. 79(7), p 389-396, 398, 399. (in Estonian)

III **Pitsi, T.**, Liebert, T., Vokk, R. Calculations on the energy and nutrient content of kindergarten menus in Estonia. – *Scandinavian Journal of Nutrition* 2003, vol. 47, p 188-93.

IV Vokk, R., Liebert, T., **Pitsi, T.**, Ilves Annunziata, A-R. Consumption of milk products, calcium and vitamin D by Estonian children in 1996 and 2002. – *Scandinavian Journal of Nutrition* 2005, vol. 49 (4), p 159-164.

V **Pitsi, T.**, Ilves Annunziata, A-R., Liebert, T., Vokk, R Kindergarten menu calculations in Estonia since 1995. Manuscript.

THE AUTHOR'S CONTRIBUTION TO PUBLICATIONS

Paper I:
The author performed at least half of the interviews of urban children, inserted most of the data to the dietary assessment program Micro-Nutrica and provided the obtained data into further statistical analysis; is the co-author of the paper

Paper II:
The author was the coordinating person in at least half of the urban children medical surveys and is the co-author of the paper

Paper III:
The author performed and supervised menu calculations and analyses of the kindergartens' and is the co-author of the paper

Paper IV:
The author performed at least half of the interviews of urban children in 1996 and 2002, inserted most of the data to the dietary assessment program Micro-Nutrica and performed the analysis of the obtained data, is the co-author of the paper

Paper V:
The author performed or supervised the kindergarten menu calculations, performed the analysis of the obtained data and wrote the paper

TABLE OF CONTENTS

ABBREVIATIONS

%E	Energy percentage
6th HBSC survey	Health survey in 2001/2002 among 162 000 young people aged 11, 13 and 15 years from 35 countries and regions in the WHO European Region and North America
AD	All surveyed kindergarten daily menus (894) in Estonia from 1995 to 2004
CACFP	Child and Adult Care Food Program, in the United States of America
ECHNS	Estonian Children Health and Nutrition Survey, 2002
BMI	Body Mass Index
BNDNS	British National Diet and Nutrition Survey of Children, 1992/93
ETHNS	Estonian Toddler Health and Nutrition Survey, 1996
FFQ	Food frequency questionnaire
HEI	Healthy Eating Index
KGM	All surveyed kindergarten menus (58) in Estonia from 1995 to 2004
NCHS	National Centre for Health Statistics in the United States of America
P1KG1 etc (in Figures)	First kindergarten from the first period, etc
PER	Protein efficiency ratio
RDI	Recommended Dietary Intake
RNI	Recommended Nutrient Intake
TEE	Total energy expenditure
UNGKOST-2000	A survey of 4-year-old children in Norway in 2000
USDA	United States Department of Agriculture
WHO	World Health Organization

1. BACKGROUND

1.1 Introduction

Healthy eating is important for pre-school children to provide the energy and essential nutrients they need to grow, develop and be active; develop their sense of taste, acceptance and enjoyment of different foods; contribute to their sense of well-being and feeling good about them; instil attitudes and practices which form the basis for lifelong health-promoting eating and activity patterns. Children have different energy and nutrient requirements depending on their age, gender, body size, rate of growth and level of activity, but they have a relatively a high energy requirement for their size, and provision of adequate dietary energy is vital during the period of rapid growth in early childhood. To achieve this energy intake, foods which are high in energy (and also rich in nutrients) and eaten as part of small and frequent meals may be necessary for younger children who do not have large enough stomachs to cope with big meals. A good supply of energy and nutrients is crucial and healthy eating guidelines (such as to reduce fat intake and eat more fibre) should be introduced gradually and with caution. Attention must be paid to feeding practices that maximize the intake of energy-dense foods without compromising micronutrient density. A good supply of protein, calcium, iron and vitamins A and D is necessary. Calcium is needed for healthy tooth development and, together with vitamin D, helps make bones stronger. Childhood is an important time for tooth and bone development.
Appetites tend to increase during growth spurts and periods of intense activity, and fall when the pre-schooler is overly tired or excited. Food intakes of pre-schoolers can vary from day to day. Over time, the child's intake of nutrients and energy typically averages out, thus achieving a healthy balance.

Different foods contain different amounts of carbohydrates, fat, protein, vitamins, and minerals. A varied diet is far more likely to contain all the nutrients needed for growth and health than a diet that includes only one or two foods from each food group. A healthy diet uses moderation. This means it limits excess fat, sugar, and sodium. Some fat, sugar, and sodium in the diet are necessary. They provide energy (fat and sugar) or essential nutrients (fat and sodium), as well as make eating more enjoyable, but too much of these can contribute to health problems. If a child does not eat enough calories, it may slow or even stop his/her growth and also influence his/her learning abilities. Nutrient requirements are met over a period of time rather than within one day.

The pre-school years represent a time of changing nutritional needs, from the totally dependent infant whose diet consists primarily of milk to an independent feeder who is consuming a mixed diet based on normal family foods. The pre-school age is a time when food preferences start to be established. Early food experiences may have an important effect on eating patterns in later life and these appear to be changing as mealtimes are no longer a focal point of family life.

Food intake is influenced by family eating patterns, peers, and the media, the latter two become more important as the child grows older. Children are influenced by extensive marketing and advertising, which is targeted to them. Another influence on eating habits is cultural pressures predominant in industrialized countries to have a so-called ideal body shape. The desire to be thin and the stigma of obesity may be of particular concern to young people, and this may have a significant effect on body image, body esteem and self-esteem. Preferred patterns of snacking and meals may compromise dietary content during adolescence, but also starting from pre-school years, as they may reduce the consumption of fruits and vegetables – the important sources of carbohydrates, vitamins and minerals.

Promotion of healthful behaviours should begin early in life, since it has been established that atherosclerosis, hypertension, obesity, and osteoporosis begin developing in childhood. Evidence exists that cardiovascular risk factors, such as blood pressure, obesity and serum lipids and lipoproteins, track from childhood to young adulthood. In Estonia[1] main death reason are cardiovascular diseases – 62% of women's and 46% of men's deaths in 2002 were caused by diseases of the circulatory system. These facts suggest that prevention efforts should begin in childhood and promoting a healthful diet among young children should be a national public health objective. Young people who develop healthy eating habits early in life are more likely to maintain them in maturity and to have reduced risk of chronic diseases, such as cardiovascular diseases, cancer, non-insulin-dependent diabetes mellitus and osteoporosis[1,2,3,4,5,6,7,8,9,10,11,12].

1.2 Children and socio-economic situation in Estonia

Since 1995 the number of 0 to 19 year-old children in Estonia has decreased from about 402 500 children to 322 900 children in 2004. In 2004 there were about 25 400 pre-kindergarten-aged (one to two-year-old) and 48 800 kindergarten-aged (three- to six-year-old) children living here[13,14].

The absolute number of children attending kindergarten decreased from 1995 to 2002, but since that time it has been increasing again. In 2004 from one- to two-year-old children attended pre-kindergarten about 8830 and from three to eight-year-old children about 44070. 70% of all one to six-year-old children attended kindergarten or pre-kindergarten and 85% of all three to six-year-old children attended kindergarten. The percentage of all children attending pre-kindergarten or kindergarten has increased since 1995 (from 56% and 65% respectively)[13,14,15,16,17,18,19,20,21,22].

The reason for the increasing number of children's percentage in kindergartens lies probably in the socio-economical situations of families. The socio-economic situation depends on the number of children a great deal. As compared to an average household (100%) with disposable incomes in 2003 for families with children the following results were obtained: 2 adults with one child (a child is considered to be under 18 and living with his family) – 113%, 2 adults with two children – 92%, two adults with three or more children – 67% and a single adult with child/children – 86%[1].

The need for women to work is shown by the increasing mother's age at birth (in 1995 the average age of giving birth was 25.5 years and the age of giving birth to the first child – 23 years, in 2003 27.7 and 24.8 years, respectively) and the work participation rate among women was quite high. In 2004 40.7% of 20…24 year-old women, 62.2% of 25…29 year old-women, 68.3% of 30…34 year-old women, 76.2% of 35…39 year-old women, 86.4% of 40…44 year-old women, 84% of 45…49 year-old women and 77.6% of 50…54 year-old women worked[13,14].

In spite of the fact that since 1997 the average salary (incl. taxes) in Estonia had increased from about 3570 EEK to 6700 EEK in 2003 (in 1995 it was 2385 EEK and it was around 7800 EEK in 2005) there were still 17.0% of households living under poverty line (36.1% in 1997)[13,14,16,17,18,19,20,21,22]. At the same time, the percentage of households living outside poverty risk has risen from 44.6% to 68.4%. The percentage of children living under poverty line decreased from 47.1% in 1997 to 26.7% in 2003. Still, in 2003 only 58.5% of children were out of poverty risk[1].

Figures showing the amount of food products a person can afford in Estonia, Finland or Germany for one hour work reveal clearly the insufficient purchasing power of Estonians. A person employed in industry/agriculture can for an one hours work in Estonia buy 3.87l/2.5l milk with 3.5% of fat content or 0.82kg/0.53kg of broiler or 4.92kg/3.18kg wheat flour; in Finland 19.37l/11.83l, 4.07kg/2.48kg or 26.57kg/16.23kg, respectively and in Germany 25.91l/13.58l, 4.37kg/2.29kg or 44.82kg/2.35 kg, respectively[23].

Although salaries in Estonia have increased since 2000 about 1.7 times and an average expenditure on food and non-alcoholic drinks of the total expenditure in Estonia per one household member has decreased as compared to 1996 and 2004 (32,6% and 25,0%), the socio-economic situation of rural families is quite difficult. For example in 2004 expenditures on food and non-alcoholic drinks per one household member (bought, self-produced, from relatives) in the Põlva County were up to 40.7% of the whole expenditure (806.6 EEK) and in Tallinn 26.1% (807.6 EEK); while an employee's salary was 4182 EEK/month and 6781 EEK/month, respectively. At the same time, the percentage of children aged 0 to nineteen years of the whole population in the Põlva County (as well as in all the other Estonian counties) was higher than in Tallinn – 26.3% and 20.8%, respectively. It definitely means poorer food possibilities in rural families with children[14,15].

The difference between the number of children and household members altogether is demonstrated also by the Estonian Toddler Health and Nutrition Survey in 1996. Only 3 % of urban families were large (4 or more children), while large families in the country constituted 21 % of the total. 13% of the rural families had only 1 child, while it was 43% of the urban families. The average size of a rural family was bigger (4.96 members) than the size of an urban family (4.08 members). This survey also clearly shows the differences between incomes in rural and urban families and also the fact that in spite of living in Tallinn, the socio-economic situation of families with young children was anything to be satisfactory[PaperI].

Estonian Human Development Report in 2001 reveals that in East-Estonia some schoolchildren eat only once a day, at school, where they were offered a free lunch[24] and the data about salaries and food expenditures show probably the same about kindergarten children.

To sum up, as long as there exists the possibility of children not provided enough food at homes, it is extremely important to offer children high quality food in kindergartens.

1.3 History of dietary surveys in Estonia

Although the history of food science in Estonia dates back to the year 1695, when Bratt defended his thesis “Lack of grain products and fighting against it” in Academia Gustavo-Carolina[25], the history of modern food surveys in Estonia goes back to the beginning of the previous century. In 1920 the first analyses of finding out vitamin C content in different potato varieties in Estonia were carried out. Surveys of population food habits and assessment of their influence on people’s health started in 1922[26].

In the 1950s, the Experimental and Clinical Medicine Institute also started food analyses. First, breast milk vitamin C content was analyzed, followed by its analysis in potatoes and some vegetables. Afterwards, analyses of possible vitamin C hypovitaminosis in some of the Estonian population groups were carried out. In 1962 dietary surveys of rural people began and wider Estonian dietary surveys have been conducted since then[27]. The only surveys of Estonian pre-school children’s nutrition and their provision with vitamins under the supervision of M.Uibo and M.Niit were done in the 1970s[28]. Dietary surveys of schoolchildren started in 1981 by Merileid Saava. In 1984 dietary surveys in Estonia went under the jurisdiction of the Estonian Institute of Cardiology[27]. In the beginning, all the dietary surveys analyses were done “by hand”, using mainly Russian Food Composition Tables. In 1993 the PC software program ANKE 1.1.1.1 was taken into use. ANKE contains mainly nutrient databases of Russian[29], Finnish and German tables[30]. Today the nutrient assessment program DanKost2, which is a computer database of foods from the National Food Agency of Denmark[31], is also used in dietary analyses in the Estonian Institute of Cardiology[32].

Menu calculations and dietary surveys started in the Department of Food Processing at Tallinn University of Technology, started in 1995. It became possible through the nutrition assessment software program Micro-Nutrica bought by the Experimental and Clinical Medicine Institute. The Department of Food Processing received the task from ECMI to translate the program[33] and adjust it to be able to carry out Estonian dietary surveys.

1.4 Methods of assessing food habits

There are several internationally established methods used in dietary studies, the most common being described in the textbooks. The following short presentation of dietary methods is based on the textbooks of Cameron & van Staveren[34] and Merileid Saava[35].

Food consumption data may be collected at the national, household or the individual level.

National food supply data

Food supply data at the national level provide gross estimates of the national availability of food commodities. A major limitation of national supply data is that they reflect food availability rather than food consumption. Food supply data are not useful for evaluating individual adherence to dietary reference values nor for identifying subgroups of the population at risk of inadequate nutrient intakes.

Household data

Information regarding food availability at the household level is useful for comparing food availability among different communities, geographic areas and socioeconomic groups, and for tracking dietary changes in the total population and within population subgroups. However, these data do not provide information on the distribution of foods among individual members of the household.

Individual data

The five general methods for assessing dietary intake for individuals are food record methods, the 24-hour dietary recall method, food frequency questionnaires, diet histories, food habit questionnaires and combined methods. As data collected in my work are by the 3-day food record and 24-hour dietary recall methods, and food frequency questionnaires, only a brief overview of these methods is given below.

Individual data could also be divided into retrospective and prospective dietary assessment methods. Retrospective dietary assessment methods can be difficult for respondents since they must memorize and estimate what they have been eating and drinking. Prospective dietary recording methods, on the other hand, may have the effect of respondents changing their food habits to facilitate registration of food intake or to conceal their actual intake. The most common retrospective methods for assessing individual intake are 24-hour recall and use of a food frequency questionnaire; and the most common prospective method is the food record method.

• *24-hour dietary recalls*. The 24-hour dietary recall consists of a listing of foods and beverages consumed the previous day or 24 hours prior to the recall interview. Foods and amounts are recalled from memory with the aid of an interviewer who has been trained in methods for soliciting dietary information. The interview is usually conducted face to face, but may also be conducted by telephone.

• *Food frequency questionnaires*. A food frequency questionnaire (FFQ) consists of a structured listing of individual foods or food groupings. For each item on the food list, the respondent is asked to estimate the frequency of consumption based on specified frequency categories which indicate the number of times the food is usually consumed per day, week, month or year. FFQs are generally self-administered but may also be interviewer-administered. FFQs may be un-quantified, semi-quantified or completely quantified. A quantified FFQ allows the respondent to indicate any amount of food typically consumed. Some FFQs include questions regarding usual food preparation methods, trimming of meats, use of dietary supplements, and identification of the most common brand of certain types of foods, such as margarines or ready-to-eat cereals. The answers to these questions are then incorporated into the calculation of nutrient intakes. Although FFQs are not designed for estimating absolute nutrient intakes, the method may be more accurate than other methods for estimating an average intake of those nutrients having large day-to-day variability and for which there are relatively few significant food sources (e.g., alcohol, vitamin A and vitamin C).

• *Food records*. Food records, also called food diaries, require that the subject reports all foods and beverages consumed for a specified period (usually one to seven days). If nutrient intakes are to be calculated, the amounts consumed should be estimated as accurately as possible. The quantities of food are usually estimated with the help of household measurements, food models or using pictures of food and food items; alternatively, all foods and beverages can be weighed. Depending on the number of registration days, the estimation method can be used to assess the actual or usual intakes of individuals. These methods are time-consuming and the burden on the respondent is rather high. The validity of the results depends on the conscientiousness of the respondent and his/her ability to estimate quantities.

The FFQ is relatively easy to administer and is unlikely to affect dietary intake. In general, FFQs overestimate the total energy intake and are better at ranking, rather than quantifying usual intake. In contrast, food records and recalls can be used to both rank and quantify nutrient intakes. Because of day-to-day variability in intake, however, food records and recalls require multiple days of collection to measure usual intakes of individual persons. Nevertheless, mean nutrient intakes of a population can be calculated from a single dietary recall or record. Compared with FFQs, food recalls and food records (in particular) require more effort on the part of the researcher/clinician and the respondent. On the other hand, methods for collecting food record or recall information require little adaptation for different population or age groups. In contrast, the FFQ requires the food list and portion sizes to be appropriate to the population under investigation. Once a method is selected, after considering the intended purpose of the assessment as well as the constraints of the setting, researchers and clinicians can use the results of published studies included here as a guide to evaluate and possibly adopt the chosen dietary method[36].

1.5 Kindergarten meals in Estonia and some other countries

An important field of scientific interest is concentrated on the nutrition of children in *Estonia*. Supported by the Ministry of Social Affairs, a National Health Programme for Children and Youth (1996-2005) was established, integrating a School Lunch Project (1995-2002). The project had the aim to improve the quality of school lunches and to enable school teachers to conduct nutritional education as well as to enhance the health education of schoolchildren and their parents. Health promoting units at schools played an important role in realizing these aims[37,38]. The more specific aims of the School Lunch Project were monitoring dietary habits and preferences as well as health knowledge of schoolchildren from 7th and 12th grades, analyses of school lunches and correction of the menus, preparation of specific methodical material (a textbook with 250 coloured overheads) for teachers to facilitate nutrition and health education at schools, training teachers in fundamental principles of nutrition education[39]. In 1998 the project expanded to kindergartens[40].

In 2001 the School Milk Project was established. First only the first and second grade schoolchildren could have free milk, but for now free milk products (milk, non-flavoured yoghurt, and sour milk) are available for all children from kindergartens to gymnasiums and vocational schools. 425 schools are joined to the program at present[41].

Food in Estonian kindergartens is made on spot and should meet all the recommendations determined by the Public Health Recommendations for Dietary Services in preschool and school settings[42]. In 2005 children whose family income (excluding taxes, including allowances) per one household member was under 1500/month received a subsidised meal allowance by 50% or 100% upon the decision of the parents board of kindergarten[43].

There are about 400 000 children under the compulsory school age of 7 years in *Finland.* In 2003 about one half of all children under school age made use of municipal day-care services, 75% of them being in full-time care[44]. Community vouches the food provision in the kindergartens of their area. The food offered must meet the recommendations and cover two third of all day needs in the whole-day and one third in the part-day kindergartens. Often the plate model has been taken as an example. Nutrition in a kindergarten has both nourishing and educating goals – together with home they try to secure child growth and development, health and well-being; guide children to varied and balanced food choices; provide children with adequate meals and snacks; teach children good table manners; give children pleasant and non-harrying moments together while eating; give children opportunities to take part in food preparation and serving processes; give parents teachings of healthy food options and how to prepare them[45].

64 % of one- to six-year-old children in *Sweden* attend full-day pre-school day-care centres, with a further 11% in family day-care centres[46]. In Sweden more than 80 % of women with children below 7 years of age, also work outside their home[47]. Some of the Swedish pre-schools prepare their own food while others buy the service. The parents pay a fee, which in most areas is linked to the family's income and/or the child's total hours of attendance. The cost of kindergarten meals is included into the kindergarten fee. Although children get food in kindergartens, it is not specifically required by law[48]. Recommendations state to offer children 4-5 meals a day; however, exact energy and nutrient intake recommendations are not stated. In menu planning, every child's food preferences should be taken into consideration. If possible, morning meal is offered as a buffet. During lunchtime, the plate model should be taken as an example. Afternoon meal should consist of milk or a milk product, sandwich, vegetables or fruits or foods made from them (e.g., soups) and sometimes grain products. Milk, sandwiches, fruits (highly recommended) and crisp rolls can be served as snacks[47].

In 2003 around half of the one- to six-year-old children (more than 200 000) in *Norway* were daily in some kind of day-care centres. Two children out of three were at full day-care centres. Food in child day-care centres is not important only for its nutrient content but also in its social and cultural aspects. Children from full day-care centres eat usually three times a day, but the food offered for breakfasts is mostly home-brought and in some of the kindergartens children should also bring lunch and afternoon snack from home[49].

Children up to three years in *Denmark* can attend nurseries and aged three to six years kindergartens. Most nurseries provide meals for the children during the day, but meals for the children are usually not provided by the kindergarten, and the children therefore need to bring a lunchbox. Some kindergartens do, however, serve an afternoon meal, e.g., fruits. So-called meal days, when the children prepare meals for everybody, are often popular activities in the institutions. As of 1 July 2003, it has become possible to organize joint food schemes in the kindergartens. This implies that parents pay all expenses in connection with the food in addition to the normal kindergarten fees. The parent board of each kindergarten decides whether such a food scheme shall be implemented[50].

Although many aspects of childcare outside the home are regulated in *United Kingdom*, the provision of food is not, and there are few guidelines to enable this process. There is a particular lack of information about the food provided by childminders, even though this group of carers represent the largest form of paid childcare in the United Kingdom There are some guidelines which say that half-day care, involving either a morning or afternoon session, is likely to include a snack and a meal and energy and nutrients consumed during these meals should cover 40% of the whole day consumption. Children in childcare for a full day (over 6 hours) will receive the majority of their food while in childcare and therefore it is recommended that the food provided gives the children at least 70% of their daily requirement for energy and nutrients and food should be offered to children at intervals not exceeding three hours. The remaining 30% will come from breakfast and from any drinks, snacks or light meals the child receives at home[51].

In the *United States*, over 13 million of 21 million children younger than 6 years of age were in childcare. Among employed mothers, 39% of children younger than the age of 5 were cared for in another home and 26% were cared for in organized childcare facilities in 1995[52]. Many of children day-care centres have joined the USDA's Child and Adult Care Food Program (CACFP). According to CACFP, the key to a healthy eating pattern for children are moderation, balance, and variety and the caregivers should plan meals that contain plenty of fruits, vegetables, grain products, especially whole grains, with little added fat. The food provided must meet Dietary Guidelines for Americans. In this program nutrition education should also be part of childcare[53]. Like Estonia, USA has its own Special Milk Program and schools in the National School Lunch or School Breakfast Programs may participate in the Special Milk Program[54]. The position of The American Dietetic Association is that all childcare programs should achieve recommended standards for meeting children's nutrition and nutrition education has to promote healthy growth and development. Menus should be consistent with the Dietary Guidelines for Americans and foods should be provided in quantities that balance energy and nutrients with the children's small appetites[55].

There are many settings providing childcare options for children below five years in *Australia*, including long day childcare centres (more than eight hours), occasional care, preschool and family day-care. Meal-time arrangements vary from centres providing all meals and snacks to those requiring families to provide all foods. Mealtimes should be pleasant, culturally appropriate occasions and provide an environment for social learning and positive interaction, food and drinks should be nutritious and culturally appropriate and healthy eating habits are encouraged, staff should implement effective and current food handling standards and hygiene practices. It is recommended that the menu provided to children in care provide at least 50% of the recommended dietary intakes for young children[56].

1.6 Developing positive eating habits

Health promotion from the early stages in life by fostering healthy eating practices and regular physical activity has the potential for a major impact on health and well-being during childhood and later stages in life[57].

The first few years of life mean a sensitive period for the development of food acceptance patterns. By the age of 3, many children develop a dislike for certain foods. The most consistent characteristic predicting children's food selection has been preference, i.e., "children eat what they like."[52] Children's preferences are influenced by two major factors: familiarity and taste (sweetness). Familiarity is a more important dimension for children younger than four years and sweetness being primary for children older than four years of age. Extrinsic factors other than these can be expected to play important roles in the development and modification of food preferences as well[58].

Children progressively acquire and learn eating habits and practices as they grow and develop. Families and child-care settings are important social environments within which food-related behaviours among young children are developed. Family has the primary influence on the eating behaviour of preschool children. Parents can influence preschool children's dietary practices in at least five ways: controlling availability and accessibility of foods and meal structure, food modelling, food socialization practices, and food-related parenting style. Recently, some responsibility for the development of children's eating behaviour has shifted to childcare providers[52,57].

Nurseries supply a large proportion of the total food eaten by those in their care. One of the basic principles of healthy eating is to eat a variety of foods, as this will ensure an adequate intake of the range of vitamins and minerals needed for health. By offering a wide choice of foods, carers can play an important role in encouraging a varied diet and in helping to develop healthy patterns of eating from an early age. In addition, care providers can help to develop eating skills and provide an opportunity for children to learn about food[59]. Menu-planning guidelines and nutrition standards for childcare provide important tools to assure that young children are exposed to and have opportunities to consume a variety of foods and their diet is balanced. In planning a menu it is essential that a variety of sensory qualities, e.g., taste, texture, flavours, colours and temperature are provided. Young children are more likely to eat familiar foods and serving an unfamiliar food with familiar ones can increase the likelihood that the new food will be eaten. Making small, gradual changes and phasing in new foods and flavours rather than implementing a whole new menu is more likely to be acceptable to children. Unfamiliar names for new dishes (*e.g.,* risotto) can also put children off trying them. Young children have changing likes and dislikes and their appetite and willingness to foods varies. Positive messages about food and eating can be consistently reinforced to children through: the snacks, drinks and meals provided; the activities they engage in; the attitudes and behaviour of staff and carers towards food and food choices. Continuing improvements in food and nutrition in the early years settings will make a valuable contribution to children's health and educational development[9,59].

Eating together is a time of pleasant social sharing. It is good practice for carers to sit with children during meals. It is important that the carer eats and drinks in front of the children because it provides a good role model for healthy eating[51]. Childcare providers' modelling is more effective than if she comments the food choices while eating. Unfortunately, a survey in the USA revealed that in spite of the suggestion that childcare providers should be a model for children while eating, they actually were not consuming the same food as the children and often did not eat at all, or if they did, they frequently ate fast food and sodas[52].

Some children may eat slowly. It is important to ensure that all children have enough time to eat. Do not hurry children as they eat[51]. The same USA survey revealed also that in 25% of observations, childcare providers hurried the children to finish their snack or meal[52].

Mealtimes offer an opportunity to extend children's social and language skills. Children can learn from the carer about table manners, and can practise their speaking and listening skills[51]. A survey of two- to four-year old children in Illinois (USA) confirmed that eating is a social experience and the eating behaviours of others can serve as models which have an impact on the young children preferences – peers had a positive influence on the acceptance of certain vegetables. If children were routinely exposed to other children with preferences different from their own, the set of foods they would learn to accept would be enlarged. The results indicated that children only did not choose the non-preferred food if their peers preferred something they previously indicated as a least preferred choice, but they also ate it. Food preferences of three-year-olds were more malleable than those of four-year-olds[58].

A recent development is that children's food habits are strongly influenced by the mass media and advertisements in the press, radio and television. Increasing children's knowledge of brand names, fostering more positive attitudes towards consumption of snacks, encouraging demands that cause parents to purchase advertized foods, and stimulating direct sales of advertized foods to children are also wellknown phenomena in marketing[48,60]. This may also lead to increasing consumption of sugary foods. High consumption of soft drinks, sweets, cakes and biscuits, ice cream, etc. is associated with a high energy, sugar and fat intake and/or a nutritionally deficient diet[61]. While a person's diet is of good quality in general when food of this type comprises at most 15 per cent of the energy intake, actually today such food represents on average 25 per cent of the energy intake among children[62].

If we do not start with healthy eating habits in early childhood, the consequences might not be favourable. For example, in England where schoolchildren could choose their own lunch at schools preferred high fat main dishes (e.g., burgers)

(18% of choices), chips and other potato products cooked in oil (18%) and soft drinks (17%) and the least popular choices were fruit (1%), fruit juice (1%), and vegetables and salads (2%)[63].

Kindergartens are ideal places for promoting healthy eating by teaching children about nutrition, body image and physical activity with age-appropriate knowledge and skill development; involving parents in take-home learning activities. In kindergartens a large part of children can readily be reached, they eat their meals there and eating is a socially learned behaviour. Also, role models, like teachers have a powerful effect on children through the examples they set.

Menu changing is not always as simple as it seems, particularly concerning some new foods introduction to pre-schoolers. For example, in London an attempt by a chain of nurseries to improve its menus led to complaints by parents that their children were returning home hungry at the end of the day. Old favourites such as pizza, burgers and chips were replaced by new dishes including salmon, couscous, and risotto to increase the variety of meals offered to children and improve their nutrient intakes. However, faced with the children's refusal to eat these new foods as well as parent protests that the dishes were too 'exotic' for such a young age group, the nurseries were forced to reintroduce a more familiar menu. Changing nursery menus will not improve nutrient intake if children refuse to eat the food being offered. However, encouraging children to eat healthily does not mean denying them food that they enjoy[59] and it must be also taken into consideration that children are not small adults and proposals which may be very reasonable for adults may have harmful effects on the young[64].

1.7 General aims of the thesis

The overall objective was to investigate the kindergarten menus over the period of 1995-2004, compare them with the recommendations and find out if the possible shortages would be compensated with the food children eat at homes. More specific tasks were

1) to calculate the energy and nutrient levels from kindergarten menus and evaluate them in relation to the current[42] Estonian recommendations;
2) to give an overview of shortages resulting from Estonian children individual level surveys (ETHNS and ECHNS);
3) to compare the results of kindergarten menu analyses with individual level surveys and other pre-school children surveys conducted earlier in Estonia and abroad;
4) according to all the above, to find out the shortages of kindergarten menus and give suggestions for correcting them or making proposals for possible changes in recommendations if necessary.

2. SUBJECTS AND METHODS

2.1 Data of calculated kindergarten menus, ETHNS and ECHNS

Menu calculations

Menu calculations of several children's institutions have been performed at the Department of Food Processing since 1995.

The number of calculated menus:

- 34 school lunch menus, total 421 school lunches
- 11 school snack menus, total 95 snacks
- 58 kindergarten menus (KGM), total 894 daily menus (AD)[PaperIII,PaperV]
- 2 kindergarten menus for children under three years of age, total 55 days
- 10 menus of total food supply in children homes, regular boarding schools, sport boarding schools and summer camps
- 1 menu of 1 Russian (St.Petersburg) kindergarten and 1 Russian school menu (full day), both ten days

The number of possible consumers in schools was over 36000 pupils and in kindergarten over 5000 children. The menus were from almost all regions of Estonia. The analyzed menus in kindergartens reflect every month and in schools every school month of the year[65]. This thesis will only cover the kindergarten menu calculations for children over three years of age. Data about children's homes and boarding schools menu calculations can be found in my diploma[66] and master's thesis[67]. The results of summer camp menu analysis are reported in bachelor's thesis of Nehhožina[68]. The results of the school menu calculations will be published.

To find out possible time trends all the menus were divided into two 5-year-groups: the first period – 1995-1999, the second period 2000-2004.

All the kindergarten menu analyses in this thesis belong to the dietary method category of national food supply data, which means that evaluating individual adherence to dietary reference values is not possible. Still, the data of offered meal qualities in kindergartens and their adequacy for children nutrition according to recommendations are given. Children may consume less food than offered, but the food provided by kindergartens must meet nutrition requirements. All the results are calculated from menus and receipts received from kindergarten kitchens.

Individual level dietary surveys

Our department has also contributed to two extensive pre-school children surveys in Estonia. Study subjects in the Estonian Toddler Health and Nutrition Survey (ETHNS) in 1996[PaperI,PaperII,69] and Estonian Child Health and Nutrition Survey in 2002 (ECHNS)[PaperIV,70] were children from the central region of the city of Tallinn, the capital of Estonia (considered urban children), and Viljandi County, in southern Estonia (considered rural children). All the children of the appropriate age were invited to participate. In 1996, participants included 114 urban and 163 rural children, aged three to four years. In the follow-up study

(2002), 74 urban and 75 rural nine- to eleven-year olds were examined. Of this group, 51 urban and 73 rural children had participated in the 1996 survey. The follow-up (2002) study also included three- to six-year children from the same regions. In these surveys, food intake was analyzed at the individual level. Dietary data were obtained by the three-day food diary and the 24-hour recall method in 1996. The food frequency method, although used in 1996, was not included in 2002. Parents completed a questionnaire to provide family demographic and socio-economic information. The study also included physical and dental examination, anthropometric measurement and a blood sample.
In the *24-hour recall method,* an interviewer asked parents and/or children about previous day's menu and wrote down all the food the child ate the day before the interview. The eaten quantities were determined by showing different sized dishes, weighed afterwards. The fat content of all used fats or milk products were specified, additional questions about eating were asked, if needed. In 1996 three- day and in 2002 two-day food intake were examined using this method.
In the *3-day dietary record method,* children and/or parents were given a diary were they had to record all the food eaten during the next three days each time right after eating to minimize dangers of forgetting. A portion size was suggested to be written down in household measures (spoonful, decilitre, diameters or lengths in centimetres, etc) and in grams only if it was indicated on the item's label and the whole item was eaten. Afterwards, these household measures were weighed for every food item and grams used for menu input.
In the *Food Frequency method,* parents were given questionnaires with a list of food items and asked to mark the amounts and frequencies their children ate. It turned up to be too difficult, so it was not used in the 2002 survey.

As the kindergarten age is mostly between three to six, from individual level data, only that age-group was chosen for the current thesis and only the data gathered by the three-day dietary record method was used because the FFQ was not used in 2002 and the number of surveyed children was too modest to obtain reliable results by the 24-hour recall method. Children with incomplete three-day diaries or otherwise inappropriate for the analysis (non-Estonians, more than one child from the same family, non- typical eating days) were excluded from the analysis. Finally, the number of children analyzed in this thesis is 80 urban children and 112 rural children from 1996; and 40 urban children from 2002. The group of rural children in 2002 was too small to obtain statistically reliable results.

2.2 Overview of nutrient assessment PC program Micro-Nutrica

Micro-Nutrica is a MS DOS-based program (originally Finnish Nutrica from the beginning of the 1980s and Micro-Nutrica from 1991) for calculating menus. Originally its database had information about 600 foodstuffs (66 nutrients) and 600 ready-to-eat meals with recipes. Nutrient data of the origin of foodstuffs are mostly from Finnish and Swedish databases[71].

For the menu input, foods already existing can be used or everybody can add the exact ones needed. Over the years, we have added about 400 foodstuffs and over 1000 ready-to-eat meals to the database. Nutrient data of added foodstuffs are taken from Swedish food composition databases[72,73,74], Russian food composition databases[75], USDA National Nutrient Database for Standard Reference (USA)[76], information from packages (nutrient content, recipes) and were calculated from recipes or similar foodstuffs. Recipes for ready-to-eat meals came mostly from the analyzed institutions.

Nutrient intake can be calculated per day, per meals and per foods. The program enabled us to calculate food intake (grams) by food groups and nutrients intake from these food groups. It is also possible to calculate energy contribution from macronutrients and nutrients calculation per 1000 kcal.

In the international surveys of food consumption and nutrient intake, it is essential that the dietary data are comparable when different databases and calculation programs are used. In the comparison of Micro-Nutrica with nutrient intake data calculated on the basis of the Swedish food composition database PC-kost[77], no statistically significant differences were observed in the mean intakes of energy, total fat, saturated fat, carbohydrates, dietary fibre, alcohol, cholesterol, vitamin A, retinol, beta-carotene, alpha-tocopherol, riboflavin, niacin, vitamin B_{12}, vitamin C or phosphorus. PC-kost yielded a 20% higher intake for vitamin D and 23% higher intake ($P<0.001$) for thiamine than Nutrica, which is mainly attributed to the differences in the enrichment of foodstuffs between Sweden and Finland. Conversely, PC-kost yielded 53% lower values ($P<0.001$) for selenium than Nutrica, owing to the increased selenium content in many Finnish foodstuffs, as a result of the addition of selenium to fertilisers[78]. Statistically significant differences were found for protein, monounsaturated fatty acids, vitamin B_6, iron and sodium (5-9% higher values from PC-kost) and for polyunsaturated fatty acids, folic acid, zinc, calcium, magnesium and potassium (4-10% lower values from PC-kost). The results indicated that, for a dominant part of the examined nutrients, the estimated intakes calculated by means of standardized procedures using the PC-kost and Nutrica databases are comparable between Sweden and Finland. Differences observed for some nutrients reflect either actual differences in foods between the two countries or methodological differences in the assessment of nutrient intakes[77]. While the comparison between Micro-Nutrica and Swedish PC-kost showed no significant differences, another meant to compare Micro-Nutrica with Russian Food Composition Database pointed out that the Micro-Nutrica database gave lower estimates of energy and nutrient intakes. The difference reached the significance level for energy, fat, carbohydrate and calcium intake, but it was particularly large for fat intake, reaching almost -24% compared with the Russian database. The study does not explain, whether the difference was more likely to be due to the Finnish database 'underestimating' the true fat or other nutrient content of foods found in the Baltic region or to the Russian database 'overestimating' nutrient content, as this would have required direct food analysis[79]. As a result from the comparison of Micro-Nutrica with two nutrient assessment PC software programs ANKE (Russian database[30]) and DanKost2 (Danish database[31]) it was found, that food-energy by DanKost2 was higher than calculated by Micro-Nutrica ($p<0.01$). This difference appeared mostly due to a higher mean of intake of fats (monounsaturated fatty acids) and carbohydrates ($p<0.01$). Also, food-energy calculated by ANKE was higher than calculated by Micro-Nutrica but not as high as from DanKost2[32].

Observations about energy and fat intake from these surveys will be taken into consideration while analyzing our data. Also, the fact of actual lower selenium intake, because of the very modest selenium fertilisers' use in Estonia, will be reckoned with. Regarding to some micronutrients (e.g., panthothenic acid and biotin), the Micro-Nutrica's database is not complete and therefore the current thesis does not include these micronutrients into analysis.

2.3 Used dietary recommendations for evaluating children nutrition

In 1995 Estonia's Nutrition Recommendations[80] were published (the first since independence in 1991), based on the Nordic Nutrition Recommendations[81]. In 2002 the Ministry of Social Affairs (decision No.93, June 27) established the Public Health Recommendations for Dietary Services in preschool and school settings[42] which are at the moment the standard for all institutions serving food to children. New recommendations (2006)[82], based primarily on new Nordic recommendations[61], are being to implemented however the recommendations of 2002 continue to be used as the standard and are used in this thesis to evaluate menu quality.
According to current guidelines, food in kindergartens must provide 85% of the day's energy and nutrient recommendations are divided as follows – breakfast: 35%, lunch: 45% and snack: 20% of the calories[42].

The recommended dietary intake (RDI) has been used to refer to minimum intake. In the case of fat, cholesterol and sodium, the RDI is used for the upper/maximum recommended intake. Nordic[61] recommendations have been used as a reference for fibre, as fibre recommendations for children have not been developed for Estonia. The recommended fibre intake for 4- to 6-year-old children is calculated as "age+5". Using 5 years as the average age for this group, the RI for fibre is 8.5 g per kindergarten day.

This thesis gives also an overview of energy and some nutrients intake from different food groups. It is recommended that in children diets most of the energy should come from grain products (34%), next are milk products and meat-poultry-fish-egg products (both 16%). 13% of energy should come from added fats and 10% from potatoes, fruits and berries. Sugar and sweets should cover 8% of all the consumed energy and vegetables 3%[83].

3. RESULTS AND DISCUSSION

3.1 Food energy

3.1.1 Energy intake

Energy is required for tissue maintenance and growth, to generate heat (thermo genesis) and for physical activity. Weight gain is a sensitive indicator of the adequacy of energy intake in young children. The energy requirement is the amount of dietary energy needed to balance the energy expended and that deposited in a new tissue (growth). Energy expenditure can be subdivided into basal metabolism, which represents 50–60% of total energy expenditure (TEE) in most healthy children, energy expended on physical activity (30–40% of TEE in most healthy children) and thermo genesis (approximately 5–8% of TEE)[5]. The amount of energy required will depend on the degree of physical activity in which the individual is engaged and it varies considerably[84].

According to our surveys energy levels from kindergarten menus mainly *exceeded* the RDI[PaperV,85]. It was not the same for all the KGM, but if the menu exceeded the RDI, then it was around 100kcal[PaperIII]. Of all the menus, 30% exceeded the RDI by 100 kcal and 14% by 200 kcal[PaperV].
Individual whole day energy consumption according to ETHNS and ECHNS

1. was *much below* the RDI in 1996[PaperI],
2. was *below* the RDI for boys and *close to* the RDI for girls in 2002[86].

Taking into consideration the fact that energy calculated by help of Micro-Nutrica might be slightly underestimated[32,79], the energy levels from most of the kindergarten menus could be actually even higher and would probably need a reduction. On the other hand, the analysis of average data of groups of ETHNS showed that urban children received statistically reliable greater amount of energy than rural children[PaperI].
When decreasing the energy levels in the menus of rural kindergartens, precautions should be taken not to deprive children of the possibility to consume more food in kindergarten because of poor socio-economic situation at home.
Most of the families in ETHNS admitted that their financial situation hardly makes both ends meet (76% in the country, 72% in town). 65% of urban families spent half or more of their income to food. As incomes of urban families were larger than those of rural families, the absolute expenditure on food was larger in urban families. 76% of rural families used half or more of their income to buy food, although they produced most of their products themselves. Rural families had to abandon more often foodstuffs that were too expensive for them (vegetables and fruits were declined by 27% of rural and 7% of urban families; meat was declined by 19% of rural and 7% of urban families). 90% of rural families said that they could not afford all food they liked. Fewer of the urban families (37%) felt themselves in such a limited position. The number of

families who worried about the fact that lack of food was harmful for their health was larger in rural families (in the country 28%, in town 8%)[PaperI].

There exist no established recommendations for daily variations in energy intakes. Although one and the same child could eat more on one day and less on the next depending on his activity level, the kindergarten menus should provide them every day with energy what does not differ too much from that of the previous day. In fact, only few kindergartens were able to provide children with such menus. The greatest variation in energy level within one kindergarten menu was around 1200kcal within 19 days[PaperV].

Earlier, too, kindergarten meal surveys, for instance from 1975 already, indicated energy intakes 10% greater than recommended[87] and whole day energy intakes from the menus of whole day institutions from 1978 close to the recommendation[88]. On the other hand, the energy recommendations have also decreased since then – 1930 kcal in the 1970s and 1715 kcal for boys and 1545 kcal for girls at the moment.

While in our kindergartens energy levels mostly exceeded the recommended level, the consumption of energy from kindergartens in Finland and Sweden was mostly below the recommendation. Children in Finnish whole day day-care centres should be offered meals and snacks so that these cover 2/3 of the whole day recommendations. The survey of two Helsinki day-care centres showed that energy intake covered 36 % of one- to three-year-olds and 42% of four- to six-year-olds whole day needs[89]. In Swedish kindergartens only 25% of children reached the energy intake level of their recommended 65% of the whole day recommendation. Mean energy intake of weekdays was slightly lower than at the weekend. Although the shortage was compensated with the food eaten at home, children spent around 8 hours a day in the kindergarten and the major part of children's intake should occur during the active part of the day[48].

The surveys of pre-school children's whole day energy intakes in Finland[45], Sweden[48], Norway[90], Great Britain[91,92], and United States[93] confirm the fact that children do not consume as much energy as recommended. In the mentioned surveys, the average energy intakes of three- to six-year-old children were from 1230 to 1715 kcal, being mainly around 1400 to 1500 kcal a day. Energy intakes from not so highly developed countries were even lower. For example, the estimated median energy intake of one- to four-year-old Mexican children was 950 kcal and the energy intake of urban children (1011kcal) was higher than rural ones (820kcal)[94]. Energy intake of a list of pre-school children in the age group of four- to five-years in India showed slightly higher results – 1259 kcal (boys) and 1196 kcal (girls)[95].

All of those results of the whole day individual level surveys show us that children do not consume as much energy as recommended. While in the case of rural children from ETHNS or Mexican children one could assume poor socio-economic conditions as the reason, it is definitely not true for the results from highly developed countries. Rather, it points to the fact that children do not need as much energy as recommended and there is a need to decrease the daily energy intake recommendations, in particularly considering that children's physical activity levels are also decreasing.

3.1.2 Food energy sources

In terms of the sources of energy, average energy intake in kindergarten menus (Table 1) from grain products and meat-poultry-fish-egg products was lower; and from milk products and sugar higher than recommended. A conclusion can be drawn that the lower the average energy level in a kindergarten menu, the larger proportion of energy comes from grain products and milk products. Kindergartens with energy levels below the recommendation should increase energy provided by all the food groups, except milk products and sugar. The levels of energy from milk products should probably even be decreased. Kindergartens with the recommended energy levels and too high energy levels should increase the energy derived from grain products, potatoes, fruits and berries, meat-fish-poultry-egg products and decrease the energy from milk products and sugar[PaperV].

The results based on the comparison of kindergarten menus and the results from the 1970s showed that these were quite similar. The part of energy from vegetables, grain products and milk products has slightly increased and from potatoes, fruits and berries, meat-fish-poultry-egg products, added fats and sugars has slightly decreased since the 1970s.

Table 1. Comparison of energy intakes (% of total) from different food groups in kindergarten menus in our surveys and RDI and the 1978 nutrition survey

	Kindergarten menus					RDI[83]
	From 1995 to 2004[PaperV]				In 1978[88]	
	All (*n*=57)	Energy level, kcal				
		<1290 (*n*=5)	1390±100 (*n*=27)	>1490 (*n*=9)		
Grain products, %E	30.5	32.7	30.3	29.8	29.6	34
Vegetables, %E	2.9	2.1	3	3.1	2.1	3
Potatoes, fruits, berries, %E	9.1	7.8	9.3	9.3	11.9	10
Milk products, % E	21.9	23.3	21.9	20.8	19.4	16
Meat-fish-poultry-egg, %E	10.9	9.7	11	11.4	12.8	16
Added fats, %E	12.2	11.7	12.2	12.7	12.7	13
Sugar etc, %E	10.9	10.8	10.8	11.2	11.6	8
Beverages, other foods, %E	1.6	1.8	1.6	1.6	-	-

3.2 Problems of overweight, obesity and underweight

Energy intakes are related to the problems of overweight, obesity and underweight. Neither under- nor over-consumption of energy are recommendable. First one affects children's development and could bring along other nutrient deficits as well. At the same time, excess energy intake leads to obesity[2].

The mechanism of obesity development is not fully understood and it is believed to be a disorder with multiple causes. Environmental factors, lifestyle preferences, and cultural environment play pivotal roles in the rising prevalence of obesity worldwide. In general, overweight and obesity are assumed to be the results of an increase in caloric and fat intake. On the other hand, there is supporting evidence that excessive sugar intake by soft drink, increased portion size, and steady decline in physical activity have been playing major roles in the rising rates of obesity all around the world. Consequently, both over-consumption of calories and reduced physical activity are involved in childhood obesity[96].

Overweight and obesity in childhood are known to have a significant impact on both physical and psychological health. The most widespread consequences of childhood obesity are psychosocial. Discrimination against overweight children begins early in childhood. Because obese children tend to be taller than their non-overweight peers, they are apt to be viewed as more mature. The inappropriate expectations that result may have an adverse effect on their socialization[97]. Obesity is also one of the risk factors of cardiovascular diseases, diabetes, etc. It is not still quite clear if obesity is the independent risk factor or if it has an influence for cardiovascular diseases only together with other risk factors[98]. Also, hyperlipidemia, hypertension, and abnormal glucose tolerance occur with increased frequency in obese children[97]. Obesity tracks over time, that is, obese children, particularly obese adolescents, tend to become obese adults[2]. Approximately 33% of obese pre-school children become obese adults[99] and about 70% of obese adolescents grow up to become obese adults[97].

Defining childhood overweight and obesity is not very simple. The definition of overweight and obesity in children and adolescents is less standardized than in adults because natural age-related physiological variations in body composition during childhood make it difficult to distinguish between normal and excessive adiposity. For population screening of obesity, anthropometric measures of height, weight and skinfold thicknesses remain the most feasible and practical methods[100]. Body mass index (BMI) is the criterion for judging the obesity. BMI (overweight BMI 25.0–29.9, obesity BMI>30.0) for adults are not appropriate for classifying young people. What is why values correspond to the adult BMI are used in children.

Comparison of ETHNS results concerning the height and weight of three- to four-year-old children and those of international NCHS and Estonian children's standard value confirms that the examined heights and weights correspond to those standards. In the comparison of USA and Estonian children's height and weight percentiles, it became apparent that the height of 54.9% of rural and 62.4% of urban children and the weight of 63.9% of rural and 72.4% of urban children is greater than the given indicators of American children of the same age[PaperII].

The results of all the observed children in ETHNS and ECHNS and the use of Cole[101] international cut off points to determine overweight and obesity and Grünberg[102] cut off points to determine underweight revealed that on average 1% of the children were underweight, 86% had normal weight and 13% overweight. Figure 1 shows that no obese children were found, there were more overweight girls than boys and in 2002 all the surveyed boys had normal weight. The presence of underweight was minimal. Kindergarten menu calculations unfortunately did not include measurements and weight determination of children; neither were any statistical data about measurements of Estonian kindergarten children was also found from literature for purposes of comparison.

Although over-consumption of calories and reduced physical activity are involved in childhood obesity[96] and also BNDNS revealed that BMI was positively correlated with energy intake (r=0.12; p<0.0001)[103], in ETHNS and ECHNS surveys no correlation between BMI and energy consumption was found, although there was a very slight correlation between child's and mother's BMI (r=0.17; p<0.0131).

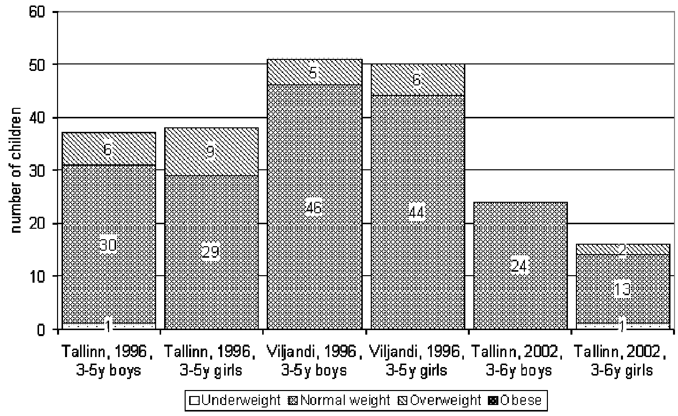

Figure 1. Number of children being underweight, normal weight, overweight and obese according to ETHNS and ECHNS

The prevalence of overweight in USA in 1999-2000 was 10.4% among two-through five-year-olds, compared with 7.2% in 1988-1994[104] and the prevalence of obesity among children six to eleven years of age increased 54% from 1960 to 1994[2].

Although it is supposed that overweight and obesity are not major concerns before adolescence, several surveys of pre-school aged children give us results to be worried about and show clearly that childhood obesity has reached epidemic levels. A survey of six- to seven-year-old German children in 2002 revealed the overall prevalence of overweight in children 9.4%, the obesity prevalence was 2.5%[105]. Comparing German data from 1982 and 1997, then the percentage of five- to six-year-old overweight/obese children had increased from 8.5/1.8% to 12.3/2.8%[106]. Between 1995 and 1999, a total of 3400 children aged between five and seven years were recruited in Kiel, northwest Germany and the results of their BMI analyses were quite frightening – 23% of the surveyed children were overweight[107]. French pre-school children time trends of BMI showed also increasing tendencies. The prevalence of obesity increased from 1.8 to 4.9%, and the prevalence of overweight rose from 9.6 to 16.9% from 1989 to 1999 among five-year-old children[108]. In 1991/92 in Bristol-Avon area, UK, it has been found out that 19.9% of four-year-old boys and 20.8% of 4-year-old girls were overweight and 7.5% of boys and 7.8% of girls were obese. For five-year-olds, the percentages were 18.2% and 19.3%; and 8.1% and 6.1%, respectively[109]. The 1998/99 Scotland survey of three-year-old children reported the prevalence of obesity (girls 8.0%, boys 9.0%), and severe obesity (girls 4.1%, boys 4.4%)[110]. Obesity is not only a problem in Europe, USA and Canada. The survey of Chinese pre-school children showed increasing tendencies among them also. The prevalence of obesity of four-year-old boys was 12.5% in 2002 as compared to 4.4% in 2000; and the prevalence of obesity of girls was 10.7% and 4.2%, respectively[111]. In some European countries such as the Scandinavian countries, the prevalence of childhood obesity is lower as compared with Mediterranean countries; nonetheless, the proportion of obese children is rising in both cases[100]. In Baltic countries the prevalence of overweight and obesity in children and adolescents is significantly less prevalent than in most other European countries[112]. But still we have to be on guard of the problem because eating habits here are changing into "western type" more and more and at the same time children's physical activity decreases, giving place to TV and PC. While it is known that the percentage of overweight and obese children is higher among adolescence than pre-school children it was quite pleasing to see that these percentages among Estonian adolescence were still below the numbers of other countries concerning percentages of overweight and obese pre-school children. Figure 2 gives a comparison of overweight and obese 15-year-old children in the USA and some European countries according to the 6th HBSC survey in 2001/2002[113].

Almost all researchers agree that prevention could be the key strategy for controlling the current epidemic of obesity. While about 50% of the adults are overweight and obese in many countries, it is difficult to reduce excessive weight once it becomes established. Children should therefore be considered the priority population for intervention strategies[97]. On the other hand, overweight

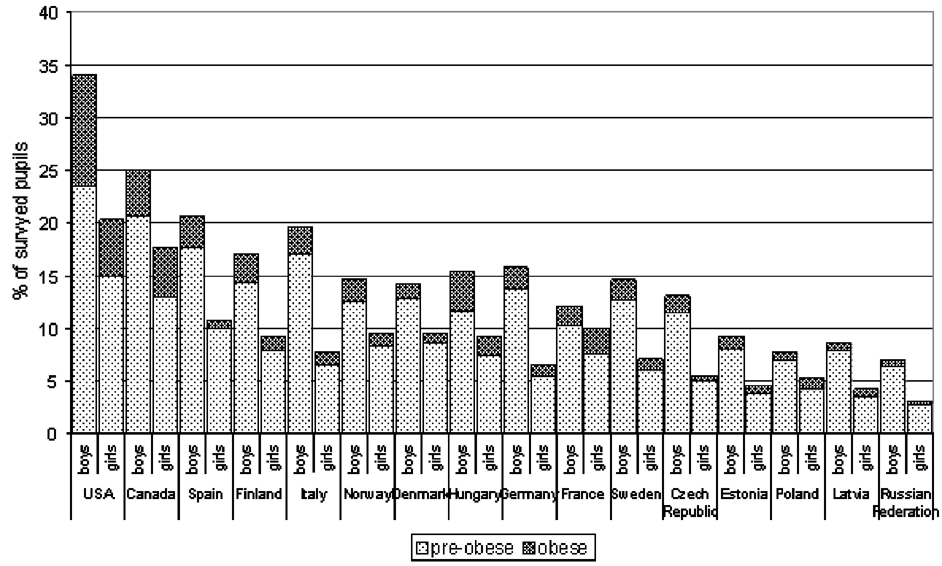

Figure 2. 15-year old children who are overweight or obese according to BMI (choice of countries in the 6th HBSC survey[113])

children do not need to achieve weight loss. Their BMI can be normalized if they maintain a fixed weight while still growing in height[62].

Not only overweight is a rising problem; underweight among children is rising as well. The 1998/99 Scottish survey of three-year-old children showed that the prevalence of under-nutrition was 3.3% for girls and 3.2% for boys. The study showed for the first time that the coexistence of under-nutrition and obesity is associated with social deprivation. For example, Scottish children in the most deprived families had a 30% higher risk of obesity and 50% higher risk of under-nutrition when compared to children in the least deprived group[110].

The problem of underweight concerns more adolescence[98,102,114,115], but there are also many pre-schoolers who neglect some food because they would like to be models or actors one day. Thus underweight might not show the actual food shortages but is influenced by TV and peers and an increasing pressure of being thin for being successful. For example in one Swedish study, 28% of the seven-year-old girls studied stated that they wished to be thinner and 22% that they had made attempts to lose weight[48].

One reason for the decrease in BMI of children and adolescents could be the quicker increase in the prices for food than for salaries at the beginning of the 1990s. Thus, one reason why the mean BMI decreased in the 1990s among young Estonians might be attributable to a decrease in the purchasing power of families. There are also other possible reasons for the decrease in BMI, such as relating a slim body with better possibilities and success in a future job[112]. While the wish to decrease weight increases with age in girls, then in contrast, 22% and

30% of boys wish to decrease their body weight at the age of eight to ten, but only 13% and 49% at the age of 15 to 17 years, respectively[116].

A survey about diet opinions in the USA indicated that five-year-old daughters of dieting mothers were more likely to have ideas about dieting at an early age, but if it would influence their eating and dieting behaviours in the future remained unclear. The survey also revealed that 13 girls out of 197 were already dieting at the age of five[117]. Early concerns about ones weight is confirmed by a survey of pre-adolescent children in Indiana, USA. 42% of girls selected an ideal figure thinner than their current figure. Results from this study indicate that the onset of disparate figure perceptions and expectations regarding thinness among females may be evident as early as six-seven years of age[118].

Although neither ETHNS nor ECHNS revealed significant problems of overweight, obesity and underweight, signs of these problems in other countries should make us cautious as well. Clearly, it is of prime importance to help children keep their normal weight.

3.3 Importance of meal patterns

A balanced and appropriate diet during childhood is likely to reduce the risk of immediate health problems, such as dental caries, anaemia, constitutional growth delay, overweight and obesity. Patterns of eating are also important. For example, skipping breakfast leads to midmorning fatigue and interferes with cognition and learning[119], effects that are more pronounced in young people nutritionally at risk than in the well nourished[120]. Those who skip breakfast also appear more likely to consume snacks with a high fat and low fibre content during the remainder of the day. In addition, eating breakfast, particularly if the meal includes fortified breakfast cereals, has been associated with improved overall nutritional status[121], and young people who consume at least two meals a day, with or without snacks, have a more nutrient-dense diet[122]. Skipping meals, particularly breakfast, often results in a greater consumption of mid-morning snacks as a substitute, and these tend to be high sugar and high-fat foods[4].

Eating breakfast has a major effect on calcium intakes. The study of French 235 children and adolescents explored the connection between breakfast consumption and calcium status[123]. Also, a survey in the USA confirmed that the intake of calcium (r=0.7223) at breakfast correlates with the consumption of it in the whole diet. It appeared that 33 to 35 % of the whole calcium was consumed during breakfast[124]. Fortified breakfast cereals can also make an important contribution to daily vitamin and mineral intakes. Parents should work together with carers to ensure that children have breakfast, either at home or in childcare[51].

Energy contribution to different meals in the surveyed kindergartens was not as recommended[PaperIII].

Breakfast calorie levels of both AD and KGM were below the recommendation[42] (in 95 % of the menus less than 500 kcal); on the other hand, snacks contributed to more energy than that in the recommendations (in 89% of the menus over 280 kcal). Therefore, most of the kindergartens would need to increase the energy provided at breakfast and decrease the energy at snack time to comply with current guidelines[PaperV].

Either pre-school children in Estonia are at home or in the kindergarten they usually eat breakfast. The energy intakes from breakfasts may not be substantial, but enough to keep them going. ECHNS showed that three- to six-year-old children (when did attend kindergarten) had their first meal around 9.30. As the survey was carried out in summer months, children got up a little later and so also had their meals later than usually in kindergartens. In 89% of the days, children ate something between 9.00 and 12.29 and an average energy consumption of all children was 386 kcal within this period, which is lower than the RDI for breakfast in kindergarten eaten around 9 o'clock. Also, lunch was mostly eaten a little later than in kindergartens (around 13 o'clock) – in 94% of the days children ate something between 13.00 and 15.59, average energy intake of that period was 387 kcal, which is also below RDI for a kindergarten lunch. In kindergartens, children eat snack around 16 o'clock. 81% of children ate something within 16.00 and 18.59; average energy intake of that period was 303 kcal, which slightly exceeds RDI for kindergarten snack. Average energy consumption from 9.00 to 18.59 was 1076 kcal, which is 69% of the whole day consumption. 25.8% of total energy consumption came from food eaten after 19 o'clock. This survey showed that children would like to eat less in the evenings and lunchtime and more in the evenings[86].

There is no comparable survey of pre-school-aged children breakfast habits, but it was pleasing that Estonian pupils have quite good habits of eating breakfast, in contrast, with Finnish[125] and English[63] pupils this habit was not decreasing very much as children came older. According to the 6th HBSC survey, 11-year old Estonian pupils were in the 13th place (75.1% of interviewed boys and 75.2% of interviewed girls), 13-year old pupils were in the 6th place (76.9% and 71.6%, respectively), but 15-year old pupils were already in the 3rd place (76.4% and 67.0%, respectively) in eating breakfast every schoolday[4]. It might be influenced by the fact that in contrast to some other countries (Denmark[50], Norway[49]), children in Estonia are provided always with proper breakfast in kindergarten.

Regardless of the results of kindergarten menus, it is good that our kindergartens do provide the food to children, it is made on spot and children can have a warm meal at least once a day, often even three times a day. Dietary survey of over 2000 childcare centres in Norway in 2003 revealed that 15% of centres offered children food for breakfast, but in 78% of the centres children had to eat the food they brought with them from home. The percentages for food offered for lunches were 61 and 16%, respectively; and for afternoon snacks 39 and 39%. Drinks for meals were offered in over 90% of the centres for every meal. Only 2% of the centres reported offering a warm meal every day, while 43% of the centres offered a warm meal once a week. Around 40% of the centres offered soups less frequently than once a month and the same amount reported was never offering soup for children at all[49].

In our kindergartens, lunch usually contains of soup or meat with supplements[PaperIII].

Children need to eat regularly and it is recommended that children be offered something to eat at least every three hours. Children need nutritious snacks between meals. The best snacks are those which are low in added sugar. A variety of snacks should be offered including fruits, vegetables and any type of bread, such as sandwiches, teacakes or fruit buns[51]. It must also be taken into consideration that pre-schoolers may eat well at one meal of the day and less well at others. Young children have small appetites and are not generally able to consume all they need without snacks; these are an important part of their nutritional intake. It is good to offer three meals and two or three healthy snacks with a variety of foods of differing tastes, textures, and colours to help maintain the child's interest[6].

The actual food consumption situation in kindergartens shows that children do not eat the whole meal in the mornings and they often feel hungry right after snack or a little while after eating it. That is why a suggestion has been made to Estonian nutrition recommendations that kindergartens should have rights to decide whether they use the current energy contribution recommendations or change breakfast into a morning snack and snack into dinner with the energy contributions from these meals 25% and 30-35% of total energy intake, respectively. Kindergartens could also offer healthy snacks in charge of main meals[PaperV,82].

3.4 Balance of the macronutrients, fatty acids contribution, cholesterol

A certain level of fat is vital in any diet, as a source of essential fatty acids and fat-soluble vitamins A, D, E and K. It has the advantage of carrying considerable amounts of energy in a small volume, making it a particularly important part of the diet of those, such as children who have high energy requirements but relatively small appetites. An argument for limiting fat intake in children is that atherogenesis is a lifelong process, and may be accelerated by a high-fat diet due to its effect on blood lipid levels. Post-mortem studies have shown that the relationship between blood lipid levels and the extent of atherosclerotic lesions is already present in childhood; and a preference for a high-fat diet established in childhood may be hard to change in later life. On the other hand, it has been feared that limiting fat intake by children may reduce the supply of energy and fat-soluble vitamins to inadequate levels. Still, between the ages of two and five, children should gradually adopt a diet that, by age five, contains less than 30% but more than 20%E from fat[91]. As children below two years of age should eat more fat than adults, skimmed milk and low-fat margarine are not recommended for them, but small children should also limit their intake of saturated fat[5].

The menu calculations of Estonian kindergartens[PaperIII,PaperV] (Figure 3) as well as children's individual level nutrition surveys[PaperI,86] cannot assure that energy derived from fat was higher than recommended in every menu or all of the children. Conversely, in some of the menus fat contributed even less energy than recommended, but current RDI for fats contribution is slightly higher than they are in Nordic recommendations[61] and will be in the new Estonian recommendations from the year 2006[82]. Energy derived from macronutrients in kindergarten menus depended also on the total energy level – the higher the total energy level the bigger part of it contributed to fats[PaperV].

In 21% of the KGM (Figure 3) fats contributed more than 35%E, but in 59% of the menus the energy intake from fats was between current recommendations[42] (30%E to 35%E), which means that fat content was under 30%E (newest recommendations[82]) only in one third of the menus. An average energy derived from fats was 32.5% and from saturated fatty acids 14.5% from AD. Saturated fatty acids contributed more than 10%E in all KGM. While energy intake from saturated fatty acids was too high, it decreased with asn increase in the total energy level. Comparing the first and second period days, energy derived from saturated fatty acids showed a tendency to increase ($p<0.0056$)[PaperV].

Around 38 to 39% of all fats in KGM came from added fats. The second largest source of fats was milk products and the third meat-egg-poultry-fish products.

In ETHNS and ECHNS altogether fats contributed more than 35%E in 46% of the children menus and between 30%E and 35%E in 36% of the children menus. In 1996 (Figure 4) the percentage of children having fat intake over 35%E was higher in the Viljandi County. Comparing the years 1996 and 2002, the percentage of children having fat intake below 25%E had increased and over 35%E decreased. All children's average energy intake from fats in 1996 was higher in the Viljandi County (35.8%E vs. 34.8%E). Although the average energy intake from fats of all children in Tallinn in 2002 was lower than in 1996 (34.8%E vs. 34.0%E), we cannot assure that it was a decreasing trend. The intake of saturated fats in ETHNS and ECHNS was over 12%E in 85% of the children menus and only in 3% of the children menus it was lower than 10%E. The average intake of saturated acids in 1996 was higher in Viljandi (15.4%E vs. 14.7%E, $p<0.041$).

Energy derived from protein from both KGM[PaperIII,PaperV] and individual level surveys was not a problem (too high fat intake influenced mainly energy amounts derived from carbohydrates), but the total protein amount in average in three- to five-year-old children diets in 1996 was below RDI[PaperI].

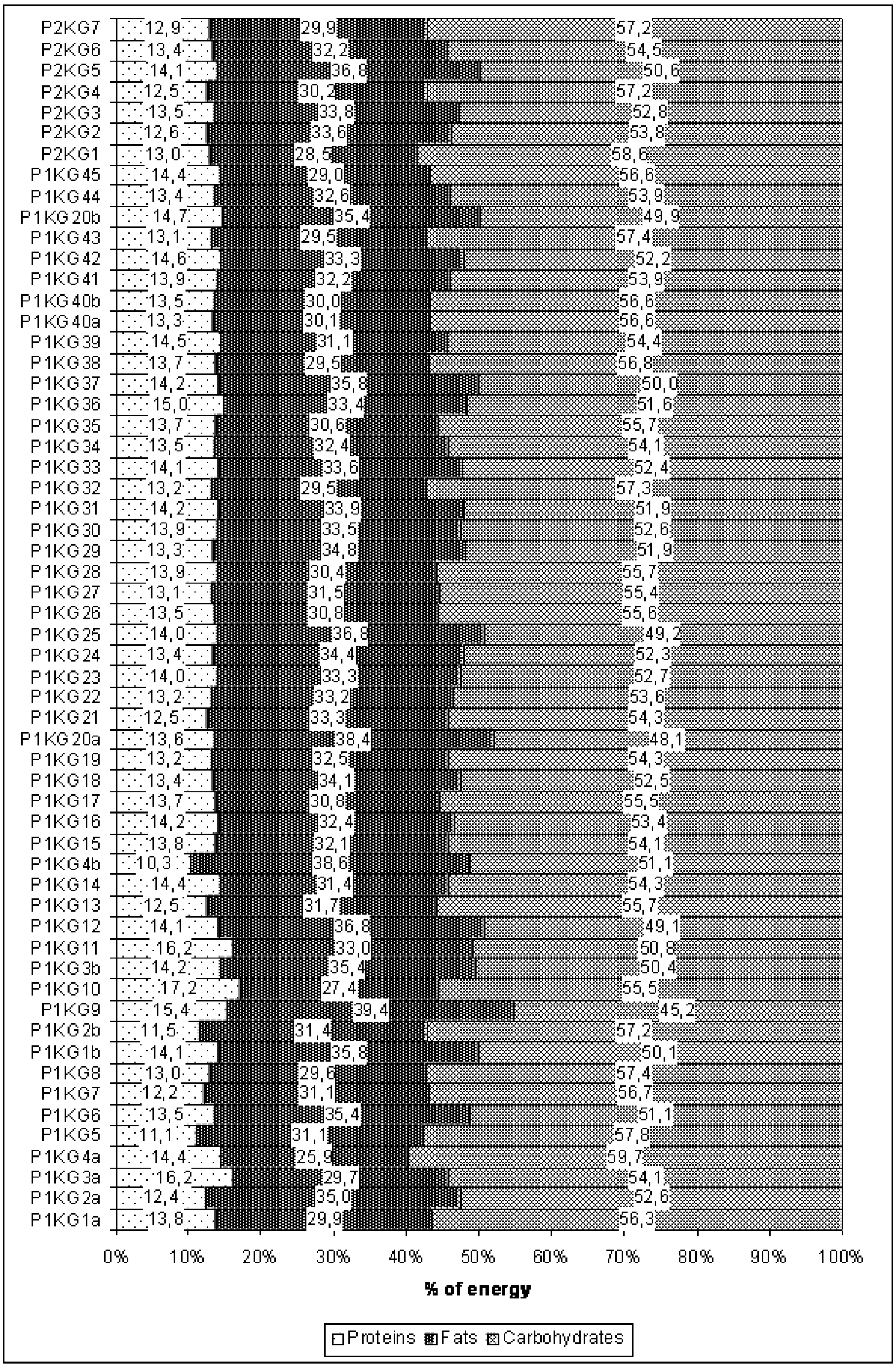

Figure 3. Macronutrient levels in KGM

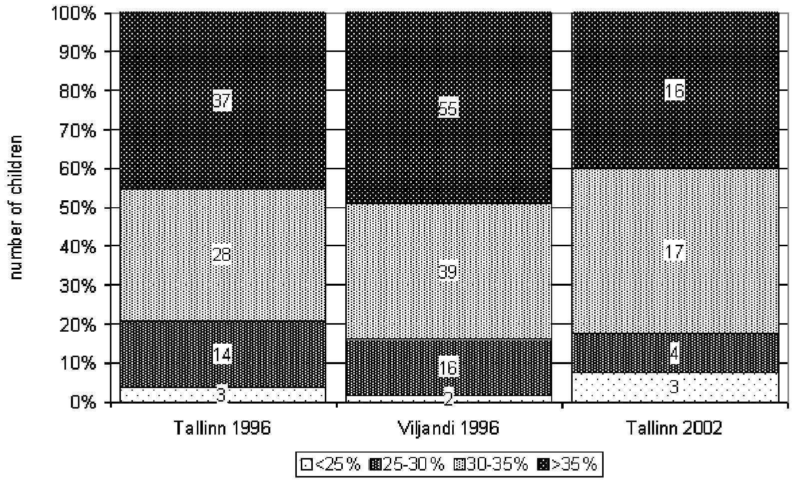

Figure 4. Children's distribution by the energy contributed from fats according to ETHNS and ECHNS

Too high cholesterol level in kindergarten menus was also not a problem[PaperIII]; it exceeded the recommended 255 mg only in three KGM, that was not much. Average cholesterol intakes from ETHNS and ECHNS were also below the RDI. Still cholesterol consumption exceeded the RDI in 31% of rural and 13% of urban children in 1996 and in 5% of urban children in 2002.

In the Norwegian UNGKOST-2000 survey[90], the percentage of children having more than 35%E coming from fats was much lower (around 30% of children) than in ETHNS and ECHNS, but also in their survey, fats contributed in 70% of children menus over 30%E. Still their average energy intake from fats (32.5%) was lower than in Estonia. Several studies from Estonia[126,127], Finland[45,125], Sweden[128] show that energy intake from fat is slowly decreasing over the years. But the results also show that in spite of some decrease of fat intake, the intake of saturated fatty acids is still a problem both in Estonia and Nordic countries[45,90,128].

The decrease of energy intake coming from fats might be caused by general changes in people's food consumption, especially from added fats and milk products. While in 1988 the most often used fat for frying was margarines (mainly solid ones), then in 1998 around 85% of families used vegetable oil for frying. Also, the use of sour cream or mayonnaise as salad dressing had changed more in favour of vegetable oil. At the same time, also the consumption of butter and milk (over 2,5% of fat content) had decreased[129]. Although there have been positive changes in added fats selection, too high saturated fats intake (and even the increase of it) shows that more attention must be paid to hidden saturated fatty acids in foods.

While in Estonia energy intake from fats is lower in kindergartens than at homes, a survey among Swedish pre-schoolers showed that the energy derived from fats was highest in kindergarten (38%), while at home it was 36% in kindergarten days and 34% in weekend days. It was mainly caused by a high carbohydrate intake during the weekends, i.e., high intake of sucrose[48].

The tendency of fat contribution and its decrease in Estonia seems pleasing because, for example, surveys from Germany, Spain and UK show much more frightening numbers. A survey of German six- to eleven-year-old children showed that fat contributed an average 41%E (saturated fatty acids 20%E)[130]. In Spanish studies from the 1990s total fat intake of children aged six- to ten-years ranged from 38%E to 48%E , of which saturated fat ranged from 16% to 18% and in children aged 11–14 years, total fat intake already from 41%E to 51%E (saturated fat from 12% to 18%)[131]. A survey of over 1400 1.5- to 5-year-old children in 1995 in Great Britain showed that fats contributed 47.0%E in boys and 44.9%E in girls[132]. Very interesting is the fact that in spite of much higher rate of obese children in the USA[113], the surveys of 2–19-year-old children from 1988-94 showed that fats contributed only 33.5%E and saturated fatty acids 12.2%E[133]. Quite similar was the fat intake in Mexican children[94]. Energy derived from fats was also very high in Holland and Australia, while it was much lower among children from undernourished countries, such as Kenya and Tanzania (12%E) [134].

While the use of protein efficiency ratio (PER) to rate proteins for humans is debatable, it should be noted that a recent animal study found that combinations of animal (30% of total) and plant based proteins (70% of total) had a higher PER value than the animal or vegetable proteins eaten alone[135].
Although PER is higher if animal and plant proteins are consumed in ratio 30:70, in KGM it was 66:34.
Also, the survey of 14-year old schoolchildren in 1998/99[127] gives an estimated ratio of 62:38 and the ratio in the survey of kindergarten aged children in 1978 is similar – 63:37[88].

Like fats and saturated acids, cholesterol levels also show decreasing tendencies over the years, being 410 mg in 1984/85, 384 mg in 1988/89 and 320 mg in 1998/99 among Estonian schoolchildren[127]; and a survey among 9- and 15-year-old schoolchildren in Tartu in 1998/99 showed cholesterol consumption levels over RDI only in 15-year-old boys (352 mg) [136]. Although cholesterol intake of pre-school children in our surveys did not exceed the recommended maximum, there is a danger exceeding it when children grow older and their total energy intake increases.

Although energy derived from fat sources was below the current maximum RDI in most KGM menus, children's individual dietary surveys showed that summary energy intake from fats was over the RDI. As the recommended energy amount derived from fats will decrease in new recommendations[82], too high energy levels from fats and too low energy levels from carbohydrates are a problem among Estonian pre-schoolers, the same is true for too high saturated fatty acids intakes.

3.5 Micronutrient consumption in general

Vitamins, minerals and bioactive components are essential to normal growth, development and normal body functions. Some vitamins and minerals are important in the immune system for protection against ill health and disease. Children aged one to five years have high requirements for vitamins and minerals due to the rapid rate of growth and bone development during these years[9]. Vitamin A is required for healthy vision, for the integrity of epithelial surfaces, and for the development and differentiation of tissues. It is also essential for normal immune response, taste, hearing and growth. In addition, several carotenoids including β-carotene, which can be converted into vitamin A, appear to act as important antioxidants in tissues. Together with vitamin C and vitamin E they deactivate or scavenge free radicals and activated oxygen, and may therefore protect against cellular damage. B-group vitamins are important in carbohydrate utilization (vitamin B_1), protein metabolism (vitamins B_2 and B_6), nervous system function and growth (vitamin B_2 and vitamin B_{12}), formation and growth of red blood cells (vitamin B_6 and vitamin B_{12}), energy metabolism (niacin), aiding the maturation of red blood cells (folic acid); essentiality of numerous reactions involved in lipid and carbohydrate metabolism (panthothenic acid), being cofactor for glyconeogenesis and fat metabolism (biotin)[5].

ETHNS revealed deficiencies in vitamin A, D, C, iron and calcium consumption. Sufficient vitamin C intake is a concern in the rural areas where 71-86% (in town 36-65%) of different age and gender groups obtained vitamin C below the RDI[PaperI]. According to ECHNS, the average consumption of vitamin D was below RDI[PaperIV]. Children's individual analysis showed also insufficient amounts of vitamins A and C and iron, as well as too large amounts of sodium.

Depending on a kindergarten deficiencies were observed in vitamin D, E, B_1, B_1, B_6, C, folic acid and copper levels[PaperIII,85].
In KGM (and AD), major shortages were in vitamin D, B_1 and C levels (Table 2). Recalculating the results to energy needs makes the situation even worse. As according to the most recent recommendations[82] energy levels should decrease even more, it is highly important to increase the micronutrient densities in food. It is difficult to estimate the possible changes in the absolute intakes of micronutrients from the first and second period because of the fact that menus are from different kindergartens and also energy intakes from the menus were different. That is the reason why densities of all calculated days in the first and in the second period are used in this case also.
Comparison of the two periods showed that not only the levels of most of the micronutrients had fallen with the decrease of energy[PaperV(table1)], but also the densities of vitamin D, calcium, magnesium, phosphorus, zinc, iodine and selenium had decreased. Also, sodium densities had fallen, but it is recommendable. On the other hand, vitamin B_1, B_2 and C densities had increased.

Table 2. Micronutrient levels and average densities from AD, recalculated intake of AD and KGM compared to the RDI

	AD					KGM	
	Intake			Densities		% of the menus	
	Mean *n*=894	Mean, % RDI[42]	REC to energy needs, %RDI [42]	I period *n*=747	II period *n*=147	Under RDI[42]	Under RDI[42] when REC
Vitamin A (µg-ekv)	1364 ± 120	321	310	895	1178	5	2
Vitamin D (µg)	1.4 ± 0.0	32	31	0.97	0.83*	100	100
Vitamin E (mg)	6.6 ± 0.1	130	125	4.5	4.2	33	28
Vitamin B_1 (mg)	0.6 ± 0.0	89	86	0.42	0.45*	78	91
Vitamin B_2 (mg)	1.0 ± 0.0	121	117	0.73	0.76**	16	17
Niacin (mg-ekv)	14.9 ± 0.1	160	154	10.5	10.4	0	0
Vitamin B_6 (mg)	0.9 ± 0.0	115	112	0.62	0.64	12	19
Vitamin B_{12} (µg)	6.9 ± 0.6	1020	986	4.6	5.6	0	0
Folic acid (µg)	121 ± 2	110	106	85.6	84.5	21	26
Vitamin C (mg)	29.0 ± 0.7	76	73	20.1	22.9*	84	91
Sodium (mg)	2005 ± 24	337	326	1468	1076**	0***	0***
Potassium (mg)	2180 ± 14	233	225	1544	1511	0	0
Calcium (mg)	668 ± 6	131	127	477	451*	7	10
Magnesium (mg)	211 ± 2	207	200	150	138**	0	0
Phosphorus (mg)	1003 ± 6	262	253	713	668**	0	0
Iron (mg)	9.1 ± 0.1	196	189	6.44	6.05	0	0
Zinc (mg)	7.7 ± 0.1	139	134	5.5	5*	0	0
Copper (mg)	1108 ± 40	229	221	766	784	0	0
Iodine (µg)	194 ± 2	253	245	139	115**	0	0
Selenium (µg)	47.5 ± 0.4	233	225	33.5	30.8*	0	0

REC recalculated to recommended energy level

*p<0.05 **p<0.0001 significant difference between micronutrient densities in the first and second period

*** under the maximum recommended level

Deficiencies in children's diets reported in earlier nutrition surveys in Estonia are similar to those found by our surveys. Both school- and pre-school children's surveys from the end of the 1970s revealed shortages in vitamin A, B_1, B_2, B_6 and C intakes, whereas deficits increased with age[137]. Variations were also noted in relation to seasonal differences with springtime vitamin deficits twice of those of other periods of the year[87]. Another kindergartens' menu survey showed, in addition, deficiencies in vitamin D and calcium intakes[138], but no deficiency in iron and zinc intakes[139]. A whole day nutrition analysis of four- to six-year-old children in 1978 revealed in addition to the deficiencies of vitamins A, B_1, B_2 and D, the deficiency in vitamin E consumption[88].

According an Australian study, children's intake of iron, calcium and zinc was more likely to be lower than recommended for those attending childcare. Data adapted from the 1995 Australian National Nutrition survey showed on average children derive 38-52% of their day's total nutrient intake from kindergarten food, while it is recommended that the menu provided to children in care provide at least 50% of the recommended dietary intakes for young children[56]. A comparison of Swedish kindergarten children's food in weekdays and weekend days showed that the intake of main micronutrients was higher in weekdays[48], which clearly shows the positive role of the food in kindergarten.

One of the reasons not deriving enough B group vitamins (especially vitamin B_1) might be, in addition to low fruit and vegetable consumption, the decreasing consumption of bread. If in 1994 about 93% of 11-15-year-old pupils ate bread at least once a day, then in 1998 only 54% of pupils did so[140]. Among 15-19-year-old Estonians less than 50% consumed 1-2 slices of bread, near 40% consumed 1-2 slices of graham bread and around 35% 3-4 slices of white bread a day in 2004[141]. About 100g bread a day could probably be enough to eliminate vitamin B_1 deficiencies[142].

This thesis focuses on vitamins D and C, calcium and iron, because these micronutrients showed the greatest shortages in KGM as well as in individual level surveys and their deficiency has been reported in other surveys made in Estonia. Although calcium level from KGM[PaperIII,PaperV] was not a problem, calcium deficiency among schoolchildren[PaperIV,143] and the fact that there were too many children who failed to meet the RDI according to individual level surveys show that calcium is too important not to handle it in the current thesis. Also, the sodium excess intake[PaperIII] will be covered.

3.6 Vegetable and fruit – a source of fibre and vitamin C

Vegetables and fruits are rich in many nutrients – carbohydrates (including fibre), vitamin C, minerals, etc. In addition, they contain many phytochemicals, which are not necessary for life but they help to promote optimal health by lowering risk for chronic diseases. It is estimated that there may be more than

100 different phytochemicals in just one serving of vegetables[144]. As the subject of phytochemicals is very wide, it will not be handled in this thesis. Main attention is paid to vegetable and fruit consumption in general, and fibre and vitamin C intakes.

Vitamin C is essential for the prevention of scurvy and for the promotion of wound healing. Furthermore, it is important for the optimal functioning of the immune system and for the synthesis of collagen, and it has antioxidant properties. Vitamin C is particularly valuable in assisting the absorption of non-haem iron from vegetables and other non-haem sources. The principal positive effect of fibre in children is probably that of regulating bowel movement. Some forms of dietary fibre are better than others for increasing stool weight and frequency, softening faeces, increasing faecal bulk and reducing gastrointestinal transit time. The effects appear to vary according to the type of fibre consumed: insoluble, coarsely ground fibre has more marked effect in retaining water, and thereby increasing stool frequency, than finely ground soluble fibre[5].

From KGM calculations appeared (Table 3) that children were offered around 100g of vegetables, 100g potatoes and 50g fruit every kindergarten day – it is about 4 portions altogether. It is quite good, although the share of fruits could be higher. As Micro-Nutrica does not allow determining whether the vegetables and fruits were eaten fresh or heated, it may be only assumed that most of the vegetables and around half of the fruits were eaten as heated which means also some vitamin loss.

Table 3. Vegetable, potatoes, fruit and juice drink levels (g) in kindergarten food

	Vege-table	**Potatoes**	**Fruit, juice**		**Vege-table**	**Potatoes**	**Fruit, juice**
KGM	*n*=52	*n*=52	*n*=57	**AD**	*n*=559	*n*=559	*n*=659
min	40	55	15	min	0	0	0
max	215	220	175	max	292	420	384
mean	102	114	52	mean	92	100	50

Vegetables, potatoes and fruits are very good sources of carbohydrates and the lack of their intake can also be seen from too low part of energy derived from carbohydrates both from kindergarten and school menus as well as in ECHNS[PaperV,86].

On the other hand, according to ETHNS and ECHNS, no children were found who did not consume at least a small amount of vegetables during surveyed days and only one child out of 234 children did not eat any potatoes during the observed days. The results about average fruit consumption were similar – all urban children in 1996, 93% of rural children in 1996 and 93% of urban children in 2002 consumed some fruit (e.g., berries, jam, dried fruit, and whole juice) in observed days. The amounts consumed (Figure 5) show that the consumption of fruit was higher (p<0.0001) than the consumption of vegetables (in contrast to kindergarten menus). The consumption of potatoes was higher in rural children

($p<0.0001$) and the consumption of fruit was higher in urban children ($p<0.0001$). Comparing the urban children in 1996 and 2002, the consumption of vegetables had increased ($p<0.0008$) but the consumption of fruit and potatoes remained the same. In ETHNS, 19% of urban children consumed more than 400g of fruit and vegetable a day (10% of children more than 500g a day), but from rural children only one child consumed more than 400g of fruit and vegetable a day. In 2002 already 38% of urban children consumed more than 400g of fruit and vegetable a day and 15% more than 500g a day.

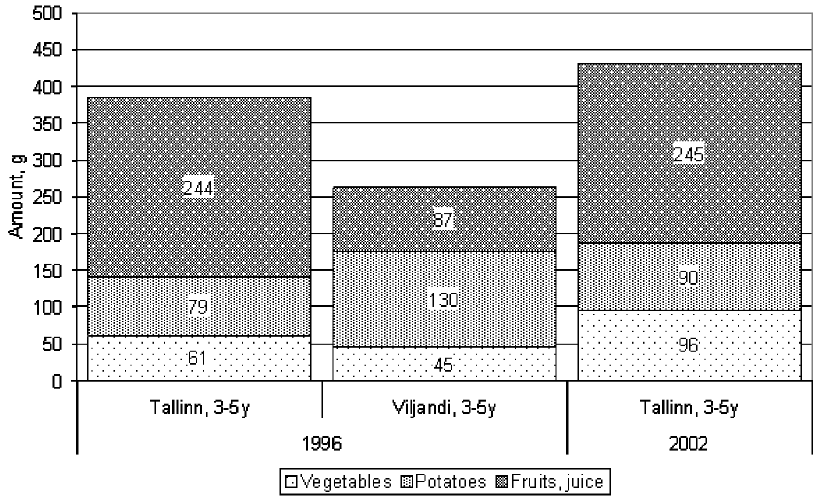

Figure 5. Consumption of vegetable, potatoes and fruit in ETHNS and ECHNS

As the 1995 recommendations did not include exact recommendations for fibre consumption for children, earlier surveys used the minimum recommendation of 20g a day and because of that most of the kindergartens showed shortages in fibre consumption[PaperII,85]. Comparing the results with RI, fibre level from KGM was not a problem. Also, fibre densities from menus were relatively good – 7 to 12.8 g per 1000 kcal[PaperV]. Fibre intake according to ECHNS urban children was also over RI (12g a day)[86] and from ETHNS survey slightly lower (urban 11.8g, rural 11.4g/day). On the other hand, in 2002 there were 28% of children whose fibre consumption was below 8 g a day (in 1996 11% of urban and 17% of rural children).

The results of vegetable and fruit consumption in ETHNS and ECHNS altogether revealed correlations between their intakes and several micronutrient intakes. These correlations with every micronutrient might not be huge, but they prove that vegetable and fruit play an important part in deriving vital micronutrients. The correlations were as follows: with vitamin A (r=0.13, $p<0.0412$), with vitamin B_1 (r=0.48, $p<0.0001$), with vitamin B_2 (r=0.24, $p<0.0002$), with niacin (r=0.35, $p<0.0001$), with vitamin B_6 (r=0.48, $p<0.0001$), with folic acid (r=0.58, $p<0.0001$), with vitamin C (r=0.8, $p<0.0001$), with sodium (r=0.21, $p<0.0011$), with potassium (r=0.48, $p<0.0001$), with calcium (*r*=0.22, *p*<0.0008), with magnesium (*r*=0.35, *p*<0.0001), with phosphorus (*r*=0.21, *p*<0.0012), with iron (*r*=0.20, *p*<0.0028), with zinc (*r*=0.25, *p*<0.0001), and with copper (*r*=0.24, *p*<0,0002). In addition, as expected there was also a correlation between fruit and vegetable consumption and carbohydrates intake in general (*r*=0.39, *p*<0.0001) and with fibre intake (*r*=0.41, *p*<0.0001).

As referred to in the previous section, in addition to being the source of carbohydrates (fibre), vegetables, potatoes and fruits give a notable amount of vitamin C. In KGM most of the vitamin C came from vegetables (29%), followed by juice drinks (23%). Fruits-berries-juices gave 19% of vitamin C and potatoes 17%. Also, milk products gave quite a large of vitamin C (13%)[PaperV]. From fruits-vegetables-juices, the correlation with vitamin C was highest for juice drinks (AD *r*=0.73, *p*<0.0001 and ETHNS/ECHNS *r*=0.60, *p*<0.0001).

Deriving sufficient quantity of vitamin C from kindergarten menus seems to be a major problem[PaperIII,85]. The average level of vitamin C did not meet RDI in 84 % of the KGM. The average level of vitamin C (mean 29.0 mg, median 22.6 mg) of AD was also below RDI (38.3 mg) and levels during the kindergarten days were mainly between 10 and 20 mg[PaperV]. An analysis of average data of groups in ETHNS in 1996 showed that urban children derived statistically reliably bigger amount of vitamin C (in town 64±53 mg, in the country 31±24 mg, *p*<0.0001)[PaperI].

The fact that urban children in Estonia were provided more vitamin C than rural ones was proved also in a survey conducted among Tartu schoolchildren[136].

While other vitamins intakes do not show significant trends of improvement, vitamin C intakes had slowly increased from year to year. This was already found out in 1975, when, as compared to the beginning in the 1960s, vitamin C intakes showed an improvement[145]. Not only have the absolute numbers increased, but also vitamin C densities in schoolchildren food have increased from 34 mg/1000 kcal in 1984 to 53 mg/1000 kcal in 1998[127].

In our KGM surveys, vitamin C absolute levels unfortunately did not show significant improvements, but vitamin C densities in AD in the second period were slightly higher than in the first period (*p*<0.04).
On the other hand, according to ECHNS, vitamin C intake in 2002 in the younger urban children group had increased even to 76 mg a day[86].
The data of individual level analysis are encouraging – shortages in vitamin C levels in kindergartens would hopefully be compensated by eating at home.

At the same time, when our pre-schoolers derive more vitamin C from home food than from that of kindergarten, the results of Swedish pre-schoolers showed contrary results – the intake of weekdays was higher (76 mg) than of weekend days (58 mg)[48]. While in Estonia ensuring enough vitamin C might be a problem, in Finland already in 1995 children aged three to six got around 75 mg vitamin C a day, which was substantially more than recommended[45]. Vitamin C consumption is not a problem among Norwegian pre-schoolers either[90] but vitamin C intakes among pre-schoolers in Great Britain were comparable to Estonians[91] and children who consumed fruit juice had significantly higher vitamin C intakes than those who did not (72 mg compared with 40 mg). Still, 35% of the surveyed children did not meet their RDI of 30 mg vitamin C a day[146]. The intakes of vitamin C among Mexican and Indian pre-schoolers were even lower; being around 15 mg a day in India[95] and 22 mg a day in Mexico[94].

While in Estonian KGM, the major source of vitamin C was vegetables, a survey from the USA revealed about 45% of vitamin C coming from fruit juices[147], but in the survey of English schoolchildren the main source of vitamin C were potatoes[63]. According to the USA Department of Agriculture's 1989-1991 Continuing Survey of Food Intakes, 25.1% of vitamin C in two- to five-year-old children came from orange and grapefruit juices and additional 17.2% from other fruit juices[148].

In the recent Nordic recommendations[61], the recommendation for vitamin C intake for adults has increased while for kindergarten-aged children decreased (from 45 mg to 30 mg), however, no explanation was given, it is clear that our kindergarten menus need an improvement concerning vitamin C, especially when the energy levels should be cut down. Promoting fruit and vegetable in the menus will lead to an increase in vitamin C intake.
The survey of Danish children showed that the intake of fibre was much higher than in our survey (17.9g/day)[149], but the surveys in Finland[45], Sweden[48] and Norway[90] showed quite similar consumption as our survey; and the survey of English pre-schoolers showed a much lower fibre consumption – only 6.1g per day[6]. Thus, based on earlier surveys, it can be suggested that fibre intakes among schoolchildren have increased[150] and not only the absolute intakes but also densities[151].

In spite of all kinds of campaigns, such as "5-a-day"[152], the real consumption of fruit and vegetable is usually below recommendations. According to the 6th HBSC survey in 2000/2001, Estonian schoolchildren were the last in the list concerning fruit consumption. The situation of eating vegetables every day was not much better in Estonia – our pupils shared the end of the list with Spain, Hungary and Malta. Similarly to fruit consumption, vegetable consumption also decreases with age[4]. Earlier surveys among Estonian pupils showed an increasing tendency of fruit and vegetable consumption from 1991 to 1998[140]. Also, the survey conducted among young adults in 2004 revealed that only 28% of them ate 200g of fruit and vegetable per day during the last seven days[153].

Although the guidelines in USA recommend that all Americans, including children at the age of two and older, consume at least 5 servings of fruits-juice-vegetables daily[52], the USA Department of Agriculture's 1989-1991 Continuing Survey of Food Intakes revealed that only 20% of children consumed five or more servings of fruit and vegetable per day and nearly one quarter of all vegetables consumed by children and adolescents were French fries[154]. Another survey of 5-year-old girls in Pennsylvania reported that a majority of girls ate 3 servings of fruit and vegetable a day and mean vitamin C intake was 83 mg a day. The study found out that girls who consumed more fruit and vegetable tended to have higher micronutrient intakes and lower fat intakes. This research provides also evidence that girls' fruit and vegetable intake and its relationship to nutrient intake is positively associated with parents' fruit and vegetable intake and negatively associated with their use of pressure in child feeding[155]. The majority of childcare centre menus in USA provide an acceptable variety of vegetables, but not fruit. On the other hand, kindergarten surveys in the USA have showed that in some day-care centres, children were allowed to bring money to purchase carbonated beverages, pickles, frosties or shakes, or candy bars, which likely minimized their consumption of fruits-juice-vegetables offered in the meals served[52].

31% of KGM included also some sweets (excl ice cream, cookies, pastry), but according to ECHNS/ETHNS there has been a slight decrease in sweets consumption – while 80% of urban children in 1996 consumed some sweets, then in 2002 75% of the children did so.

According to the Swedish recommendations, children between four and ten years should eat around 400 grams of fruit and vegetable a day[62]. In spite of these recommendations, the situation of eating fruit and vegetable is not much better in Sweden. Only 44% of schoolchildren were reported eating one fruit a day and 49% eating vegetables regularly in 2001/2002[156]. A survey of two- to six-year-old North London pre-schoolers indicated that only 30% of respondents ate fruit more than once a day and 17% vegetables more than once a day, while 31% and 418% ate them less than once a day, respectively. The amount of fruit or vegetable that parents themselves reported eating was positively correlated with child's intakes (vegetable r=0.49, fruit r=0.39)[157]. In BNDNS, peas and carrots were the only cooked vegetables, excluding potatoes, eaten by more than half the children during the study period. Just fewer than half the sample ate baked beans (beans are quite uncommon among Estonians). Leafy green vegetables were eaten in small amounts by only 39% of the children and raw vegetables or salad by less than 24%. The most popular fruits were apples and pears, followed by bananas[92].

Taking the average consumption of Estonian children in 2002 and comparing it to the results of the survey of Danish children in 2000/01[149] and Norwegian[90] children in 2000, the average consumption of potatoes and fruit was highest in Estonia, but the consumption of vegetable was highest in Denmark. As in Estonia, according to the study of Swedish pre-schoolers[48], children also consumed fruit in greater quantities than vegetable. According to Norway UNGKOST 2000 survey[90], the number of children eating fruit and vegetable over 400g and over 500g a day was similar to Estonian children – in Norway 12% of girls and 8% of boys consumed fruit and vegetable over 400g a day and 4% and 5% even over 500g a day, respectively. Concerning kindergarten food abroad, only 12% of the Norwegian childcare centres offered vegetables as a part of warm meal once or frequently a week; 29% of the centres did not offer them at all. At the same time, fresh fruit were offered every day in 78% and fresh vegetables in 16% of the centres[49].

In menu planning it is important to know the best sources of vitamin C and keep in mind that the losses in food preparation could be high. Vegetable and fruit, especially spinach, tomatoes, potatoes, broccoli, berries, oranges and other citrus fruits, are the best sources of vitamin C. Vitamin C is highly labile and is destroyed by several factors including heat, light and oxygen. A diet containing a diversity of plant foods, eaten either raw or lightly cooked, is therefore recommended. Foods such as stews, soups, jams and compotes normally undergo prolonged cooking, which will significantly reduce and usually destroy all the vitamin C present[5].

In spite of the possibility of getting enough vitamin C from the food eaten at home also kindergartens should pay attention to their low vitamin C intake levels and offer more vitamin C rich foods.

3.7 Milk and fish products – calcium and vitamin D

The most obvious function of calcium is to provide rigidity to the skeleton by virtue of the insoluble salts it forms with phosphoric acid, but calcium salts also constitute a very large reservoir of calcium for the maintenance of the (ionized) calcium concentration in the extra cellular water at or very close to 4.8 mg per 100 ml (1.2 mmol per litre). The protection of this critical concentration by parathyroid hormone and vitamin D reflects the vital role that calcium plays in the neuromuscular system, in regulation of the heart, in enzyme-mediated reactions and in many other metabolic processes[158]. A net absorption of calcium is approximately 200 mg/d (20% of dietary calcium intake).1.25-dihydroxy-vitamin D_3 is an extremely important regulatory hormone for intestinal absorption of calcium at low and moderate calcium intakes (i.e., approximately 200mg/meal), a majority of calcium is absorbed by active transport[159]. Adequate vitamin D promotes calcium absorption and helps the body adapt to a low calcium intake. In the absence of vitamin D, less than 10% of dietary calcium may be absorbed compared to the typical 30%[160].

Vitamin D is primarily synthesized in the skin by the action of ultraviolet B radiation from sunlight, after which it is further converted in the liver and kidneys to the active metabolite 1,25-dihydroxyvitamin D3. Dietary vitamin D is obtained from fatty fish (sardines, salmon, herring, tuna, etc.), margarines (which in most countries are fortified with vitamin D), some dairy products, eggs, beef, and liver. Milk and milk products provide the richest and most easily absorbed dietary sources of calcium. Other good sources include nuts and fish. Components binding calcium, such as phosphorus, phytate and oxalate, can reduce its bioavailability[5].

The role of calcium and other minerals in achieving peak bone mass begins before birth. Premature infants tend to have lower bone mineral content later in life, although this may in part be due to their tendency to be light and short for their age. Low birth weight is also associated with low bone mass later in life[161]. Calcium absorption efficiency varies throughout the lifespan. When demands for calcium are high, as during periods of rapid growth in infancy and puberty, calcium absorption and retention are increased. In infants and young children, calcium absorption can be as high as 60%[160]. In early puberty (age of growth spurt), calcium absorption is about 34%, whereas in late adolescence and adulthood, fractional calcium absorption decreases to about 25% to 30%[162].

There were considerable shortages ofvitamin D content in kindergarten menus[PaperIII,85]. The average level of vitamin D provided by all KGM was below RDI. Vitamin D levels of AD were above RDI on only 19 days of 894 (2%) days. Vitamin D levels were mainly between 0.5 and 1.0 µg in AD. Although calcium level from most of the KGM was sufficient, low levels of vitamin D may affect calcium absorption[PaperV].

In ETHNS none of the kindergarten-aged children did obtain vitamin D according to recommendations, although rural children consumed it more than urban children. The average amount of vitamin D in the country was 2.04±1.35µg, in town 1.57±0.83 µg, p<0.01). Calcium consumption met the RDI (in town 695±244 mg, in the country 605±220 mg, p<0.005)[PaperI]. The situation had not improved much in 2002. Vitamin D consumption in Tallinn was still 1.5±0.1 µg, although the calcium consumption had increased (769±221 mg).

More than one half of vitamin D (55%) in KGM was obtained from meat-poultry-fish-egg products and its level is mostly correlated with fish level (r=0.55, p<0.0001) (Figure 6). One of the reasons why the levels of vitamin D were low was probably that in spite of fish being one of the biggest sources of vitamin D, it was not served very much or very often in most of the kindergartens. As seen from Table 4, some fish was served in 25% of the surveyed days but the average level was only 7 g per kindergarten day. 11% of KGM did not include any fish.

From ETHNS it appeared that the percentage of children eating some fish during the observed days was higher for rural children (55% vs. 11% of children eating some fish) and the percentage of urban children consuming some fish had increased from 1996 to 2002 (11% to 33%). Also, ETHNS and ECHNS showed the correlation between fish and vitamin D intake (r=0.39, p<0.0001). Although the percentages of children eating fish in Tallinn had increased, the average consumed amounts had decreased.

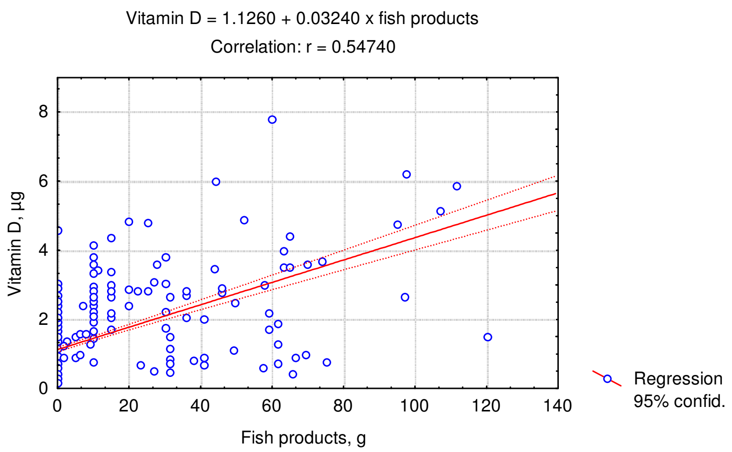

Figure 6. Correlation between vitamin D and fish products level in AD

Table 4. Milk products, milk and fish levels (g) from kindergarten food

	Milk products	**Milk**	**Fish**		**Milk products**	**Milk**	**Fish**
KGM	*n*=57	*n*=52	*n*=57	**AD**	*n*=659	*n*=559	*n*=659
Nom*	0	0	6	Nod**	0	103	496
min	271	242	0	min	20	0	0
max	898	761	48	max	980	810	120
mean	454	392	7	mean	448	387	7
median	447	383	5	median	432	378	0

* - number of menus where level was 0, ** - number of days when level was 0

Calcium level in 7% of KGM was below RDI and after recalculating the menus to the recommended energy level, 10% of the menus did not meet the RDI (Table 2, p 38). Calcium densities in kindergarten-aged children were similar in kindergarten menus (473 mg /1000 kcal) and home menus (ETHNS urban 492mg/1000kcal and rural 465mg/1000kcal, ECHNS urban 488mg/ 1000kcal)[PaperI,PaperV,86].

Although the mean intakes of calcium in ETHNS and ECHNS met the RDI, 44% of urban and 46% of rural children in 1996 and 25% of urban children in 2002 failed to meet the current 600 mg a day recommendation[PaperIV].

Most of the calcium in KGM (83%) came from milk products[PaperV]. The average milk level from KGM (table 4) was slightly below 400g a day. There were no kindergarten menus which did not include milk or milk products in average, although milk was not offered in 18% of AD. In a kindergarten, milk in some form should be served every day[PaperV].

A high correlation between milk/milk products and calcium level was also demonstrated by both AD and ETHNS/ECHNS. The correlations between milk and calcium were slightly lower (r=0.78, p<0.0001) than the correlations between milk products intake in general and calcium (*r*=0.89, *p*<0.0001 and *r*=0.90, *p*<0.0001, respectively).

In ETHNS, average drinking milk consumption was slightly higher in the Viljandi County (Figure 7), but the amounts of milk used in preparing food was much higher (*p*<0.0001) than in Tallinn. Drinking milk consumption had increased (*p*<0.03) as compared to 1996 and 2002. It also appeared that all the children consumed at least some of the milk products during the observed days and only one child in 2002 did not drink any milk. The consumption of yoghurt, cheese, curd and pudding in 1996 was higher in Tallinn (*p*<0.0001), but the consumption of ice cream in the Viljandi County (*p*<0.02).

The results of a study of elderly woman in the USA found that milk consumption in childhood and adolescence appears to be needed not only for growth and development, but possibly also to assure, within genetic limits, an optimal peak of bone mass and thus greater latitude for the maintenance of skeletal integrity in the face of bone losses. Bone densities of elderly women were higher in those who drank milk more often in childhood than the others (85.7 vs. 84.2) and they had higher calcium intakes both in childhood (720 mg/day vs. 648 mg/day) and in the adult age (1017 mg/day vs. 664 mg/day) [163]. The period of childhood and adolescence is the period of life during which peak bone mass is largely accrued and also the period during which the prevention of late life bone loss and osteoporosis-related fractures is considered to begin[164]. At least 40% or more of the body's total skeletal mass is formed during the adolescent growth spurt[165]. Research indicates that the peak calcium accretion rate occurs at age 12,5 for girls and 14 years for boys[166].

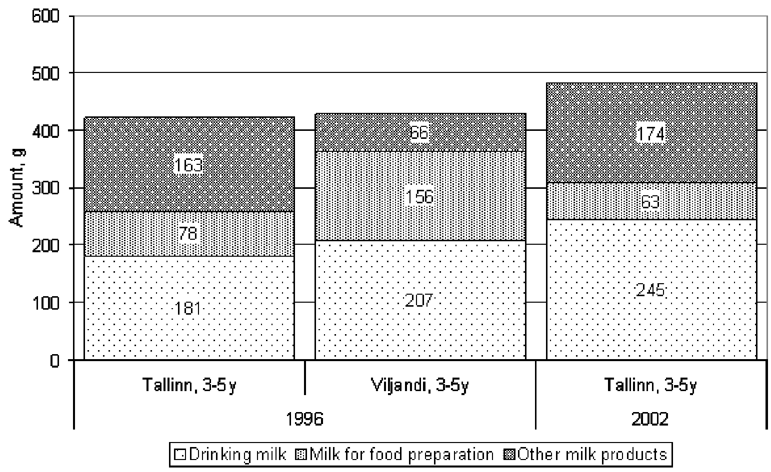

Figure 7. The consumption of milk and milk products in ETHNS and ECHNS

It is likely that variations in calcium nutrition early in life can account for as much as 5% to 10% difference in peak adult bone mass. Such a difference, although small, could potentially contribute more than 50% to the hip-fracture rates later in life[167]. A recent study of females aged between 11 and 32 years in the USA showed that approximately 90% of total body bone mineral content is achieved by age 17.9, 95% by 19.3 years and 99% by age 22.1 years[168], which points outagain the importance of consuming enough calcium starting from early childhood.

Calcium recommendations in different countries are different, varying from 450mg[169] to 800mg[170] a day for children aged four to six, but clinical studies show the advantages of higher calcium consumption. In one intervention study (USA), when six- to ten-year-olds consumed 1600mg calcium a day, bone mass accumulation was 3% to 5% higher than when calcium intake was 1000mg a day or less[171].

Although the calcium need of pre-schoolers is not very high and it also does not seem to be a major problem to meet the RDI[PaperIII,85] as in schools, the development of eating patterns that will be associated with adequate calcium intake later in life may be regarded as of high importance in that age group[172].

Vitamin D intake is not a problem only in Estonia, but in other countries as well. A study of English preschool children in 1992/93 showed that Vitamin D intake was also low. Vitamin D intakes from food were, depending on the location, 1.1-1.3 µg per day[173]. Another survey conducted in Great Britain among 3.5-year-old children in the middle of the 1990s gave slightly higher results – 1.56µg a day, but it still is not enough. At the same time, their calcium consumption also met the recommendation at 752mg a day[91].

Low vitamin D intake is related to fish consumption. Not only Estonian pre-schoolers consume too little fish. The survey among 1000 Estonian 15-74-year-old inhabitants showed also that adolescence is very modest in relation to fish – although almost 30% of them eat fish once a week, there are also close to 15% of those who eat fish less frequently than once a month. Furthermore, figures for fish as a main dish are even more modest. Fish was mainly consumed as additional food, on sandwiches or in salads[141].

In other countries too it is difficult to be provided enough vitamin D. In BNDNS, about a third of all children ate fish during the study period, which was probably one of the reasons why only 5% of children met the RNI for one- to three-year-olds (7µg/day) of dietary vitamin D intake[92]. According to Norwegian pre-school children survey (UNGKOST-2000), the consumption of fish was 25 g (girls) and 28 g (boys) a day and vitamin D intakes 2.4 µg and 2.7 µg respectively[90].

Although there was no problem with average calcium intake from individual level surveys, calcium densities in ETHNS[PaperI] and ECHNS[86] were quite low as compared the calcium densities in the USA[174] in school menus (689mg/1000kcal). On the other hand, they were much higher than calcium densities in school-aged children in Estonia, which in different surveys[PaperIV,127,136] were from 275mg/1000kcal to 441mg/1000kcal.

Mean daily calcium intake of pre-school children in the USA is much higher (852 mg/day) than in Estonia but still 44% of children had mean calcium intake lower than their recommendation (800mg/day) [175]. Also, the calcium consumption of Swedish pre-schoolers[48] was a little higher than in Estonia, but Norwegian pre-schoolers[90] consumed amounts of calcium comparable with our pre-schoolers. Calcium consumption in the USA shows a trend to decrease – while in 1971 the consumption of pre-school children was 921 mg a day, in 2000 it was 838 mg[176]. While pre-schoolers in most countries meet the recommended levels of calcium intake, a survey of one- to four-year-old Mexican children also revealed that 51% of one- to three-year olds, 73% of four-year-olds and 70% of five- to six-year-olds were at the risk of calcium inadequacy[94]. According to BNDNS, 11% of under three-year-olds and 24% of over three-year-olds consumed less calcium than recommended, but their recommendations are also lower than ours[146].

In the USA it is found that milk intakes were inversely associated with intakes of juice drinks, soda pop and added sugar beverages in pre-schoolers. They concluded that dairy foods remain an important source of calcium and vitamin D, while added sugar beverages and, to a lesser extent, 100% juice decrease diet quality of young children. The findings indicated that as early as age of two, children with higher milk intakes were less likely to consume beverages with added sugar and were more likely to obtain adequate amounts of key nutrients in their diets[177]. A study of adolescent food trends (USA) between 1965 and 1996 found that teens' intake of milk decreased by 36%, while their consumption of soft drinks increased dramatically[178]. The high consumption of carbonated beverages and the declining consumption of milk are major problems because the data of a survey of 14-year-olds showed strong associations between cola beverage consumption and bone fractures in girls. High intake of dietary calcium was protective[179]. In a Swedish pre-schoolers study, the children drank on average more soft drinks during the weekend days (225g) than during the weekdays (125g)[48]; in Norway[90] soft-drinks consumption is more modest (60-70g), but BNDNS[180] in UK showed that most of the children (86%) drank some soft drinks within the surveyed week and the consumed amounts were close to 300g a day[146]. In Sweden there was a tendency for low milk consumers to receive a greater part of their energy from soft drinks than was the case for high milk consumers[48] and several surveys[4,156] reveal boys drinking more soft drinks than girls, but our surveys did not confirm that fact.

KGM did not include soft drinks, but in ECHNS/ETHNS, 24% of urban children and 21% of rural children in 1996 consumed some soft drinks in the surveyed days, and in 2002 the percentage of urban children was already 58%. It has been reported that people do not use milk products because they are afraid of getting fat, however our survey did not find any correlation between milk products consumption and child’s BMI, but there was a slight correlation between soft drink consumption and BMI (r=0.20; p<0.039).

The Child and Adult Care Food Program (CACFP) in the USA has heeded the importance of milk products in children diets. This USA federal food program reimburses childcare organizations that provide nutritious food for children to meet the needs of children in day-care centres in low-income areas. While assessing and comparing dietary intake of children attending two day-care centres (one centre participates in the CACFP, in another children bring all meals and snacks from home) it appeared that children receiving CACFP meals at day-care had significantly higher mean daily intakes of calcium (714±180mg vs. 503±143mg) than the children who brought all of their meals and snacks from home and they also consumed significantly more servings of milk (2.9±0.9 vs. 1.5±0.7 servings)[181].

The whole day nutrition survey of four- to six-year-old children in 1978 in Estonia showed that their calcium consumption met the RDI, whereas 79% of calcium came from milk products[88]. This percentage is slightly lower than from KGM where 83% of calcium came from milk products[PaperV]. In the USA pre-schoolers diets, milk and milk products provided also 83% of the calcium[174], but other surveys[92,148,175] from abroad show more modest results. Several surveys confirm our result[PaperIV] that the part of calcium coming from milk products decreases with age[127,176,182].

While according to our surveys general milk consumption had not decreased from 1996 to 2002, a Danish[149] survey showed a slight decrease, but they still consume it about 100g more than in Estonia.

Milk and milk products consumption of Swedish pre-schoolers is slightly lower than that of Estonians – they consumed around 400g a day and the consumption was higher in weekdays[48]. According to another Swedish survey, milk consumption decreases in adolescence[60], also confirmed by our survey[PaperIV]. Norwegian[90] pre-schoolers too consumed less milk products, but the intakes of yoghurt and cheese were higher. Yoghurt was daily in use in 36% of the childcare centres in Norway but it was mainly brought from home, only 12% of the centres offered yoghurt by themselves[49]. A survey of German one- to thirteen-year-old children within 1986 to 2001 revealed that during the study period, the consumption of milk products by children remained stable, since the reduced consumption of fluid milk was compensated for by an increased consumption of yoghurt. Low-fat milk products increased to nearly 25% of milk products[183].

Individuals who increase calcium intake through calcium-rich foods, such as milk and milk products, consume not only more calcium, but also more of other nutrients, such as protein, riboflavin, phosphorus, folate, thiamin, niacin, vitamin B6, vitamin B12, magnesium, zinc, and iron[184].

While obtaining enough calcium from KGM was not a concern, there is still a risk for calcium deficiency in terms of the whole day menu calculations, especially with such low vitamin D intake levels. Kindergartens should strongly consider how to increase vitamin D intake – using more fish and vitamin D-fortified fat spreads. As Vitamin D intake is below RDI not only by children but also among all of the population[185], milk fortification with vitamin D should be considered on a national level. Finland started milk and sour milk fortification with vitamin D (0.5µg/dl) during 2003, which together with fortified fat spreads (10µg/100g) has increased average Vitamin D consumption among Finnish children and adolescences from 3.7 to 6.6 µg per day[PaperV,186].

3.8 Iron and anaemia

Iron deficiency in young children is widespread and has serious consequences for child health. Prevention of iron deficiency should therefore be given high priority. In Europe, information on the prevalence of iron deficiency in children is limited. Most studies have investigated only the prevalence of anaemia, usually by measuring haemoglobin levels, and not its etiology, even though iron deficiency is likely to be the most common cause[5]. Iron deficiency in early life is associated with delayed development, children seem to have language delay, poor coordination, and delayed motor skills, but there is still much uncertainty about the subject. Some studies also showed strong effects of iron on learning and memory, but not on attention. If iron deficiency occurs in pre-school, the consequences appear reversible with treatment[187,188].

There are two types of iron in food: haem iron and non-haem iron, and they are absorbed by different mechanisms. About 10% of dietary iron is derived primarily from the haemoglobin and myoglobin of meat and is referred to as haem iron; it is readily absorbed. Non-haem iron is in the form of iron salts found in vegetables and plant protein foods, and accounts for about 90% of dietary iron[64]. The average absorption of haem iron (present in haemoglobin and myoglobin in meat (particularly liver) and fish) from meat is around 25%[5] and absorption of non-heam iron in plant foods such as rice, maize, black beans, soybeans and wheat is around 2% to 20%[189]. In contrast to non-haem iron, the absorption of haem iron is influenced very little by other constituents of the diet and by iron status. Absorption of non-haem iron is much lower than that of haem iron and depends on the iron status of the individual: more non-haem iron is absorbed by iron-deficient individuals and less by those who are iron-replete. Moreover, the absorption of non-haem iron depends on its solubility in the intestine, and this is determined by the composition of foods consumed in a meal. Vitamin C is a potent promoter of iron absorption. The promoters and inhibitors present in the diet are often stronger determinants of iron status than its actual iron content[5]. The enhancing effect of vitamin C on the absorption of iron, and probably of zinc, from a meal depends on the presence of adequate amounts of vitamin C. For example, consuming food containing 25 mg ascorbic acid will approximately double the amount of iron absorbed from cereals. To be effective, foods and drinks rich in vitamin C should be consumed at the same time as foods containing non-haem iron, to allow the necessary conversion of ferrous iron to ferric iron. The strongest inhibitors of iron absorption are phytates and polyphenols. Phytates are storage forms of phosphates and minerals present in cereal grains, vegetables, seeds and nuts. Phenolic compounds exist in almost all plants. A few phenolic compounds specifically bind iron and therefore inhibit its absorption. These are found in tea, coffee and cocoa, and also in many vegetables and several herbs and spices. The polyphenol tannin, which is found in tea, is responsible for the inhibitory effect of tea on iron absorption[5,146].

Kindergarten menus provided children with sufficient amount of iron[PaperIII,85]. Although no iron deficiency was found in KGM, in terms of the sources of iron, the actual absorbed iron may be insufficient for children. Most of iron in these menus was also derived from grain products (59%), from where it is not absorbed so well; and only the second largest source of iron was meat-poultry-fish-egg products (17%)[PaperV].

From ETHNS results it was revealed that 45% of urban and 18% of rural children have haemoglobin concentration less than 110 g/l, only 38% of urban and 65% of rural children had all examined blood indicators within bounds of WHO standard values. The blood tests show that some of the children have anaemia, this comes forward very clearly when comparing Estonian children haemoglobin values to the American acknowledged standard's lower borderline. It is known that iron deficiency in organism exists even before it shows in blood tests. As iron deficiency can cause mental disability, it is especially harmful for little children[PaperII].

Although the blood test showed anaemia in many children, the amount of iron obtained from food (in town 7.9±2.6 mg, in the country 7.7±2.8 mg) in ETHNS in 1996 met the RDI of 2002 (5.5 mg per day), but it did not meet the recommendation of 1995 (10 mg per day). The results of the correlation analysis established that the major source for iron was grain (country r=0.55, town r=0.29) and greens (country r=0.31, town r=0.18); and less meat (country r=0.24, town r=0.10), which may be one of the reasons not absorbing actually as much iron as needed[PaperI].

From ECHNS in 2002 it appeared that the average iron intake of urban children had increased to 8.9±0.3 mg[86] that met the current RDI and only one child had iron intake below the recommended 5.5 mg a day. In 1996, 19.5% of urban and 16.1% of rural children failed to meet the 5.5 mg recommendation. Diets with such components like whole rye bread are with only imaginarily sufficient[PaperII] iron concentration. As urban children obtained more food with vitamin C, the absorption of iron should probably be better than that of rural children.

Eating enough meat is not only correlated with iron intakes but according to ETHNS and ECHNS meat consumption is also correlated with another problematic micronutrient intake – zinc (r=0.57, p<0.0001).

Reports from the World Health Organization estimate that 46% of the world's five- to fourteen-year-old children are anaemic, with the overwhelming majority of this anaemia occurring in individuals from the developing world[189]. According to the United Kingdom survey blood anaemia occurs in 10–30% of pre-school children living in inner cities in the United Kingdom[5]. The iron deficiency problem is not restricted to those in poverty or to underdeveloped countries[190]. A survey of Mexican children in 1999 revealed that 23% to 32% of pre-school children depending on age were at risk of iron inadequacy[94].

The surveys of pre-school children in Norway[90] and Great Britain[91,146] show the iron deficiencies from food, but in a survey of England pre-schoolers it was found out that children with high (above median) intakes of iron and vitamin C had a higher mean haemoglobin level and a lower prevalence of anaemia compared with children with low (below median) intakes of these dietary constituents[191]. Another English survey (BNDNS) found that 37% of children drank tea and tea drinkers had significantly lower intakes of iron from all food sources and lower intakes of vitamin C (46.1 mg as compared to 55.1 mg). Tea drinkers had also slightly lower haemoglobin concentration levels[146]. Haem iron (from meat) contributed only about 4% of all iron intakes, while main iron sources were cereal products, many of which are fortified[92]. Also, according to the USA Department of Agriculture's 1989-1991 Continuing Survey of Food Intakes in two- to five-year-old children's diets, the greatest iron source was ready-to-eat cereals (31.0% of all iron intake) [148].

Providing advice about good dietary sources of iron is a more straightforward strategy to tackle the important issue of poor iron status. The attention focused on poor iron status should not obscure advice about the importance of obtaining adequate dietary calcium, particularly to young children who have yet to achieve peak bone mass[192]. The results of a dietary intervention study demonstrate that young children absorb a similar amount of iron from a high-calcium diet than from a lower calcium diet[193]. Strategies to optimize iron status in pre-school children include, in addition to meat offering, consuming an iron-fortified breakfast cereal, vitamin C-rich fruits or drink at breakfast, and avoiding tea with (or after) meals[194].

All kindergarten caterers and parents should be informed of the possibility of iron deficiency while not offering enough iron from haem sources and of the positive effect of vitamin C on iron absorption.

3.9 Sodium and salt

The majority of sodium is found in extra-cellular fluids. Although sodium is essential in the control of extra-cellular volume and acid–base balance, cellular electrical activity, nerve conduction and muscle function[5], too high sodium intake is a major risk factor for adult health, but habits for salty food intake get started in childhood. Excessive sodium intake in children leads to natriuresis and increased calcium excretion, and may cause hypertension later in life. High sodium concentrations in drinking water have been associated with elevated blood pressure already in children of school age[195].

There is now increasing evidence that sodium intake in infancy may be important in relation to blood pressure later in life. A carefully controlled randomized trial conducted in The Netherlands among newborn babies studied the effect of a low or a normal sodium diet on blood pressure during the first six months of life. Those babies receiving a modestly restricted salt intake had a significantly lower systolic blood pressure than those on a normal sodium intake. A subgroup of those babies were studied after 15 years of follow-up and the blood pressure of the group that was exposed to a low sodium diet for the first six months of life continued to be significantly lower than that of the control group. Increasing consumption of processed foods means that salt intake is now almost entirely dependent on the amount of salt added by the food manufacturers, which now accounts for up to 80% of our current intake. It is noticed that some low-fat products contain more salt than their non-low-fat alternatives[196].

Most of the sodium in KGM came from added salt (45% of total sodium intake) and the second largest source was grain products (21%), which means that in Estonia the use of processed foods is not that high yet and to decrease salt intake cooks should use less salt in food preparation. Sodium average level in all KGM exceeded RDI and average level from AD was 2005 mg, which is over 5 g of salt already during the kindergarten day. Only in 8 days out of 894 it was below the RDI level[PaperV].

Too much salt has been a problem from the first kindergarten menu surveys[PaperIII,85], but it seems that sodium density is slowly decreasing (Table 2, p 38) in kindergarten food.

ETHNS and ECHNS revealed also whole day sodium average consumptions over RDI (700 mg), for urban children 1640 mg and for rural children 1600 mg in 1996, for urban children 1738 mg[86] in 2002.

Salt intakes are too high not only in Estonia. The survey of almost 300 Finnish kindergartens revealed that while children under three years of age could consume 2.5 g of salt per one kilogram of food, the actual consumption was twice as much[197] and salt density in the diet of children is similar to that in the diet of adults[198]. According to a survey of five-year-old children in Finland, whole day sodium intake of surveyed children was higher than in our surveys – 2200 mg a day and 43% of total sodium intake was derived from added salt in food preparing[195]. Also, the results of sodium intake of USA pre-schoolers were slightly higher than Estonians.

To achieve the decrease of sodium levels from KGM and children's whole day menus, the caterers and parents should be educated so that they would know more about sodium-rich foods and that kind of foodstuffs are preferred.

4. CONCLUSIONS

The preschool years are critical for growth and development, with more rapid and frequent transitions in dietary patterns occurring than in other age groups. Although the importance of preschool diet has been well established, measuring dietary intake in children younger than five years remains a challenging area of study. The majority of pre-school children attend kindergartens and one way to find out nutrition situation among children is to analyze kindergarten menus. Unfortunately, these results represent the analysis of the food served to children not children' actual intake and therefore only reflect possible maximum energy and nutrient levels from served menus in these kindergartens. Therefore, the results of kindergarten menu calculations between 1995 and 2004 have been compared to pre-school children's individual level dietary survey results from Tallinn and the Viljandi County from 1996 and 2002. The overall aim of the current thesis was to investigate Estonian kindergarten menus, compare them to recommendations and find out if the possible shortages would be compensated with the food children eat at homes.

Based on the current study, the following conclusions can be drawn.

Individual level surveys confirmed that children, in spite of the improving socio-economic conditions, consumed energy as much as recommended or less. This means that energy recommendations for pre-school-aged children might be slightly too high. Energy levels from kindergarten menus, on the other hand, mostly exceeded the recommendation. From these facts it can be concluded that children probably do not eat all the food offered in kindergartens. It was also found out that energy levels within one kindergarten menu varied too much from day to day.

Energy contribution to different meals in kindergarten menus did not meet the current recommendations – energy from breakfast is too small and from afternoon snack too high. On the other hand, ETHNS and ECHNS showed that children would like to eat less in the mornings and more in the evenings.

According to the current recommendations, energy derived from fats was not too high in all of the kindergarten menus, but it was quite high in whole day surveys of children's individual level.

Cholesterol levels from kindergarten menus and from children's individual level surveys were acceptable. Sufficient fibre intake was not a problem in pre-school children either, but in spite of the fact that schoolchildren consume more energy, their fibre consumption did not increase to a level recommended and children over the age of 16 might already consume insufficient amounts of fibre, especially when they eat insufficient amounts of vegetable, fruit and bread.

The major problem in pre-school children diets both at home and in kindergartens was too low vitamin D intake and in kindergarten menus also too low vitamin C level. Calcium level from kindergarten menus was not a problem but individual level surveys showed that there were too many children in already pre-school age not meeting the RDI for calcium. Although absolute iron level was quite sufficient, the sources of iron revealed that actual iron intake may not be adequate. Sodium excess intake was a concern both in kindergarten menus and children's individual level surveys. A decrease in the sodium densities of all kindergarten days from the first five years and last five years was significant. Concerning other micronutrients, deficiencies were also determined in many kindergarten menus or children's individual menus, however not to such a great extent as mentioned above.

5. SUGGESTIONS

As in the recent Nordic recommendations, energy intake requirements were given not by age groups any more, but for every age independently (e.g., for 3-year-olds, for 4-year-olds, etc) the suggestion was made to use the same system in the Estonian Nutrition and Food Recommendations[82] from 2006. Using these recommendations, an average energy intake recommendation in kindergarten would be about 100 kcal lower than recommended today. According to the current RDI and the new recommendations, *energy levels from most of the kindergartens should be decreased, but definitely not below the recommended level* to avoid energy deficiency of children from low-income families who might not be provided a proper meal at homes. On the other hand, taking into consideration increasing obesity rates among children all over the world, it is essential that energy consumption should not exceed the energy actually spent. For children who are still growing, and gain weight for that reason, the main aim is to ensure that their weight would not deviate from the established weight curves. To avoid too substantial energy level variations in different days, a suggestion was made that *energy levels from kindergarten menus should not be lower than recommended or not to exceed the recommendation over 20%.*

As a result of the analysis of energy contribution to different meals, a suggestion was made *that it should be up to a kindergarten to choose whether they offer a proper meal in the morning and a snack in the evening or on the other way round. Kindergartens should also have a possibility to offer 1-2 snacks on the charge of other meals.* This suggestion was also added into the Estonian Nutrition and Food Recommendations[82] from 2006.

Although according to the recommendations from 2002[42], energy derived from fats was not too high, in the newest recommendations[82], their part has decreased. Thus *energy derived from fats (especially saturated fatty acids) needs to be decreased and energy derived from carbohydrates needs to be increased in most of kindergarten menus and children's diets.* In terms of increasing carbohydrates levels, it should be taken into account that the increase has to be derived from starchy foods such as bread, potatoes, rice and pasta and from vegetable and fruit

and not from sugary foods like cookies, candies, pastries and soft drinks. Regarding concrete menu the following considerations should be followed:
* if the total energy level is higher than that recommended and energy derived from fats needs to be decreased, less saturated-fatty-acid-rich foods (fatty meat products and milk products (e.g., butter, sour cream)) should be offered and/or the lowered fat content variances should be taken into use and probably some more carbohydrate-rich foods (vegetable, fruit, grain products) should be offered;
* if the total energy level is higher than that recommended and energy derived from fats needs to be increased, more mono- and polyunsaturated-rich foods (fish, oils, nuts, seeds) should be offered and at the same time, probably less saturated-fatty-acid-rich foods should be offered and/or the lowered fat content variances should be taken into use;
* if the total energy level is lower than that recommended and energy derived from fats needs to be decreased, more carbohydrate-rich foods and less saturated-fatty-acid-rich foods should be offered and at the same time, there might be a need for increasing mono- and polyunsaturated-rich food intake;
* if the total energy level is lower than that recommended and energy derived from fats needs to be increased, more mono- and polyunsaturated-rich foods should be offered and at the same time, there might be a need for increasing carbohydrate-rich foods intake.

To avoid insufficient fibre intakes in later life, pre-school children should eat more vegetable, fruit and bread (desirably whole bread), they should develop healthy eating habits already in kindergarten-age. In 2005 5-a-day campaign was arranged by the Estonian National Institute of Health Development[199] among Estonian schoolchildren and in 2006 the campaign will continue and include also kindergarten children[200].

Eating more fruit and vegetable would probably solve the problem of obtaining enough vitamins C and A , and some other micronutrients being in deficiency in both kindergarten menus and children whole day diets. As the problem of too low vitamin D intakes does not concern only pre-school aged children but the whole population of Estonia, our *milk products producers should strongly consider fortifying their products with vitamin D*. This suggestion has been made on behalf of the Department of Food Processing to the Ministry of Agriculture. Also, *fish consumption should be increased* because it is a good source of vitamin D and essential fatty acids. Parents should also be informed of the importance of calcium and therefore *eating enough milk products and not replacing drinking milk with soft drinks*. *The part of iron coming from haem sources should be higher than it is now.* As in Estonia people and caterers do not use as much produced food as in other countries, decreasing sodium intakes should be achieved mostly through *adding less salt during food preparation*.

While the energy levels from kindergarten menus should be decreased, it is highly important in the menus to *increase the densities of micronutrients, being already in deficit*.

As the analyzed kindergarten menu calculations were from different parts of Estonia, made in different seasons and came from different backgrounds, they were not very easy to compare. Another suggestion for evaluating menus in future could be made. It was not used in this thesis because menu calculations done over the years did not include all the criteria for computing the Healthy Eating Index (HEI). It was developed as a summary measure of the population's dietary quality and adherence to the Food Guide Pyramid, a food guidance system developed by USDA to meet the Dietary Guidelines for Americans; it can be used to track changes over time. The HEI includes ten components that assess adherence to the dietary guidelines (servings of grains, fruit, vegetable, milk and dairy products, and meat; the percentage of calories from fat and saturated fat; intake of cholesterol and sodium; and the variety of food group selections)[176]. Using this index in further surveys will enable better comparison of them and with the surveys from abroad.

All the kindergartens should calculate their menus once in a while and correct them according to the recommendations. To help them realizing it the first step has been taken by the Estonian National Institute of Health Development. In February, the first public menu-calculating web site in Estonia was opened at www.terviseinfo.ee. It would not allow for calculating nutrient intakes from anyones recipes yet but it has quite an extensive database of foodstuffs and recipes to offer. Further development of this site is under way.

Encouraging pre-school children to eat a healthy, varied diet will provide all the nutrients they need for healthy growth and development and will help to establish good eating habits for life.

REFERENCES

1. Estonian Ministry of Social Affairs of Estonia, Social Policy Information and Analysis Department. Social sector in figures. Tallinn, 2004. p 14, 17.
2. Nicklas, T.A. Calcium Intake Trends and Health Consequences from Childhood through Adulthood. – *Journal of the American College of Nutrition* 2003, vol. 22, no. 5, p 340-356.
3. Williams, C.L., Bollella, M.C., Strobino, B.A., Spark, A., Nicklas, T.A., Tolosi, L.B., Pittman, B.P. "Healthy-Start": Outcome of an Intervention to Promote a Heart Healthy Diet in Preschool Children. – *Journal of the American College of Nutrition* 2002, vol. 21, no. 1, p 62-71.
4. Vereecken, C., Ojala, K., Delgrande, J.M. Eating habits. In: *Young people's health in context. Health Behaviour in School-aged Children (HBSC) study: international report from the 2001/2002 survey* (Eds. C. Currie, C. Roberts, A. Morgan, R. Smith, W. Settertobulte, O. Samdal, V.B. Rasmussen). WHO, Health Policy for Children and Adolescents 2004, no. 4. p 110-120.
5. Michaelsen, K.F., Weaver, L., Branca, F., Robertson, A. Feeding and nutrition of infants and young children. Guidelines for the WHO European Region, with emphasis on the former Soviet countries. *WHO regional publications. European series* 2003. No. 87, p 45, 64, 70-76, 93, 101-122.
6. Wardley, B.L., Puntis, J.W.L., Taitz, L.S. The Preschoolchild. In: *Handbook of Child Nutrition* (Eds. B.L. Wardley, J.W.L. Puntis, L.S. Taitz). Oxford University Press/Books 1997, p 54-72.
7. Canada's Food Guide to Healthy Eating "Focus on Preschoolers", Background for Educators and Communicators. Health Canada. Toronto Public Health, 1995. p 1-10.
8. Phillips, F. Nutrition and pre-school children. Conference Report. *Nutrition Bulletin* 2004, vol. 29, issue 1, p 64-66.
9. Nutritional guidance for early years. Food choices for children aged 1-5 years in early education and childcare settings. A consultation document. Scottish Executive. Astron, 2005. 48 pp.
10. Webber, L.S., Srinivasan, S.R., Wattigney, W.A., Berenson, G.S. Tracking of serum lipids and lipoproteins from childhood to adulthood. The Bogalusa Heart Study – *American Journal of Epidemiology* 1991, vol. 133, no. 9, p 884-899.
11. Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation. Geneva, World Health Organization, 2003. *WHO Technical Report Series*, No. 916, p 34-38.
12. Maser, M., Varava, L. Health Promotion in Kindergartens. Estonian National Institute of Health Development. Tartumaa, 2003. p 67-68. (in Estonian)
13. Statistical Yearbook of Estonia 1996. Statistical Office of Estonia. Grafinet Ltd, 1996. p 51, 63, 81, 145.

14. Statistical Yearbook of Estonia 2005. Statistical Office of Estonia. Ofset Ltd, 2005. p 38, 42, 64, 138, 195, 214.
15. Statistical Yearbook of Estonia 1997. Statistical Office of Estonia. Kirjastus ja Trükk AS Atlex, 1997. p 51, 87, 155, 163.
16. Statistical Yearbook of Estonia 1998. Statistical Office of Estonia. Multico Ltd, 1998. p 85, 164.
17. Statistical Yearbook of Estonia 1999. Statistical Office of Estonia. Tallinn Book Printers Ltd, 1999. p 66, 176.
18. Statistical Yearbook of Estonia 2000. Statistical Office of Estonia. Tallinn Book Printers Ltd, 2000. p 68, 186.
19. Statistical Yearbook of Estonia 2001. Statistical Office of Estonia. Tallinn Book Printers Ltd, 2001. p 66, 218.
20. Statistical Yearbook of Estonia 2002. Statistical Office of Estonia. Tallinn Book Printers Ltd, 2002. p 62, 218.
21. Statistical Yearbook of Estonia 2003. Statistical Office of Estonia. Ofset Ltd, 2003. p 58, 210.
22. Statistical Yearbook of Estonia 2004. Statistical Office of Estonia. Ofset Ltd, 2004. p 64, 214.
23. Lepane, L. Food habits and buying preferences of Estonians. Estonian Institute of Economic Research, 2004. (in Estonian)
24. Social Problem Areas in Estonian Society. Estonian Human Development Report, UNDP 2004.
25. Kalnin, V. The history of dietary assessment in Estonia (until XX century). *Toitumine ja Tervis*. University of Tartu, 1991, vol I, part I, p 56-59. (in Estonian)
26. Uibo, M. About Food Surveys in the Hygiene Department of the University of Tartu. *Toitumine ja Tervis.* University of Tartu, 1991, vol I, part II, p 85-87. (in Estonian)
27. Saava, M. Overview of the surveys of nutrition and metabolism in Estonian inhabitants in Experimental and Clinical Medicine Institute and Estonian Institute of Cardiology (in Estonian). *Toitumine ja Tervis.* University of Tartu, 1991, vol I, part II, p 3-5. (in Estonian)
28. Saava, A. Historical review. Department of Public Health, University of Tartu, 2003. Available: http://biomedicum.ut.ee/arth/english/history/, Dec 15, 2005.
29. Schneider, D. International trends in adolescent nutrition. – *Social Science and Medicine* 2000, vol. 51, p 955–967.
30. Saava, M. Nutrition of retired people. – *Toit ja Toitumine. Food and Nutrition* IV/Department of Food Processing. Tallinn: Tallinn University of Technology, 1998, p 42-51.
31. Møller, A. Danish food tables, The Danish Food Agency. Copenhagen: Gyldendahl, 1989 (in Danish).
32. Saava, M., Vokk, R., Deikina, J., Pilv, E. Comparison of Dietary Data Calculated by different Computerized Programs – *Toit ja Toitumine. Food*

and Nutrition VI/ Department of Food Processing. Tallinn: Tallinn University of Technology, 1998, p 52-58.
33. Knuts, L-R., Rastas, M., Seppänen, R., Haapala, P. Micro-Nutrica: version 2,0 Manual of Nutrition programme Micro-Nutrica. – *Toit ja Toitumine. Food and Nutrition* II/ Süvalep, I., Pitsi, T. Department of Food Processing. Tallinn: Tallinn University of Technology, 1996. 96 pp. (in Estonian)
34. Cameron, M.E., van Staveren, W.A. Manual on Methodology for Food Consumption Studies. Oxford University Press, 1988. p 33-52.
35. Saava, M. Methods in assessing food habits. Estonian Institute of Cardiology, Department of Nutrition and Metabolism Surveys. Tallinn, 1997. 48 pp. (in Estonian)
36. Serdula, M.K., Alexander, M.P., Scanlon, K.S., Bowman, B.A. What are pre-school children eating? A review of dietary assessment. – *Annual Review of Nutrition* 2001, vol. 21, issue 1, p 475–499.
37. Vokk, R., Boeing, H. Public Health aspects of nutritional science in Estonia: Status, research activities, and perspectives. - *Zeitschrift fürErnährungswissenschaft* 1998 Band 37, Nummer 3 September, 221-226.
38. Vokk, R., Liebert, T., Pappel, K., Pitsi, T., Lipre, E. School lunch in Estonia: dietary habits and food preferences of schoolschildren. – *Toit ja Toitumine. Food and Nutrition* X/Department of Food Processing. Tallinn: Tallinn University of Technology, 2002, p 78-92.
39. Liebert, T., Vokk, R., Lipre, E., Urho, U-M., Pappel, K. School lunches in Estonia and other countries. – *Toit ja Toitumine. Food and Nutrition* VII/Department of Food Processing. Tallinn: Tallinn University of Technology 1999, p 41-52.
40. Vokk, R., Liebert, T., Pitsi, T., Pappel, K. School Lunch Program. In: *The Health of Children and Youth – 10 years of the National Health Programme for Children and Youth.* National Institute for Health Development, 2005, p 28-30, 57. (in Estonian)
41. Lepik, L. Tuiksoo, E. School Milk Program conduces healthy eating among children. Ministry of Agriculture. Press release 1.06.2005. Available: http://www.agri.ee/index.php?item=14429&action=press&id=1693, Dec 20, 2005. (in Estonian)
42. Regulation on health protection requirements and nutrition in catering facilities in pre-school institutions and schools. Ministry of Social Affairs, Estonia, No. 93, 27.06.2002. RTL 30.07.2002; 84: 1298. (in Estonian)
43. The procedure for paying benefits of catering costs in pre-school children and municipal schoolchildren institutions in Tallinn and in Tallinn Music School. Ordinance of Tallinn City Council No.7 from March 4, 2004. (in Estonian)
44. Early Childhood Education and Care in Finland. Brochures of the Ministry of Social Affairs and Health. Helsinki, Finland, 2004:14.
45. Hasunen, K., Kalavainen, M., Keinonen, H., Langström, H., Lyytikäinen, A., Nurttila, A., Peltola, T., Talvia, S. Child, family, food. The

recommendations for breastfed and pre-school children, pregnant and lactating woman.– *Sosiaali- ja terveysministeriön julkaisua* 2004, vol. 11, p 150-154, 232. (in Finnish)
46. Sweden. In: *Starting Strong: Early Childhood Education and Care*. OECD, 2001. p 176-178.
47. Guidelines for childcare menus. Livsmedelverket, Department of information and nutrition. 2002
Available: http://www.slv.se/templates/SLV_Page.aspx?id=2486, Dec 15, 2005. (in Swedish)
48. Sepp, H. Pre-school Children's Food Habits and Meal Situation - Factors Influencing the Dietary Intake at Pre-school in a Swedish Municipality. Acta Universitatis Upsaliensis. – *Comprehensive Summaries of Uppsala Dissertations from the Faculty of Social Sciences* 114, Uppsala, 2002. 64 pp. (in Swedish)
49. Directorate for Health and Social affairs. Food and mealtimes in childcare institutions. Oslo, 2005.
Available:http://www.shdir.no/vp/multimedia/archive/00005/IS-1324_5639a.pdf Dec 10, 2005. (in Norwegian)
50. Childcare options. Ministry of Science Technology and Innovation, Denmark. Available: http://www.workindenmark.dk/Childcare_options/0/4/0, Dec 5, 2005.
51. Nutrition Guidelines for the Under Fives. Guidelines for managers of under fives facilities, catering staff and others involved in feeding young children in education and social work services, day care, residential care and hospitals. NHS Tayside, Health Promotion Department, UK, 2001. 40 pp.
52. Nicklas, T.A., Baranowski, T., Baranowski, J.C., Cullen, K., Rittenberry, L., Olvera, N. Family and child-care provider influences on preschool children's fruit, juice, and vegetable consumption – *Nutrition Reviews* 2001, vol. 59, no. 7, p 224-235.
53. Building Blocks for Fun and Healthy Meals. A Menu Planner for the Child and Adult Care Food Program. United States Department of Agriculture, Food and Nutrition Service FNS-305, 2000, p 16, 21.
54. Special Milk Program. Unites States Department of Agriculture. Food and Nutrition Service. Available: http://www.fns.usda.gov/cnd/Milk/AboutMilk/about.htm, Nov 25, 2005.
55. Position of The American Dietetic Association: Nutrition standards for child-care programs. – *Journal of the American Dietetic Association* 1999, vol. 99, p 981-988.
56. Childcare Nutrition. Victorian Government Health Information. State Government of Victoria, Australia, Department of Human Services. Available: http://www.health.vic.gov.au/nutrition/child_nutrition/childcare.htm, Nov 15, 2005.

57. Pe´rez-Rodrigo, C., Aranceta, J. Nutrition education in schools: experiences and challenges. – *European Journal of Clinical Nutrition* 2003, vol. 57, no. 1, p S82–S85.
58. Birch, L.L. Effects of Peer Models' Food Choices and Eating Behaviors on Preschoolers' Food Preferences. – *Child Development* 1980, vol. 51, issue 2, p 489-496.
59. Stanner, S. Facts behind the headlines. Improving nursery menus without parent protests. –*Nutrition Bulletin* 2004, vol. 29, issue 1, p 6-7.
60. Von Post-Skagegård, M., Samuelson, G., Karlström, B., Mohsen, R., Berglund, L., Bratteby, L-E. Changes in food habits in healthy Swedish adolescents during the transition from adolescence to adulthood. – *European Journal of Clinical Nutrition* 2002, vol. 56, p 532–538.
61. Nordic Nutrition Recommendations, NNR, 2004 – Integrating nutrition and physical activity. 4th edition Nord 2004:13, Nordic Council of Ministers, Copenhagen. 436 pp.
62. Background material to the Action Plan for Healthy Dietary Habits and Increased Physical Activity. Livsmedelverket. National Institute of Public Health. Uppsala and Stockholm, July 2005. 186 pp.
63. Nelson, M., Bradbury, J., Poulter, J. School Meals in Secondary Schools in England. Food Standards Agency. Department for Education and Skills. Research Report RR557. King's College London 2004. 75 pp.
64. Wardley, B.L., Puntis, J.W.L., Taitz, L. Healthy eating to prevent adult disease. In: T*he Handbook of Child Nutrition*. (Eds. Wardley, B.L., Puntis, J.W.L., Taitz, L.S). Oxford University Press/Books, 1997, p 88-112.
65. Pitsi, T., Ilves Annunziata, A-R. Dietary surveys of children – brief overview of the related methods, analysis software, institutions under survey and resulting recommendations. – *Toit ja Toitumine. Food and Nutrition* XIII/Department of Food Processing. Tallinn: Tallinn University of Technology, 2005, p 12-15.
66. Pitsi, T., Süvalep, I. Using Micro-Nutrica in healthy children food program. – *Diploma thesis, Tallinn University of Technology,* 1995. (in Estonian)
67. Pitsi, T. Balancing school lunch menus. – *MSc thesis, Tallinn University of Technology,* 1997. (in Estonian)
68. Nehhožina, T. Menu analysis of Kuti-Muti and Mereranna summer camps. *BSc thesis, Tallinn University of Technology,* 2000. (in Estonian)
69. Estonian Toddler health and Nutrition Survey. Handbook of used materials in the survey with recommendations. – Tufts University of Nutrition Science and Policy. Tallinn University of Technology, Department of Food Processing. University of Tartu, Centre of Physical Anthropology, 1997. 50 pp. (in Estonian)
70. Liivand, P. Child nutrition survey in Viljandi County during summer 2002. – *BSc thesis*, *Tallinn University of Technology*, 2003. (in Estonian)
71. Knuts, L.R., Rastas, M., Seppänen, R., Haapala, P. Micro-Nutrica Versio 2.0. List of Codes. Turku, 1993. 114 pp. (in Finnish)

72. Food Composition Tables. Energy and nutrients. Statens Livsmedelverk. Svenskt Tryck Stockholm, 1988. 398 pp. (in Swedish)
73. Food Composition Tables. Energy and nutrients. Statens Livsmedelverk. Norstedts tryckeri, 1993. 213 pp. (in Swedish)
74. Food Composition Tables. Fatty acids. Statens Livsmedelverk. Svenskt Tryck Stockholm, 1989. 125 pp. (in Swedish)
75. Eds. Nesterin, M.F., Skurihhin, I.M. Chemical composition tables of Food products 1 and 2. Pištševaja promõšlennost, Moscow, 1987. 360 and 225 pp. (in Russian)
76. USDA National Nutrient Database for Standard Reference. Nutrient Data Laboratory. Agricultural Research Service. Available: http://www.nal.usda.gov/fnic/foodcomp/search/ Dec 1, 2005.
77. Hakala, P., Knuts, L.R., Vuorinen, A., Hammar, N., Becker, W. Comparison of nutrient intake data calculated on the basis of two different databases. Results and experiences from a Swedish-Finnish study. – *European Journal of Clinical Nutrition* 2003, vol. 57, no. 9, p 1035-1044.
78. Knuts, L.R, Rastas, M., Seppänen, R., Haapala, P. Micro-Nutrica Versio 2.0. Käyttäjän Opas. Turku, 1993. 92 pp. (in Finnish)
79. Vaask, S., Pomerleau, J., Pudule, I., Grinberga, D., Abaravicius, A., Robertson, A., McKee, M. Comparison of the Micro-Nutrica Nutritional Analysis program and the Russian Food Composition Database using data from the Baltic Nutrition Surveys. – *European Journal of Clinical Nutrition* 2004, vol. 58, p 573-579.
80. Eds. Kuivjõgi, K., Liebert, T., Mitt, K., Saava, M., Teesalu, S. Estonian Nutrition Recommendations. Tallinn, 1995, 48 pp.
81. Nordic Nutrition Recommendations, 2nd Edition. PNUN (Standing Nordic Committee on Food). 1989. Oslo: Nordic Council of Ministers.
82. Vaask, S., Liebert ,T., Maser, M., Pappel, K., Pitsi, T., Saava, M., Sooba, E., Vihalemm, T., Villa, I. Estonian Nutrition and Food Recommendations. – Estonian Society of Nutritional Science, National Institute for Health Development, 2006. 117 pp. (in Estonian)
83. Eds. Maser, M., Pitsi, T., Sirel, M., Vaask, S. Reference Book for Healthy Eating. – Estonian Society of Nutritional Science, 2001. 36 pp. (in Estonian)
84. Wardley, B.L., Puntis, J.W.L., Taitz, L.S. The schoolchild and adolescent. In: *Handbook of Child Nutrition* (Eds. Wardley, B.L., Puntis, J.W.L., Taitz, L.S). Oxford University Press/Books, 1997, p 73-87.
85. Pitsi, T., Vokk, R. Kindergarten nutrition surveys 1995-1996. – *Toit ja Toitumine. Food and Nutrition* VII/Department of Food Processing. Tallinn: Tallinn University of Technology 1999, p 24-40.
86. Pitsi, T., Liivand, P., Ilves Annunziata, A-R., Veldre, G., Minajeva, A. Analysis between kindergarten-aged children nutrition and nutrient intakes from kindergarten menu. – *Toit ja Toitumine. Food and Nutrition*

XI/Department of Food Processing. Tallinn: Tallinn University of Technology 2003, p 52-66. (in Estonian)
87. Eds. Rajasaar, I., Ilves Annunziata, A-R. Estonian Children and Families. Situation analysis. Tallinn: UNICEF, Allprint Ltd. 1994, p 93.
88. Vagane, E., Saava, M., Pauts, V., Preem, R., Toomsalu, L., Niit, M. Metabolism changes in ESSR in the background on unbalanced eating. Zakljutšitelnõi otšjot. Final Report, manuscript. Tallinn, 1980. 109 pp. (in Estonian)
89. Lahti-Koski, M. Ravitsemuskertomus 1998. *Kansanterveyslaitoksen julkaisuja* B2/1999. 83 pp. (in Finnish)
90. Dietary intake among 4-year old children. Survey of all over Norway UNGKOST-2000. Directorate for Health and Social affairs. Oslo, Printhouse 2002. 32 pp. (in Norwegian)
91. Rogers, I., Emmet, P. Fat content of the diet among *pre-school* children in Britain; relationship with food and nutrient intakes. – *European Journal of Clinical Nutrition* 2002, vol. 56, issue 3, p 252.
92. Buttriss, J. Survey of pre-school eating habits. – *Nutrition & Food Science* 1995, no 4, p 24–27.
93. Dennison, B.A., Rockwell, H.L., Baker, S.L. Fruit and Vegetable Intake in Young Children. – *Journal of American College of Nutrition* 1998, vol. 17, no. 4, p 371-378.
94. Barquera, S., Rivera, J.A., Safdie, M., Flores, M., Campos-Nonato, I., Campirano, F. Energy and nutrient intake in preschool and school age Mexican children: National Nutrition Survey 1999. – *Salud Publica de Mexico* 2003, vol. 45, No. 4, p S540-S550.
95. Khetarpaul, M., Khetarpaul, N. Nutritional profile of Indian rural preschoolers. – *Nutrition & Food Science* 2005, vol. 35, No. 6, p 428-435.
96. Dehghan, M., Akhtar-Danesh, N., Merchant, A.T. Childhood obesity, prevalence and prevention – *Nutrition Journal* 2005, vol. 4, p 24-35.
97. Dietz, W.H. Health Consequences of Obesity in Youth: Childhood Predictors of Adult Disease. – *Pediatrics* 1998, vol. 101, No. 3, p 518-525.
98. Lilienberg, K. Anthropometrical indicators and their relationships with blood plasma lipids and arterial blood pressure on the basis of Tallinn schoolchildren surveys in 1984-86 and 1998-99. - *Master's thesis, Tallinn University of Technology,* 2002. (in Estonian)
99. Myers, S., Vargas, Z. Parental perceptions of the preschool obese child. – *Pediatric Nursing* 2000*,* vol. 26, No. 1, p 23-30.
100. Livingstone, M. Childhood obesity in Europe: a growing concern. – *Public Health Nutrition* 2001, vol. 4, No. 1a, p 109-116.
101. Cole, T.J., Bellizzii, M.C., Flegal, K.M., Dietz, W.H. Establishing a standard definition for child overweight and obesity worldwide: international survey. – *British Medical Journal* 2000, vol. 320(7244) p 1240-1243.

102. Grünberg, H., Adojaan, B., Thetloff, M. Growing and growth disorders. Methodical reference book for evaluating children physical development. Tartu: University of Tartu, 1998. 17 pp. (in Estonian)
103. Gibson, S. Hypothesis: Parents may selectively restrict sugar-containing foods for *pre-school* children with a high BMI. – *International Journal of Food Sciences & Nutrition* 1998, vol. 49, No 1, p 65-70.
104. Ogden, C.L., Flegal, K.M., Carroll, M.D., Johnson, C.L. Prevalence and Trends in Overweight among US Children and Adolescents, 1999-2000. – *Journal of American Medical Association* 2002, vol. 288, p 1728-1732.
105. Will, B., Zeeb, H., Baune, B.T. Overweight and obesity at school entry among migrant and German children: a cross-sectional study. – *BMC Public Health* 2005, vol. 5, No. 1, p 45.
106. Kalies, H., Lenz, J., von Kries, R. Prevalence of overweight and obesity and trends in body mass index in German pre-school children, 1982-1997. – *International Journal of Obesity and Related Metabolic Disorders* 2002, vol. 26, No. 9, p 1211-1217.
107. Müller, M.J, Koertzinger, I, Mast, M., Langnäse, K., Grund, A. Physical activity and diet in 5 to 7 years old children. – *Public Health Nutrition* 1999, vol. 2, No. 3a, p 443–444.
108. Romon, M., Duhamel, A., Collinet, N., Weill, J. Influence of social class on time trends in BMI distribution in 5-year-old French children from 1989 to 1999. – *International Journal of Obesity* 2005, vol. 29, no. 1, p 54-59.
109. Reilly, J.J., Dorosty, A.A., Emmett, P.M. Prevalence of overweight and obesity in British children: cohort study. – *British Medical Journal* 1999, vol. 319, p 1039.
110. Armstrong, J., Dorosty, A.R., Reilly, J.J. Child Health Information Team, Emmett P.M, Coexistence of social inequalities in undernutrition and obesity in preschool children: population based cross sectional study. – *Archives of Disease in Childhood* 2003, vol. 88, p 671-675.
111. You, Y., Chen, M., Zhai, Y., Yang, Z.X. Three years follow-up study on the changes of overweight and obesity among 862 pre-school children in Beijing city. – *Wei Sheng Yan Jiu* 2005, vol. 34, No. 5, p 620-621.
112. Harro, M., Villa, I., Liiv, K., Aru, J., Alep, J. Nutrition-related health indicators and their major determinants in the new member states: case of Estonia. – *Journal of Public Health* 2005, vol. 13, p 111–119.
113. Mulvihill, C., Németh, A., Vereecken, C. Body image, weight control and body weight. In: *Young people's health in context. Health Behaviour in School-aged Children (HBSC) study: international report from the 2001/2002 survey* (Eds. C. Currie, C. Roberts, A. Morgan, R. Smith, W. Settertobulte, O. Samdal, V.B. Rasmussen). WHO, Health Policy for Children and Adolescents 2004, No. 4. p 120-129.
114. Lilienberg, K., Saava, M. The correlation of anthropometric characteristics of Tallinn schoolchildren with blood plasma lipids and arterial blood pressure (1998-1999). *Papers on anthropology* 2000./*Eesti*

Antropomeetria Aastaraamat 2000, Tartu: University of Tartu, 2000, p 49-55.
115. Rannamäe, R., Tamm, L. Health of Tallinn schoolchildren. In: *Book of presentations from the 48th and 49th Conference of Estonian Society of Health Protection* (Eds. Lutsoja, H., Tamm., L.). Estonian Society of Health Protection, 2004. (in Estonian)
116. Harro, M. The health of Estonian schoolchildren and its dependence of the socio-economic conditions of their families. – *Eesti arst* 2002, vol. 4, p 216-221. (in Estonian)
117. Abramovitz, B.A., Birch, L.L. Five-year-old girls' ideas about dieting are predicted by their mothers' dieting. – *Journal of American Dietetic Association* 2000, vol. 100, p 1157-1163.
118. Collins, M.E. Body Figure Perceptions and Preferences among Preadolescent Children. – *International Journal of Eating Disorders*, vol. 10, issue 2, p 199-208.
119. Mathews, R. Importance of breakfast to cognitive performance and health. – *Perspectives in Applied Nutrition* 1996, vol. 3, p 204–212.
120. Pollitt, E,, Mathews, R. Breakfast and cognition: an integrative summary. – *American Journal of Clinical Nutrition* 1998, vol. 67, p 804S–813S.
121. Ruxton, C.H., Kirk, T.R. Breakfast: a review of associations with measures of dietary intake, physiology and biochemistry. – *British Journal of Nutrition* 1997, vol. 78, p 199–213.
122. Siega-Riz, A.M., Carson, T., Popkin, B. Three squares or mostly snacks – What do teens really eat? A sociodemographic study of meal patterns. – *Journal of Adolescent Health* 1998, vol. 22, p 29–36.
123. Preziosi, P., Galan, P., Deheeger, M., Yacoub, N., Drewnowski, A., Hercberg, S. Breakfast Type, Daily Nutrient Intakes and Vitamin and Mineral Status of French Children, Adolescents and Adults. – *Journal of the American College of Nutrition* 1999, vol. 18, p 171-178.
124. Ortega, R.M., Requejo, A.M., López-Sobaler, A.M., Andrés, P., Quintas, E., Navia, B., Izquierdo, M., Rivas, T. The Importance of Breakfast in Meeting Daily Recommended Calcium Intake in a Group of Schoolchildren. – *Journal of the American College of Nutrition* 1998, vol. 17, No. 1, p 19-24.
125. Lyytikäinen, A. Trends in Finnish children dietary habits. Sweets and soft drinks are becoming more common during the schoolday. Research Centre for Health Promotion, University of Jyväskylä. Conference of Children and Adolescence dietary habits in Nordic Countries, November 25, 2003. 2 pp. (in Swedish)
126. Ladva, R., Harro, M. Dietary habits among 9- and 15-year old schoolchildren. – *Eesti Arst* 2000, vol. 9, p 545-546. (in Estonian)
127. Saava, M. Nutrition – important risk factor of cardiovascular diseases in changing socio-economical conditions. Final report of the Public Health

Project No 88-9 accomplished during Public Health program in the Ministry of Social Affairs. Estonian Institute of Cardiology, 2002, 78 pp (in Estonian)

128. Bergström, E., Hernell, O., Persson, L.A. Dietary changes in Swedish adolescents. – *Acta Paediatric* 1993, vol. 82, No. 5, p 472-480.

129. Lilienberg, K., Saava, M. Trends in the dietary habits of families of schoolchildren in Tallinn over a 10-year period (1988-89 and 1998-99). – *Toit ja Toitumine. Food and Nutrition* IX/Department of Food Processing. Tallinn: Tallinn University of Technology 2001, p 33-40.

130. Koletzko, B., Dokoupil, K., Reitmayr, S., Weimert-Harendza, B., Keller, E. Dietary fat intakes in infants and primary school children in Germany. – *American Journal of Clinical Nutrition* 2000, vol. 72, No. 5, 1392S-1398s.

131. Moreno, L.A., Sarría, A., Lázaro, A., Bueno, M. Dietary fat intake and body mass index in Spanish children. – *American Journal of Clinical Nutrition* 2000, vol. 72, No. 5, p 1399S-1403s.

132. Davies, P.S.W. Diet composition and body mass index in pre-school children. – *European Journal of Clinical Nutrition* 1997, vol. 51, issue 7, p 443-448.

133. Troiano, R.P., Briefel, R.R., Carroll, M.D., Bialostosky, K. Energy and fat intakes of children and adolescents in the United States: data from the National Health and Nutrition Examination Surveys. – *American Journal of Clinical Nutrition* 2000, vol. 72, no. 5, p 1343S-1353s.

134. Roma-Giannikou, E., Adamidis, D., Gianniou, M., Nikolara, R., Matsaniotis, N. Nutritional survey in Greek children: nutrient intake. – *European Journal of Clinical Nutrition* 1997, vol. 51, p 273-285.

135. Hernändez, M., Montalvo, I., Sousa, V., Sotelo, A. The Protein Efficiency Ratios of 30:70 Mixtures of Animal:Vegetable Protein Are Similar or Higher than Those of the Animal foods Alone. – *Journal of Nutrition* Bethesda 1996, vol. 126, issue 2, p 574.

136. Villa, I., Alep, J., Harro, M. Nutrition of Estonian schoolchildren over the last 15 years. – *Eesti Arst* 2002, vol. 81, No. 1, p 9-18. (in Estonian)

137. Saava, M., Niit, M., Pauts, V., Toomsalu, L., Tšaiko, L., Sink R. The supplement of Estonian children with vitamins and prophylactic vitaminizing. *Toitumine ja Tervis.* University of Tartu, 1991, vol I, part II, p 6-9. (in Estonian)

138. Männik, L. Menu calculations in Estonian kindergartens. *Toitumine ja Tervis*. University of Tartu, 1991, vol I, part I, p 101-103. (in Russian)

139. Mitšenkov, V., Sergejeva Ž, Nadolinski S, Petrušihina L. The content of copper, manganese, zinc and iron in pre-school institutions menus in Estonia. *Toitumine ja Tervis.* University of Tartu, 1991, vol I, part I, p 98-100. (in Russian)

140. Kepler, K., Maser, M., Kasmel, K., Tasa, E. Estonian school-aged children's health, health behaviour and social environment in changing society 1991-1998. Estonian Centre of Health Education, 1999, 56 pp. (in Estonian)

141. Riivits-Arkonsuo, I. Awareness of Healthy Eating among Estonian Population. The Estonian Society of Nutritional Science, Turu-uuringute AS, Tallinn 2005. 12 pp.
142. Chemical Composition Tables. – *Toit ja Toitumine III. Food and Nutrition* IV/Department of Food Processing. Tallinn: Tallinn University of Technology 1997, 86 pp. (in Estonian)
143. Liebert, T., Pitsi, T., Vokk, R. Analyses of school lunch menus. – *Toit ja Toitumine. Food and Nutrition* X/Department of Food Processing. Tallinn: Tallinn University of Technology 2002, p 93-104.
144. Dresbach, S.H., Rossi, A. Phytochemicals – Vitamins of the Future? Ohio State University Extension Fact Sheet. Available: http://ohioline.osu.edu/hyg-fact/5000/5050.html, 5 Dec, 2005.
145. Silla, R., Teoste, M. The health of Estonian Youth. Tallinn: Valgus 1989, p 129. (in Estonian)
146. Watt, R.G., Dykes, J., Sheiham, A. Drink consumption in British preschool children: relation to vitamin C, iron and calcium intakes. – *Journal of Human Nutrition and Dietetics* 2000, vol. 13, issue 1, p 13-19.
147. Hampl, J.S., Taylor, C.A., Johnston, C.S. Intakes of Vitamin C, Vegetables and Fruits: Which Schoolchildren Are at Risk? – *Journal of the American College of Nutrition* 1999, vol. 18, No. 6, p 582-590.
148. Subar, A.F., Krebs-Smith, S.M. Dietary Sources of Nutrients Among US Children, 1989-1991. *Pediatrics* 1998, Part 1 of 2, vol. 102, issue 4, p 913.
149. Fagt, S., Matthiessen, J., Trolle, E., Lyhne, N., Christensen, T., Hinsch, H-J., Hartkopp, H., Biltoft-Jensen, A., Møller, A., Daae, A-S. The dietary habits of Danes 2000-2001. Developments in Danish diet – consumption, purchasing and habits. Danish Veterinary and Food Administration. Available: http://www.foedevarestyrelsen.dk/FDir/Publications/2002010/Rapport.pdf, Dec 20, 2005. (in Danish)
150. Saava, M. Dietary fiber intake of the Estonian population. – *Toit ja Toitumine. Food and Nutrition* IV/Department of Food Processing. Tallinn: Tallinn University of Technology 1997, p 27-37.
151. Saava, M., Pauts, V., Tšaiko, L., Sink, R. Dietary factors and main risk factors for atherosclerosis at a school age. – *Eesti Arst* 1995, vol. 4, p 319–325. (in Estonian)
152. Stables, G., Goodman, S.L., Meyer, S.M., Disogra, L., Farrell, M., Miller, M., Reeve, L., Lemaire, R., Berendson, K., Lazarek, P., Nagy, A., Slagmoolen, M., Dudley, P., Aarum, O.A., Annerstedt-Heino, K. International 5 A Day Programs: A Smorgasbord in 5 A Day for Better Health Program. In: *5 a Day for Better Health Program.* (Eds. Stables, G. et al). National Institutes of Health. National Cancer Institute, 2000. p 169-189.
153. Health Behaviour among Estonian Adult Population in 2004. National Institute for Health Development. Tallinn, 2005. p 56.

154. Krebs-Smith, S.M., Cook, A., Subar, A.F., Cleveland, L., Friday, J., Kahle, L.L. Fruit and vegetable intakes of children and adolescents in the United States. - *Archives of Pediatrics & Adolescent Medicine* 1996, vol. 150, No. 1, p. 81-86.
155. Fisher, J.O., Mitchell, D.C., Smiciklas-Wright, H., Lipps, L. Parental influences on young girls' fruit and vegetable, micronutrient, and fat intakes. – *Journal of American Dietetic Association* 2002, vol. 102, p 58-64.
156. Skinnars Josefson, M. Food, activity and body. A descriptive study of schoolchildren's habits in fifth, seventh and tenth grade. Karolinska Institute. Institute of Environmental Medicin. The Unit of Cardiovascular Epidemiology, 2003. 27 pp. (in Swedish)
157. Cooke, L.J., Wardle, J., Gibson, E.L, Sapochnik, M., Sheiham, A., Lawson, M. Demographic, familial and trait predictors of fruit and vegetable consumption by pre-school children. – *Public Health Nutrition* 2004, vol. 7, No. 2, p 295–302.
158. Nordin, B.E.C. Calcium in health and disease. University of Adelaide. *Food, Nutrition and Agriculture* 1997, No. 20, p 13-26.
159. McCarthy, J.T., Kumar, R. Divalent Cation Metabolism: Calcium. In: *Atlas of Diseases of the Kidney, Volume 1* (Ed. Schrier, R.W.), p 5.1-5.14.
160. Consensus Development Conference Statement. Optimal Calcium Intake. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health, 1994 vol 12, no 4, p 1–31.
161. Bone health and osteoporosis: a report of the Surgeon General. - Rockville, MD.: U.S. Dept. of Health and Human Services, Public Health Service, Office of the Surgeon General; Washington, 2004, p 110-156.
162. Human Vitamin and Mineral Requirements. Report of a joint FAO/WHO expert consultation Bangkok, Thailand. Food and Nutrition Division, FAO. Rome, 2002, p 170-460.
163. Sandler, R.B., Slemenda, C.W., LaPorte, R.E., Cauley, J.A., Schramm, M.M., Barresi, M.L., Kriska, A.M. Postmenopausal bone density and milk consumption in childhood and adolescence. – *American Journal of Clinical Nutrition* 1985, vol 42, p 270-274.
164. Anderson, J.J.B. Calcium Requirements during Adolescence to Maximize Bone Health. – *Journal of the American College of Nutrition* 2001, vol. 20, No. 2, p 186S-191S.
165. Matkovic, V., Heaney, R.P. Calcium balance during human growth: evidence for threshold behavior. – *American Journal of Clinical Nutrition* 2001, vol. 55, p 992.
166. Bailey, D.A., Martin, A.D, McKay, H.A., Whiting, S., Mirwald, R. Calcium accretion in girls and boys during puberty: a longitudinal analysis. – *Journal of Bone and Mineral Research* 2000, vol. 15, p 2245.
167. Ilich, J.Z., Kerstetter, J.E. Nutrition in Bone Health Revisited: A Story beyond Calcium. – *Journal of the American College of Nutrition* 2000, vol. 19, p 715-737.

168. Bryant, R.J., Cadogan, J., Weaver, C.M. The New Dietary Reference Intakes for Calcium: Implications for Osteoporosis. – *Journal of the American College of Nutrition* 1999, vol. 18, p 406S-412S.
169. Mason, P. Calcium – an Update. – *The Pharmaceutical Journal* 2002, vol. 268, p 329-330.
170. American Academy of Pediatrics. Calcium Requirements of Infants, Children, and Adolescents (RE9904). – *Pediatrics* 1999, vol 104, No 5, p 1152-1157.
171. Johnston, C.C., Miller, J.Z., Slemenda, C.W., Reister, T.K., Hui, T.K., Christian, J.C., Peacock, M. Calcium supplementation and increases in bone mineral density in children. – *The New England Journal of Medicine* 1992, vol. 327, p 82.
172. Policy Statement. American Academy of Pediatrics. Calcium Requirements of Infants, Children, and Adolescents (RE9904). – *Pediatrics* 1999, vol. 104, No. 5, p 1152-1157.
173. Davies, P.S.W., Bates, C.J., Cole, T.J., Prentice1, A., Clarke, P.C. Vitamin D: seasonal and regional differences in preschool children in Great Britain. – *European Journal of Clinical Nutrition* 1999, vol. 53, p 195-198.
174. Miller, G.D., Jarvis, J.K., McBean, L.D. The Importance of Meeting Calcium Needs with Foods. – *Journal of the American College of Nutrition* 2001, vol. 20, No. 2, p 168S-185S.
175. Nitzan Kaluski, D., Basch, C.E., Zybert, P., Deckelbaum, R.J., Shea, S. Calcium intake in preschool children – a study of dietary patterns in a low socioeconomic community. – *Public Health Reviews* 2001, vol. 29, No. 1, p. 71-83.
176. Briefel, R.R. Secular trends in dietary intake in the United States. – *Annual Review of Nutrition* 2004, vol. 24, p 401–431.
177. Marshall, T.A., Eichenberger Gilmore, J.M., Broffitt, B., Stumbo, P.J., Levy, S.M. Diet Quality in Young Children Is Influenced by Beverage Consumption. – *Journal of the American College of Nutrition* 2005, vol. 24, No. 1, p 65-75.
178. Cavadini, C., Siega-Riz, A.M., Popkin, B.M. U. S. Adolescent food intake trends from 1965 to 1996. – *Archives of Disease in Childhood* 2000, vol. 83, p 18.
179. Wyshak, G., Frisch, R.E. Carbonated beverages, dietary calcium, the dietary calcium/phosphorus ratio, and bone fractures in girls and boys. – *Journal of Adolescent Health* 1994, vol. 15, No. 3, p 210-215.
180. Walker, A. UK National diet and nutrition survey: young people aged 4-18 years, Vol. 2 - Report of the oral health survey. Department of Health, 2000. 292 pp.
181. Bruening, K.S., Gilbride, J.A., Passannante, M.R., McClowry, S. Dietary intake and health outcomes among young children attending 2 urban day-care centers. – *Journal of the American Dietetic Association* 1999, vol. 99, No. 12, p 1529-1535.

182. Barr, S.I. Associations of social and demographic variables with calcium intakes of high school students. – *Journal of the American Dietetic Association* 1994, vol. 94, p 260.
183. Alexy, U., Kersting, M. Time trends in the consumption of dairy foods in German children and adolescents. – *European Journal of Clinical Nutrition* 2003, vol. 57, No. 10, p 1331-1337.
184. Barr, S.I., McCarron, D.A., Heaney, R.P., Dawson-Hughes, B., Berga, S.L., Stern, J.S., Oparil, S. Effects of increased consumption of fluid milk on energy and nutrient intake, body weight, and cardiovascular risk factors in healthy older adults. – *Journal of the American Dietetic Associtíon* 2000, vol. 100, p 810.
185. Highlights on Health in Estonia. WHO Regional Office for Europe. European Communities and World Health Organization, 2002, p 26.
186. Lamberg-Allardt, C., Kärkkäinen, M., Uotila, T., Natri, A-M. Sprucing up Finnish Situation about Vitamin D – from sun, food or pills? (Suomalaisten D-vitamiinitilanteen kohentaminen - auringosta, ruoasta vai purkista?) – *Suomen lääkärilehti* 2003, vol. 58, No. 9, p 1055-1056.
187. Beard, J.L., Connor, J. Iron status and neural functioning. - *Annual Review of Nutrition* 2003, vol. 23, p 41-58.
188. Harris, R.J. Nutrition in the 21st century: what is going wrong. – *Archives of Disease in Childhood* 2004, vol. 89, No. 2, p 154-158.
189. Tapiero, H., Gaté, L., Tew, K.D. Iron: deficiencies and requirements. - *Biomedical Pharmacother* 2001, vol. 55, p 324-332.
190. Theil, E.C. Iron, ferritin, and nutrition. – *Annual Review of Nutrition* 2004, vol. 24, p 327–343.
191. Gibson, S.A. Iron intake and iron status of preschool children: associations with breakfast cereals, vitamin C and meat. - *Public Health Nutrition* 1999, vol. 2, no. 4, p 521-528.
192. Wells, A. Drinks for young children: the dental and nutritional benefits of milk. **–** *Nutrition & Food Science* 2000, vol. 30, Issue 2, p 270-283.
193. Ames, S.K. Effects of high compared with low calcium intake on calcium absorption and incorporation of iron by red blood cells in small children. – *American Journal of Clinical Nutrition* 1999, vol. 70, p 44-48.
194. Gibson, S.A. Iron intake and iron status of preschool children: associations with breakfast cereals, vitamin C and meat. – *Public Health Nutrition* 1999, vol. 2, No. 4, p 521-528.
195. Heino, T., Kallio, K., Jokinen, E., Lagström, H., Seppänen, R., Välimäki, I., Viikari, J., Rönnemaa, T., Simell, O. Sodium intake of 1 to 5-year-old children: the STRIP Project. – *Acta Paediatrica* 2000, vol. 89, issue 4, p 406-410.
196. Antonios, T.F. Salt intake in early life and cardiovascular risk. – *Acta Paedrica* 2000, vol. 89, issue 4, p 397-398.
197. Ed. Meronen, K. Too much salt in school and kindergarten food. Finfood. (in Finnish) Available:

http://www.finfood.fi/finfood/finnfoo1.nsf/9b7b469a6c690df7c2256473003cddc1/80449c843029c3e5c22564a40034312c!OpenDocument&Highlight=0,p%C3%A4iv%C3%A4kodissa, Dec 4, 2005.

198. Ed. Lahti-Koski, M. Nutrition in Finland. National Public Health Institute 1999, 32 pp.

199. Campaign of fruits and vegetables. National Institute for Health Development. Available: http://www.tai.ee/?id=2703, Dec 22, 2005.

200. National Strategy Action Plan 2006 for Prevention of Cardiovascular Diseases. National Institute for Health Development, 2005. (in Estonian)

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to all who have supported in different ways me and have made the completion of this thesis possible. My special thanks, however, are due to:

My supervisor, Prof. Raivo Vokk, Head of the Department of Food Processing, who first directed me to the analysis of children dietary surveys, for offering me the opportunity to conduct my research and for his valuable time spent guiding me.

My supervisor, Anne-Reet Ilves Annunziata (PhD, RD) from J.Gerald and R.Dorothy Friedman School of Nutrition Science and Policy, Tufts University, USA, who first introduced me to dietary assessment methods and with whom my co-work began in 1996. Without her no ETHNS or ECHNS would have ever taken place and her expertise and guidance were fundamental.

Prof. Andres Öpik, the Dean of the Faculty of Chemical and Materials Technology of Tallinn University of Technology, for providing me the opportunity to perform my studies in the Department of Food Processing, Tallinn University of Technology.

All my colleges at the Department of Food Processing of Tallinn University of Technology, for their enthusiasm, valuable advice and all the support they have given to me. Special thanks to Tiiu Liebert, Riina Täht, Erge Tedersoo, Katrin Laos and other PhD and bachelor degree students at the department for their advice, help and valuable opinions. Also, many thanks to all the bachelor students who gathered and analyzed some of the kindergarten menus.

The teams in ETHNS and ECHNS, starting again with Anne-Reet Ilves Annunziata, but also to Ide Süvalep, Liie Viin, Jaana Vainu and Piret Liivand, who were the other interviewers in these surveys; and Gudrun Veldre from the University of Tartu for performing all the anthropometrical work and her advice in this field. Also, sincere thanks to all the children and their parents for taking part in these surveys.

Merileid Saava, who had carried out so many dietary surveys in Estonia before me and who kindly provided me with all the material she had. For providing additional materials of dietary surveys I am also grateful to Sirje Vaask and Inga Villa.

Ebu Tamm from the Institute of Mathematics is thanked for the help with statistical analysis.

Special thanks are due to my family for supporting me all through the years. My husband Olle for being so understanding, who endured all the bellyful of unwashed dishes and continuous eating of canned food during writing this thesis. My children Sarah, Emil, Nils and Jens for helping and “helping” me in every possible and impossible way. My mother, father, sisters, mother-in-law and sister's daughters for babysitting; and Laidi and Iris for improving my writing skills in English. Also, I would like to thank Christina for giving me the opportunity to deal with something for my sole; my singing choir conductors and companions who made me forget about this thesis for at least some hours a week; and all my friends for cheering me up at difficult times. Although these activities probably lengthened the time spent on writing the thesis, they also gave me strength and without these the thesis might not have been written at all.

Thank you all!

ETHNS was supported by UNICEF and ECHNS by Earthwatch Institute. Both surveys were carried out in the Children Hospital of Tallinn Central Hospital and rural health clinics in Paistu, Tarvastu and Kärstna.

KOKKUVÕTE

Lasteaiaealiste laste tervislik toitumine ei ole oluline mitte üksnes sellepärast, et varustada neid kasvuks ja aktiivseks tegevuseks vajaliku hulga energia ning toitainetega, vaid ka seetõttu, et paljud haigused hilisemas elus saavad alguse lapsepõlves ning ka lapseeas omandatud toitumisharjumused jäävad püsima kogu eluks ja nende hilisem muutmine võib osutuda väga keeruliseks.

Et saada kätte kõik vajalikud toitained, peab laste toit olema mitmekesine, vahelduv ja tasakaalustatud. Laste energia- ja toitainevajadus sõltub nii vanusest, soost, kehamassist, kasvamise kiirusest kui ka aktiivsuse tasemest. Võrreldes täiskasvanutega, peab nende toit olema palju toitainetihedam, et saada kätte kõik vajalikud toitained väiksema toid- ja energiakoguse tarbimise juures. Seega on soovitav, et lapsed tarbiksid võimalikult vähe suure energiasisaldusega, kuid vähese toitainesisaldusega toite nagu karastusjoogid ja kommid. Et saada kätte vajalikud vitamiinid ja mineraalained, peaksid lapsed iga päev sööma piisavalt puu- ja köögivilju, piimatooteid, teraviljatooteid. Tähelepanu tuleb pöörata ka kala, liha ja toiduõlide piisavale tarbimisele.

Käesoleva doktoritöö eesmärk oli analüüsida lasteaedade menüüsid Eestis ajavahemikul 1995 kuni 2004, võrrelda neid soovitustega ning vaadata, kas võimalikud puudujäägid lasteaia menüüst saavad kompenseeritud toiduga, mida lapsed saavad kodudes. Käesolevas töös on analüüsitud 58 lasteaia menüü tulemusi (kokku 894 päeva), mida on võrreldud kahe suure laste toitumisuuringuga, mis toimusid aastatel 1996 ja 2002 Tallinnas ja Viljandi maakonnas.

Kuna alates 1995 aastast on toimunud toitumissoovitustes mitmeid muudatusi, siis käesolevas töös on aluseks lasteasutustele kehtiv määrus aastast 2002, kuid kuna uuemad toitumissoovitused erinevad nii mõneski osas nendest soovitustest, siis on paralleelselt võrreldud tulemusi ka nendega.

Lasteaedade menüüde analüüs ei anna tegelikku ülevaadet, mida lapsed söövad, sest on palju lapsi, kes ei söö alati kõike pakutut ära. Küll aga annab see ülevaate maksimaalsest võimalikust toidust, mida laps saab lasteaias. Kui juba seal ilmnevad puudujäägid, on laste poolt söödud tegelik toit veelgi kesisem.

Lasteaedade menüüde analüüsist selgus, et toiduga saadav energiakogus oli enamikes lasteaedades üle soovitava. Samas näitasid laste individuaalse toitumise uuringud, et lapsed tarbivad energiat soovitustele vastavalt või isegi alla selle. Seega leiab tõestust fakt, et lapsed ei jõua reeglina kõike pakutut lasteaias ära süüa. Energia jaotumine toidukordadele lasteaia menüüdes ei vastanud kehtivatele soovitustele, kuid olles tutvunud lasteaia töötajate ja vanemate arvamusega, sai hoopis tehtud ettepanek soovituste muutmiseks. Ettepanek sisaldas võimalust lasteaial endal valida, kas ta soovib jätkata vanade soovitustega või muuta hommikusöök hommikueineks ning õhtueine õhtusöögiks.

Vaadates lasteaedade toidu kvaliteeti, siis võib öelda, et energia saamine põhitoitainetest oli kehtivate soovituste järgi enam-vähem tasakaalus, kuid võttes aluseks uuemad soovitused, siis oli rasva osakaal paljude menüüde puhul soovitavast suurem. Soovitavast suurem oli rasvade osatähtsus kogu toiduenergiast ka laste individuaalsetes uuringutes. Eriti tuleb tähelepanu pöörata küllastunud rasvhapete osatähtsuse vähendamisele, sest see ei näidanud vaadeldud aastate jooksul mingeid vähenemise märke. Kolesterooli ületarbimise probleemi lastel ei esinenud, samuti oli kaetud enamikel juhtudel laste kiudainetevajadus.

Vitamiinidest esinesid suurimad puudujäägid vitamiinide D ja C osas. Kuna liiga madal vitamiin D tarbimine on probleemiks kogu Eesti elanikkonnal, siis peaks kaaluma võimalust, et piimatoodete tootjad hakkaksid Soome eeskujul oma tooteid selle vitamiiniga rikastama. Kaltsiumi defitsiiti lasteaia menüüdes ei esinenud, küll aga võivad kaltsiumi imendumist pärssida liiga väikesed vitamiin D kogused toidus. Kogu päeva laste toidu-uuringud seevastu näitasid, et kalstiumi nõuetekohase saamisega oli probleeme liiga paljudel lastel. Seega peaksid vanemad pöörama enam tähelepanu piima ja piimatoodete tarbimisele lastel. Raua defitsiiti lasteiaia menüüdes ei esinenud, samas esines uuritud laste hulgas aneemiat või viiteid selle võimalikule tekkele. Seletuseks on nii liig vähene vitamiin C tarbmine, mis aitaks kaasa raua imendumisele kui ka see, et suurem osa saadud rauast pärines halva imendumisega allikatest. Liiga suur oli naatriumi saamine nii lasteaia kui ka laste kogu päeva menüüdest.

Kõik uuritud lasteaiad ning lapsed said tagasiside puudujääkidest ning soovitused nende kõrvaldamiseks.

APPENDIX 1

ARTICLE I

Ilves Annunziata, A-R., Veldre, G., Saluste, L., Pitsi, T., Süvalep, I., Viin, L., Vainu, J. Results of the Estonian Toddler Health and Nutrition Survey: I. nutrition status and family socio-demographics – *Eesti Arst* 2000, vol. 3, p 142-144, 146, 147.

Article in Estonian, translation added

Reproduced with the kind permission from *Estonian Physician*

APPENDIX 1

ARTICLE II

Ilves Annunziata, A-R., Veldre, G., Saluste, L., Pitsi, T., Süvalep, I., Viin, L., Vainu, J. Results of the Estonian Toddler Health and Nutrition Survey: II health indicators and growth status. – *Eesti Arst* 2000, vol. 79(7), p 389-396, 398, 399.

Article in Estonian, translation added

Reproduced with the kind permission from *Estonian Physician*

Results of the Estonian Toddler Health and Nutrition Survey: II health indicators and growth status – translation

Anne-Reet Ilves Annunziata – Tufts University (Boston, USA)
Gudrun Veldre, Liidia Saluste – Centre of Physical anthropometry, University of Tartu
Tagli Pitsi, Ide Süvalep, Liie Viin, Jaana Vainu – Department of Food Processing, Tallinn University of Technology
Key words: Pre-schooler, nutrition, health, anaemia, physical development

This article is a continuation to the survey published in Estonian Physician March issue (1), covering a comparison of nutrition and bread groups between the Viljandi County and Tallinn pre-schoolers. This part deals with the same group, its anthropological measurements and blood test results, as well as other health indicators, based on the data of the previous article. The articles together give an overview of survey results about nutrition, physical development and health, excluding dental health, which is treated separately.

Materials and methods

This survey was carried out in May-June 1996 simultaneously in the Viljandi County (Paistu, Tarvastu, Suislepa, Kärstna amd Karksi-Nuia) and in the central part of Tallinn among Estonian families with 3-4-year-old children. The analysis included only data of one child of the family. The survey reflects health indicators and physical development of 262 children (150 from the Viljandi County and 112 from Tallinn). The centre of rural children was the Viljandi Hospital; the centre of urban children was the Children's Hospital of Tallinn Central Hospital.
During the survey, children were examined by a paediatrician and a dentist, they were measured anthropologically and an interview concerning nutrition was carried out, also a blood test was taken and a questionnaire about family's socio-economic situation was filled.

1. Anthropological indicators
Among the anthropological indicators, reflecting child's physical development, the following measurements were taken by standard method: child' height and weight, brachial perimeter (BP), and skinfold thickness (ST) in the part of brachial triceps. To measure skinfolds, the Lange caliper was used. By the brachial perimeter and triceps fold thickness, so-called adjusted brachial perimeter was calculated by the following formula:
Adjusted BP = $(BP – (\pi \times ST)^2) / 4\pi$

The size of a child is determined by several factors, among which child's weight at birth and ethnic belonging (nationality) were essential parameters. The result was that all children under five years have similar physical development indicators (height, weight), irrespective of their ethnic belonging and they are affected only by health and nutrition. Therefore, physical development indicators reflect also pre-schooler's health and nutrition (2). The difference of physical development can be expressed by z-score, which allows us to compare statistically other data (corresponding data of children of the same gender and age).

z-score = (parameter of surveyed child – median parameter of the children from a comparable group (NCHS)) / SD of the children from a comparable group (NCHS)

WHO recommended NCHS (National Centre for Health Statistics) data were used for comparison (2). The used indicators are height-for-age (HAZ-score), weight-for-age (WAZ-score) and weight-for-height (WHZ-score). WHO recommends to use the following criteria for evaluating dysplasia: physical development level over 2 SD – excessive, under 2SD – medium backwardness and under 3 SD – significant backwardness (2). As even slight malnourishment can negatively affect the immunity system and intellectual progress (3), attention must be paid even to slight backwardness in physical development (z-score – 1.00 – 1.99), in spite of the fact that according to WHO it is not outside the standard, as part of the children with normal physical development have their proportions below these limits (<-2.00-2.3%,<-1.00-16%).

2. Bloodtests

Capillary blood was used for analysis by the request of the parents. From the indicators used as detectors for anaemia and its forms, in the laboratories of the Children's Hospital of Tallinn Central Hospital (Sysmex K-1000) and the Viljandi Hospital (Nihon Kohden MEK 6108 OMO1), using calibrated automatic analyzers blood haemoglobin concentration (Hb), the number of erythrocytes (RBC) and the average capacity of erythrocytes (MCV) were specified. As a standard value, the following criteria recommended by WHO were used (4): haemoglobin concentration in blood >110g/l; the number of erythrocytes 4,2*10 12/l, the average capacity of erythrocytes >73fl. The Hb check test values of urban children were 11% lower, the Hb values of the Viljandi Hospital did not differ from the values given by TU Child Clinic Laboratory.

3. Questionnaire about children's health

Parents filled the questionnaire about a child's condition at birth, mother's state during pregnancy (delivery timeliness, child's weight at birth, mother's age at child's birth, occurrence of anaemia during pregnancy, use of iron supplements during pregnancy), as well as the child's physical condition during the last 6 months (colds, fever, angina, cough, belly ache, diarrhoea, vomiting, allergy, and toothache). The questionnaire contained questions about feeding (length of child breastfeed, age of solid food provision, meat and undiluted cow milk and age of provision food similar to other family members). Additionally, parents had to answer the question whether child's urine turned reddish when he/she ate beetroot (so-called beet test) and if the child had been diagnosed anaemia.

Results and discussion

1. Children physical development indicators

Tables 1 and 2 present data about 3-4-year-olds' height and weight as compared to international NCHS (2) and Estonian children's standard value (5,6). The data confirm that the examined heights and weights correspond to those standards. When comparing the USA and Estonian children height and weight percentiles, it became apparent that 54.9% of rural and 62.4% of urban children are taller and 63.9% of rural and 72.4% of urban children are heavier than the given indicators of American children of the same age (2,9).

Table 1. Height of examined children, comparison with standard values

	Children		NHANES median (9)	Estonian mean (6)	Estonian mean ±SD (5)	Children below Estonian mean (%) (5)	NCHS median	below NCHS median (%)
	Median	Mean ±SD						
Boys								
3-year-old								
Country (*n*=36)	99.39	100.27 ±3.70	98.7	100.5	96.2 ±4.4	11.1(*n*=4)	94.9	5.6(*n*=2)
min-max		92.67-107.53		79.0-113.0	91.8-100.6		91.1-98.7	
Town (*n*=29)	100.03	100.15 ±4.68				17.2(*n*=5)		10.3(*n*=3)
min-max		87.17-109.37						
4-year-old								
Country (*n*=40)	106.62	107.06 ±4.24	106.1	106.39	103.3 ±4.3	17.5(*n*=7)	102.9	12.5(*n*=5)
min-max		97.77-118.20		90.0-120.0	99-107.6		98.7-107.2	
Town (*n*=22)	108.45	108.86 ±5.17				18.2(*n*=4)		13.6(*n*=3)
min-max		100.07-118.33						
Girls								
3-year-old								
Country (*n*=28)	97.55	98.02 ±4.47	97.5	98.9	95.1 ±4.1	21.4(*n*=6)	93.9	21.4(*n*=6)
min-max		89.87-109.57		82.0-110.0	91-99.2		90.2-97.6	
Town (*n*=27)	98.6	98.41 ±4.48				22.2(*n*=6)		14.8(*n*=4)
min-max		89.33-106.07						
4-year-old								
Country (*n*=45)	105.1	106.04 ±4.44	104.9	106.34	102.3 ±4.5	13.3(*n*=6)	101.6	13.3(*n*=6)
min-max		96.37-115.38		89.0-122.0	(97.8-106.8)		97.6-105.7	
Town (*n*=26)	106.24	105.75 ±5.43				23.1(*n*=6)		23.1(*n*=6)
min-max		93.47-114.93						

NHANES- National Health and Nutrition Examination Surveys (USA) (9)s (USA) (2)

NCHS – National Center for Health Statistics (USA)

Table 2. Weight of examined children, comparison with standard values

	Children		NHANES	Estonian	Estonian	Children below	NCHS	below NCHS
	Median	Mean ±SD	median (9)	mean (6)	mean ±SD (5)	Estonian mean (%) (5)	median	median (%)
Boys								
3-year-old								
Country (*n*=36)	15.92	16.28±1.83	15.5	16.35	15.3±1.3	27.8(*n*=10)	14.6	11.1(*n*=4)
min-max		12.70-20.50		11.6-23.0	14-16.6		13.0-16.4	
Town (*n*=29)	17.17	16.48±2.17				27.6(*n*=8)		17.2(*n*=5)
min-max		11.47-20.67						
4-year-old								
Country (*n*=40)	18.2	18.16±1.87	17.5	17.93	17.1±1.8	27.5(*n*=11)	16.7	22.5(*n*=9)
min-max		14.33-22.83		12.5-25.5	15.3-18.9		14.8-18.7	
Town (*n*=22)	19.7	19.58±2.48				13.6(*n*=3)		9.1(*n*=2)
min-max		15.40-25.57						
Girls								
3-year-old								
Country (*n*=28)	15.42	15.32±2.02	14.7	15.49	14.8±1.6	39.3(*n*=11)	14.1	28.6(*n*=8)
min-max		12.03-20.60		10.0-25.0	13.2-16.4		12.6-16.1	
Town (*n*=27)	15.83	15.88±1.88				22.2(*n*=6)		18.5(*n*=5)
min-max		12.30-19.60						
4-year-old								
Country (*n*=45)	17.4	17.53±2.22	16.8	17.51	16.7±1.7	40.0(*n*=18)	16	22.2(*n*=10)
min-max		13.33-23.03		12.0-25.0	15-18.4		14.3-18.3	
Town (*n*=26)	17.12	18.02±2.67				42.3(*n*=11)		19.2(*n*=5)
min-max		13.80-23.60						

Z-scores of rural and urban children are given in Table 3. It turns out that in all the investigated gender and age groups, physical development indicator z-scores of rural children is lower than that of urban children (except HAZ-score for 4-year-old girls), but it is statistically reliable only for 4-year-old boys.
When comparing indicators in the urban and rural children group as a whole, rural children z-scores are statistically less reliable than those of urban children. It is most likely that relatively little gender and age groups are the reason why the urban and rural children indicators were not statistically reliable. Thus the size of rural children is smaller, especially among 4-year-old boys, where WAZ and WHZ scores of rural boys are statistically less reliable than of those urban boys of the same age. The differences in weight and height correspondence (WHZ score) and weight and age correspondence (WAZ score) refer to the fact that this backwardness has occurred only lately. Otherwise, height and age

connection (HAZ score) would have been affected too. The fact that the differences are greater for boys refers to environmental factors, which affect boys more.

Table 3. Physical development indicators of urban children (Tallinn) and of rural children (Viljandi)

	Boys			Girls			All the children		
	Town *x* (SD)	Country *x* (SD)	*p*	Town *x* (SD)	Country *x* (SD)	*p*	Town *x* (SD)	Country *x* (SD)	*p*
	3-year-olds								
	n=29	*n*=35		*n*=27	*n*=28		*n*=104	*n*=149	
HAZ	0.11 (1.05)	0.07 (0.87)	NS	0.28 (1.12)	0.033 (1.11)	NS	0.21 (1.01)	0,12 (0,95)	NS
WAZ	0.30 (1.11)	0.17 (0.10)	NS	0.39 (0.99)	0.018 (1.01)	NS	0.43 (1.02)	0,15 (0,94)	0,029
WHZ	0.38 (0.90)	0.25 (0.85)	NS	0.51 (0.73)	0.20 (0.75)	NS	0.50 (0.83)	0,21 (0,77)	0,005
4-year-olds									
	n=22	*n*=40		*n*=26	*n*=45				
HAZ	0.45 (0.84)	0.10 (0.71)	0.081	0.027 (1.00)	0.25 (1.10)	NS			
WAZ	0.78 (0.93)	0.17 (0.81)	0.01	0.32 (1.03)	0.20 (0.99)	NS			
WHZ	0.65 (0.73)	0.19 (0.75)	0.025	0.49 (0.96)	0.18 (0.75)	NS			
3-and 4-year-olds									
	n=51	*n*=76		*n*=53	*n*=73				
HAZ	0.26 (0.97)	0.08 (0.78)	NS	0.1 5(1.06)	0.17 (1.10)	NS			
WAZ	0.51 (1.05)	0.17 (0.90)	0.062	0.36 (1.00)	0.13 (0.99)	0.031			
WHZ	0.50 (0.83)	0.22 (0.80)	0.057	0.50 (0.84)	0.19 (0.75)	NS			

p values are determined with t-test *x*(SD) – mean (standard error)
HAZ – height-age z-score WHZ – weight-height z-score
WAZ – weight-age z-score NS p>0.05

Brachial perimeter of rural and urban children is not significantly different (Table 4). Brachial perimeter of children in this survey was greater than that of children of the USA (9).

Skinfold thickness of urban children is the same as for children of the USA, but it is not so thick for rural children. Adjusted brachial perimeter of rural children is statistically greater than that for urban children (except 4-year-old boys).

It is known generally that no substantial difference in the height of urban and rural children in Estonia exist – for 2-6-year-olds it is only ¼ cm (5). Children of the Viljandi County have always been the tallest in Estonia, exceeding their Tallinn peers in height (and also in weight) (5). These differences have been of permanent character according to similar surveys done in Estonia. Thus, it can be expected that 3-4-year-olds in the Viljandi County should be taller and heavier than their Tallinn peers. But this survey shows that children in Tallinn are taller, heavier and with thicker skinfold than children in the Viljandi County. Taking into consideration the fact that food of rural children was non-varied and contained less vitamin A and energy (on the average, 150 kcal less per day) than the food of urban children (1), it can be speculated that this is the reason for that moderate physical development of children of the Viljandi County. Triceps fold of rural children was smaller than that of urban children. As a result, the value of adjusted brachial perimeter (the indicator of muscle development) was larger than that of urban children, this refers to their more intensive physical activity.

Table 4. Brachial measures of examined children as compared to NHANES (I&II) data (9)

	Boys			Girls			Boys	Girls
	Town	Country	*p*	Town	Country	*p*	NHANES I & II (3y/4y)	
	3-and 4-year-olds							
	n=51	*n*=76		*n*=53	*n*=73		*n*=104	*n*=149
Skinfold thickness *x* (SD)	9.28	7.81	0.0001	10.36	8.78	0.0001		
(mm)	(0.96)	(1.63)		(2.34)	(1.74)			
median	9	7.7		10	8.7		9.5/9	10.0/10.0
Brachial perimeter *x* (SD)	17.51	17.54	NS	17.23	17.44	NS		
(cm)	(1.20)	(1.10)		(1.31)	(1.29)			
median	17.53	17.65		17.23	17.3		16.8/17.1	16.6/17
Adjusted brachial	17.02	18.18	0.005	15.63	17.26	0.0001		
perimeter *x* (SD) (cm)	(2.30)	(2.14)		(2.36)	(2.62)			
median	17.16	18.3		15.47	17.16		15/16.2	14.3/15.3

p values are determined with t-test NS $p>0.05$

Exceptions were 4-year-old rural boys whose indicator did not differ from that of urban children. It is most likely that the physical activity of rural children is more intensive, magnifying the energy need. At the same time, the amount of vitamin A, the microelement backing physical development, in the food of rural children (especially 4-year-old boys) was considerably lower than that in the food of urban children (1).

2. The results of blood tests

The average values of the examined indicators (Hb, RBC and MCV) and their correspondence to different standard values is given in Table 5. The chart shows that 45% of urban and 18% of rural children have haemoglobin concentration lower than 110 g/l, only 38% of urban and 65% of rural children had all the examined indicators within bounds of WHO standard values. It is known that USA hospitals regard haemoglobin concentration below 115g/l (8) as anaemia for children, an average Hb standard value is 125g/l(9). In Estonia, an average standard value for children of that age will be 79 fl(7), in the USA 81 fl(8).

Table 5. Blood tests results and their correspondence to different standard values

	Town	Country	p
Haemoglobin concentration (g/l)	*n*=101	*n*=150	
mean (SD)	110.2(8.3)	119.4(11)	0.0001
median	111	119	
<110 g/l	45%	18%	
<111 g/l	48%	20%	
<115 g/l	70%	34%	
< 125 g/l	90%	68%	
The number of erythrocytes	*n*=100	*n*=150	
mean (SD)	4.13(0.34)	4.72(0.44)	0.0001
median	4.1	4.73	
<4.2 bl/mm^3 *	55%	13%	
<5.3 bl/mm^3 **	100%	89%	
The capacity of erythrocytes	*n*=100	*n*=150	
mean (SD)	80.2(3.89)	76(4.47)	0.0001
median	80.42	76.15	
	3%	21%	
	37%	78%	
Positive beet test	86%(n=55)	79%(n=91)	

p values are determined with t-test

* INACG, 1985 (4), ** USA data (8), ***NHANES-I 50 percentile (9)

The blood tests show that some of the children have anaemia, this is obvious when comparing Estonian children's haemoglobin values to the American acknowledged standard's lower borderline. As on prophylactic visitations blood tests usually are not taken from children, on some occasions, anaemia will stay undiagnosed. Only some parents knew that their children had been diagnosed anaemia before (12% in the country, 8% in town).

The paleness of skin as a feature of iron deficiency had been noted only for few children (33% in the country, 6% in town).

Probably it is the case of iron deficiency anaemia, although on capillary blood it was not possible to determine ferritin. It is known that iron deficiency in organism exists even before it shows in blood tests. As iron deficiency can cause mental disability (10,11), it is especially harmful for little children. Children with iron deficiency can be nervous, with weak physical endurance and more susceptible to infections (12). According to the food questionnaires, all children had the risk of iron deficiency because the average iron consumption was less than recommended (10 mg per day for 1-10-year-olds). Recommended amount means that a child should get daily 30 g meat or meat products (haem iron source) and 25 mg of vitamin C (13) for iron is more difficult to absorb

from greens and grain foods (non-haem iron sources). Absorption is facilitated by eating meat and vitamin C at the same time. Some of the components, like phytan and tannin prevent non-haem iron absorption (13). Diets with such components like whole wheat rye bread are with only imaginarily sufficient iron concentration. As urban children get more food with vitamin C, the absorption of iron should be better than that of rural children. Why anaemia is more frequent among urban children although their food possibilities are better needs still to be examined.
Differences in reference values of analyzers in the country and in town must be taken into consideration. One of the possibilities is the higher level of lead in the air (gas) in town and in soil around houses (old lead colours) (14).

In additional to the factors mentioned, scanty feeding with breast milk and its substitution with cow milk in babyhood affect children's organisms iron reserves and cause its deficiency (15). It was revealed by the questionnaire that although 94% of rural and 99% of urban children were fed with breast milk, it lasted only for a very short period. Only 19% of rural and 26% of urban children's mothers breastfed these children more than 4 months and most of them gave their children other food already in the early babyhood, that, in fact, prevents iron assimilation from breast milk. Cow milk was given to 88% of rural and 64% of urban children before they were 1-year-old (39% of rural and 17% of urban children before 6 months). Science literature warns us not to use full-strength cow milk before 12 months, for it causes bleeding in intestines (30% of babies)(15).

3. General diseases of children
Children were examined for diseases during last 6 months. It came out from the questionnaires that urban children were more often ill than rural children. 41% of urban children had 3 or more cases of illness (32% of rural children, $p<0.172$) during previous winter. Also, during the 6 last months urban children had visited doctors on prophylactic visits more than rural children (44% in town and 36% in the country, $p<0.229$).
Most visits to the doctors were connected with colds among urban and rural children (55% in town and 36% in the country). During the last 6 months, 94% of rural and 91% of urban children had cough. Frequent cough was diagnosed for 24% of urban and 18% of rural children, but this difference was not statistically relevant. Nearly a quarter of parents in the country and in town answered that their child had had fever. Also, frequencies of occurrence of bellyache (45% of both urban and rural children) and angina (22% in the country and 17% in town) did not differ substantially. Urban children vomited to some extent more often (53% in town and 42% in the country, $p<0.0096$) and had diarrhoea (59% in town and 41% in the country, $p<0.013$) but this is a relatively infrequent reason to consulting doctors (8% in town and 3% in the country, $p<0.065$).

Summary

Physical development indicators (height, weight, brachial perimeter and skinfold thickness) of 3-4-year-old children who participated in the survey corresponded to the standards confirmed in the USA (2,9) and Estonia (5,6). Comparing rural and urban children, it was revealed that physical development indicators of urban children are statistically more reliable than those of rural children. Adjusted brachial perimeter as a muscle component indicator was higher for rural children, except for 4-year-old boys, whose indicator did not differ from the indicator of the urban boys of the same age. According to the previous surveys, it could be assumed that by their physical development indicators children of the Viljandi County exceed children of Tallinn, however the outcome of this survey showed a contrary tendency. Thus, differences in height of Estonians which have been stable in different parts of Estonia irrespective of social suasion, may not be true anymore. The reason might be inadequate nutrition both in quantity and quality. Significant changes in the physical development of 4-year-old rural boys occurred, their weight and age, weight and height correlation has been disturbed. Also, by muscle component 4-year-old rural boys do not outstrip urban boys. All this refers to the environmental factor, the negative effect of which has emerged lately on urban children's development.

It is known that while joining the Army the weight and muscle indicators of a greater part of Estonian boys and also their physical endurance indicators are not satisfactory (16). Most likely the roots of this deficiency lie in the childhood and are to a great extent connected with nutrition, including deficiency in micro- and macroelements.

Our data show that many children have anaemia; all the examined children had an iron deficiency risk, as average iron consumption is lower than the recommended, both in the country and in town. As iron deficiency can obstruct mental progress of children, this problem must be paid more attention to. On prophylactic visits to doctors, blood haemoglobin level should be determined. It is easier and cheaper to teach parents to observe phenomena that indicate signs of anaemia: while eating beetroot, a child's urine turns reddish (17). Commercials should be used to implicate families to use more varied and wholesome food. For example, blood-mixed dumpling, Estonian traditional food product can be recommended as a relatively cheap iron source. More frequent occurrence of anaemia of urban children can be caused by other factors, as higher environmental pollution in town (14) and more frequently occurring indigestion problems of urban children (diarrhoea, vomiting).

Concerning suffered general diseases, except more frequent diarrhoea of urban children, rural and urban children did not differ markedly. Although urban children visited doctors more often and in the opinion of their parents, they were ill more often, the reason might be more accessible medical aid in town and parents' greater attention to their children's health.

Parents who participated in the survey represented families with little children living in the area. As Tallinn and the Viljandi County are relatively more advanced in economic terms, in other parts of Estonia, where the economic situation is worse, the influences on children's nutrition, physical development and health might be even greater.

References

1. Ilves Annunziata, A-R., Veldre, G., Saluste, L., Pitsi, T., Süvalep, I., Viin, L., Vainu, J. Results of the Estonian Toddler Health and Nutrition Survey: I. nutrition status and family socio-demographics. – *Eesti Arst* 2000, vol. 3, p 142-144, 146, 147. (in Estonian)
2. WHO Measuring Change in Nutritional Status. Guidelines for assessing the nutritional impact of supplementary feeding programs for vulnerable groups. Geneva, WHO, 1983.
3. Pelletier, D.I. The relationship between child anthropometry and mortality in developing countries: implications for policy, programs and future research (review). – *Journal of Nutrition* 1994, vol. 124, suppl. 10, p 2047-2081.
4. INACG. Measurement of iron status. A report of the International Nutritional Anemia Consultative Group (INACG). Washington DC, USA: The Nutrition Foundation, 1985.
5. Silla, R., Teoste, M. The health of Estonian Youth. Tallinn: Valgus 1989, p 129. (in Estonian)
6. Grünberg, H., Adojaan, B., Thetloff, M. Growing and growth disorders. Methodical reference book for evaluating children physical development. Tartu: University of Tartu, 1998. 17 pp. (in Estonian)
7. Gibson, R.S. Nutritional assessment, a laboratory manual. New York: Oxford University Press, 1993. 204 pp.
8. Dallmann, P.R., Siimes, M.A. Percentile curves for haemoglobin and red cell volume in infancy and childhood. – *Journal of Pediatrics* 1979, vol 94, p 26-31.
9. Frisancho, A.R. Anthropometric standards for the assessment of growth and nutritional status. Ann Arbor, Michigan, USA: University of Michigan Press, 1990. 200 pp.
10. Pollitt, E., Viteri, F., Saco-Pollitt, C., Leibel, R.L. Behavioral effects of iron deficiency anemia in children. In: *Iron deficiency: brain biochemistry and behaviour*. New York, NY: Raven Press, 1982, p 195-208.
11. Pollitt, E., Lewis, N., Leibel, R.L., Greenfield, D.B. Iron deficiency and play behaviour in preschool children. In: *Human Nutrition*. Washington DC: American Association for Clinical Chemistry, 1981, p 290-301.
12. Preventing Iron defieincy in women and children technical consensus on Key Issues. 7-9 October 1998, UNICEF, UNU, WHO, MI, Technical Group International Nutrition Foundation, USA 1998.
13. National Research Council. Recommended Dietary Allowances. 10th ed. Washington DC: National Academy Press, 1989. 302 pp.

14. Wright, R.O., Shannon, M.V., Wright, R.J., Hu, H. Association between iron deficiency and low-level lead poisoning in an urban primary care clinic. – *American Journal of Public Health* 1999, vol. 89, p 1049-1053.
15. Ziegler, E.E., Fomon, S.J., Nelson, S.E. Cow milk feeding in infancy: further observations on blood loss from the gastrointestinal tract. – *Journal of Pediatrics* 1990, vol. 116, p 11-18.
16. Suurorg, L., Kaldamäe, P., Ausmees, M., Kutsar, K. Assessment of health related fitness in male students and serviceman. *Papers on anthropology VII./ Eesti Antropomeetria Aastaraamat VII*, Tartu: University of Tartu, 1997, p 329-38.
17. Tunnessen, W.W., Smith, C., Oski, F.A. Beeturia, a sign of iron deficiency. –*American Journal of Diseases of Children* 1969, vol. 117, p 424-426.

APPENDIX 1

ARTICLE III

Pitsi, T., Liebert, T., Vokk, R. Calculations on the energy and nutrient content of kindergarten menus in Estonia. – *Scandinavian Journal of Nutrition* 2003, vol. 47, p 188-93.

APPENDIX 1

ARTICLE IV

Vokk, R., Liebert, T., Pitsi, T., Ilves Annunziata, A-R. Consumption of milk products, calcium and vitamin D by Estonian children in 1996 and 2002. – *Scandinavian Journal of Nutrition* 2005, vol. 49 (4), p 159-164.

APPENDIX 1

ARTICLE V

Pitsi, T., Ilves Annunziata, A-R., Liebert, T., Vokk, R Kindergarten menu calculations in Estonia since 1995. Manuscript

Nutrient and energy content of kindergarten menus served in Estonia (1995 -2004)

Tagli Pitsi*, Anne-Reet Ilves Annunziata**, Raivo Vokk*,
*Department of Food Processing, Tallinn University of Technology, Estonia
**Friedman School of Nutrition Science and Policy, Tufts University, Boston, MA, USA

Abstract

Background: In Estonia over three-quarters all of pre-school aged children attend kindergarten. All receive three meals during the kindergarten day.

Objectives: The aim of this paper is to examine potential nutrient shortfall in the food offered through analysis of calculated kindergarten menus in various regions of Estonia.

Design: Menus were analyzed using Finnish Micro-Nutrica programme adapted for nutrients surveys in Estonia. The results were compared to Estonian standards for health protection and nutrition in catering facilities of pre-school institutions.

Results: Total energy levels of menus met or exceeded the RDI for the most part. However the distribution of energy from the different meals in most menus did not meet the recommendation – calorie levels of breakfasts were too low and snacks were too high. Energy contribution of carbohydrates was frequently below the RDI. Shortages of vitamins and minerals were noticeable with vitamins D, E, B_1 and C being below RDI. Sodium levels exceeded recommendations.

Conclusions: Redistribution of calorie levels provided by pre-school establishments should be undertaken to more accurately reflect the preferences of children. Micronutrient densities in kindergarten menus need to be increased to meet recommendations. Fortification milk with vitamin D should be considered on national level to ensure adequate intake.

Keywords: pre-school children, nutrition, energy, vitamins, Micro-Nutrica

Introduction

As it has been established that many chronic illnesses of later life such as atherosclerosis begin in childhood promotion of healthful eating behaviours should begin early in life. Studies have shown that anatomic changes in the aorta and coronary arteries of young adults are related to antecedent risk factors developed during childhood. Cardiovascular risk factors, such as blood pressure, obesity, serum lipids and lipoproteins track from childhood to young adulthood[1].

Early food experiences impact preferences and eating patterns in later life[2]. The food intake of children is influenced by family eating patterns and peer behaviour. For children who attend kindergarten food choices offered there also have an effect[3].

The energy needs per kilogram of bodyweight of kindergarten-aged children is lower than that of younger children, however the actual number of required calories increases with age.

Kindergarten food service differs from country to country. In Denmark, for example, food service is only available for children who attend nurseries (under 3-years of age). Children in kindergarten (3 to 6-year-old) must bring their own food. Although some kindergartens serve an afternoon snack such as fruit. Special "meal days", when the children prepare meals for everybody, are popular. Since July 1, 2003 parents have HAD the option of paying for kindergarten food if the parent board agrees[4].

In Estonia the numbers of children attending kindergarten has increased each year since independence IN 1991 so that by THE YEAR 2003 66% (approximately 51, 300 children) were receiving this benefit[5]. Kindergarten food service must follow the Estonian dietary recommendations for children of this age[6] and provide 85% of daily energy and nutrient requirements in the three meals offered during the day: breakfast (35%), lunch (45%) and afternoon snack (20%).

This report gives an analysis of the adequacy of the nutrients and foods offered by kindergartens in Estonia beginning in 1995 as calculated by the Department of Food Processing at Tallinn University of Technology and evaluates their adequacy for young children.

Methods

Results are listed by all kindergarten menus (KGM) and by a total of studied days (AD). The energy and nutrient intake of different meals was calculated from the analysis of recipes provided by the kindergartens using the Finnish Micro-Nutrica programme, adapted for nutrient surveys in Estonia[7].

Results represent analysis of the food as served to children and not their actual intake and therefore only reflects the possible intakes from served menus.

Fifty-eight menus from 52 kindergartens were analysed, a total of 894 days of service to over 5000 potential consumers. Analysed menus reflect every month of the year and many regions of Estonia.
To determine possible trends over time the menus were divided into two groups: 1995 to 1999 and 2000 to 2004.
Results were compared to the Estonian Public Health Recommendations for Dietary Services in preschool and school settings[6]. Although children from 1 to 7 years of age were served in this setting this report focuses only on the results of children ages 4 to 6 years of age.
The recommended dietary intake (RDI) has been used to mark minimum intake. In the case of fat, cholesterol and sodium the RDI is used for the upper/maximum recommended intake. Scandinavian[8] recommendations have been used as a reference for fiber as fiber recommendations for children have not been developed for Estonia,. The recommended fiber intake for 4 to 6-year-old children is calculated as "age+5". Using 5 years as the average age for this group, then the RI for fiber is assumed to be 8,5 g per kindergarten day.
Energy and some average nutrient intakes as provided by various food groups were also analysed for 41 menus. Estonian recommendations suggest that grain products should be the major source of food energy (34%), followed by milk (16%) and meat-poultry-fish-egg products (16%). Thirteen percent of energy should come from added fats and 10% from potatoes, fruits and berries. Sugar and sweets should be the source of 8% and vegetables 3% of all consumed energy[9].

Results
Table 1 provides an overview of the average energy and nutrient intakes from KGM. Sixty percent of the menus provided recommended level of energy (1390±100 kcal), but energy levels within the menu of each kindergarten differed significantly. Average energy intake from all meals as well as the total energy intake was lower (table 1) in the second period (2000-2004) compared to the first period (1995-1999). The distribution of the average energy contributed by various food groups was not in compliance with guidelines. Average energy contribution of grain products and meat-poultry-fish-egg products was lower (30,5% and 10,9% respectively); contribution of milk products and sugar was higher (21,9% and 10,9% respectively).
Table 2 compares the average contribution of each meal to the total daily energy in kindergarten. It can be seen that breakfast calorie levels of both categories (AD as well KGM) were below the recommendation[6] (in 95 % of the menus <500 kcal), On the other hand snacks contributed more energy then recommended (in 89% of the menus >280 kcal).
Energy derived from protein sources (Table 3) approached the RDI in most menus. Energy from fat sources varied by kindergarten. Energy intake from saturated fatty acids (table 3) was higher than recommended. Energy derived from carbohydrates was frequently below RDI. In menus of the second period

the energy contribution of fat sources was not significantly lower than in the first period; energy derived from saturated fatty acids had actually increased ($p<0,05$). Cholesterol levels were close to recommendations as was the contribution of dietary fiber. Fiber density was between 7,0 and 12,8g/1000 kcal. Shortages of vitamins and minerals were more noticeable than that of macronutrients with levels of vitamins D, E, B_1 and C being low and levels of sodium too high. All the menus failed to meet RDI for vitamin D, 33% of the menus RDI for vitamin E and 78% of the menus RDI for vitamin B_1. Eighty-four percent of the menus did not contain adequate vitamin C to meet the RDI. The average intake of vitamin C (mean 29,0 mg, median 22,6 mg) in AD was also below RDI (38,3 mg). Vitamin C levels in daily menus averaged between 10 and 20 mg and were was no significant increase in vitamin C level in menus of the second period. Vegetables were the major source of vitamin C (table 4) (30% of total intake) with beverages (juice drinks) being the second largest contributor (22% of total). On average 18% of vitamin C came from potatoes, 16% from fruits and berries and 13% from milk products. Other vitamin levels (with the exception of niacin and vitamin B_{12}) were also noted to be inadequate in some menus. The average intake of sodium in KGM exceeded RDI. Average sodium intake from AD was 2005 mg (median 1892 mg). Comparing menus of the first and second period it can be seen that average levels of vitamins and minerals in AD had decreased (table 1).

Discussion

Kindergarten food service guidelines mandate that energy levels meet the Estonian RDI of 1390 kcal which most of the menus did. The number of menus exceeding recommendations was bigger than the number of menus that did not reach RDI.

The Estonian Toddler Health and Nutrition survey of 1996 showed that average daily energy consumption of 3 to 5-year-old urban children was 1422±361 kcal and 1299±370 kcal for rural children[10]. The follow-up study (Estonian Child Health and Nutrition Survey 2002) showed daily energy consumption of 3 to 6,5-year-old urban children to be 1589±54 kcal (boys) and 1536±51 kcal (girls)[11]. The results of these two surveys suggest that children may not have the possibility to get as much energy as recommended (RDI for 4-6 year old boys is 1715 kcal and for girls 1545 kcal) or that this energy recommendation is inflated. It was interesting to note that an average of 400 kcal (about 25% of whole day's energy) was consumed after 19 o'clock, which is the time when most children have already left kindergartens[11]. According to Estonian Toddler and Child Health and Nutrition Surveys only one percent of the surveyed children were underweight. 86% of children were normal weight and 13% overweight.[10, 11]

Although children could eat more on one day and less on another menus of kindergartens should avoid large energy variations from day to day. The largest variation noted in one of these menus during a 19 day period was 1180 kcal.

Comparing menus with lower and higher mean calorie levels it can be seen that grain, milk products and beverages make a larger contribution to total calories in menus with lower mean calories (<1290 kcal) while the meat-fish-poultry-egg group, potatoes, fruits-berries, vegetable, added fats, sugar and sweets made a larger contribution to menus in the higher calorie group (>1490 kcal).
The results of the energy contribution of each meal (table 2) suggest that most kindergartens need to increase the energy provided at breakfast and decrease the energy at snack time to comply with current guidelines. Discussion with kindergarten personnel and parents has revealed that children's eating preferences do not match the current guidelines. Children do not eat all of the offered breakfast meal and often still feel hungry after eating the snack. Based on this information a suggestion has been made to Estonian Nutrition Recommendations Committee that kindergartens should have the right to decide whether they use the current energy contribution recommendations or rename meals (e.g. breakfast as morning snack; snack as dinner) which would change the energy contributions from these meals to 25% and 30-35% of total energy intake, respectively[12].
Examining whether macronutrient contribution to calories complies with recommendations (table 3) it appears that energy derived from protein and fats meet guidelines but energy derived from carbohydrates was low. And while energy intake from fats complies with Estonian recommendation their contribution to calories is greater than the latest Nordic recommendations[7]. There appeared to be a shift in menus with higher average total energy intake (>1490 kcal) with fat contribution to total daily energy being greater and carbohydrate contribution lower. Although energy contribution decrease from fats came out from a Danish survey – energy derived from fats in 1995 (35%E) was higher than in 2000/1 (34%E)[13], then our survey did not assure that trend in Estonian kindergarten days.
Energy intake from saturated fatty acids (table 3) was also higher than recommended levels. Interestingly this decreased in menus with higher total energy. Energy derived from mono- and polyunsaturated fatty acids increased with an average total energy increase so that fatty acid profile of higher calories menus was closer to the recommendation. The energy contribution of saturated fats was lower in first period days (p<0,05). Average cholesterol intake from three menus exceeded RDI. As high cholesterol together with high saturated fatty acid intake is one of the risk factors of cardiovascular diseases, then decreasing cholesterol intakes in these menus is recommended. According to RI, there was no problem of getting enough fiber from kindergarten menus. Fiber density was quite comparable with the Danish survey (8,8g/1000 kcal)[13].
The greatest nutrient shortfall was noted in vitamins, especially of vitamins D, E, B_1 and C. The average level of vitamin D provided by KGM was below RDI. Vitamin D levels in AD were above RDI on only 19 of 894 (2%) days, with intakes ranging between 0,5 and 1 µg. Although calcium intake from most of the

KGM was sufficient low levels of vitamin D are known to reduce calcium absorption[14].
Vitamin D intake is a problem in many countries. A study of English preschool children shows that Vitamin D intake from food, depending of the location, was only 1,1-1,3 µg per day[15].
More than half of the vitamin D (55%) in KGM came from the meat-poultry-fish-egg products group (table 5). Fish is one of the better contributors however it was served infrequently in most of the kindergartens. This issue needs to be addressed. Kindergartens should consider increasing the use of more fish or vitamin D-fortified fat spreads in daily meals. As Vitamin D intake is below RDI not only in children[16] but also in the whole population[17] milk fortification with vitamin D should be considered on national level. Finland began milk and sour milk fortification with vitamin D 0,5µg/dl in 2003, which together with the use of fortified spreads (10µg/100g) has increased average vitamin D consumption among Finnish children and adolescents from 3,7 to 6,6 µg per day[18].
The average intake of vitamin E from AD exceeded RDI, but one third of the menus failed to meet recommendations. Recommendations for eliminating vitamin E insufficiency by the inclusion of more oil, seeds and nuts involves major changes eliminating traditional fats sources such as butter and meat products as well as changing milk products to those with lower fat content in order to remain within total fat guidelines.
Seventy-eight percent of menus did not provide the RDI for vitamin B_1 (thiamine) the average level of thiamine intake of all days (0,6 mg) was below RDI (0,7 mg). Vitamin B_1 intakes from AD were mainly between 0,5 AND 0,6 mg. The level of this vitamin in menus needs to be increased through the use of dried fortified cereals, oatmeal, wheat germ, yeast, peas, nuts and seeds. Pork and rye bread, popular Estonian food which are good sources contain less vitamin B_1 as the above mentioned foods, but are eaten frequently[19].
Children should be offered more fruits and vegetables as snacks to address the problem of vitamin C deficiency, but budgets may have to be adjusted to allow this as fresh produce can be costly.
Although iron inadequacy was not found in any KGM, anaemia was noted in participants of the Estonian Toddler Health and Nutrition Survey. Food questionnaires in that survey revealed the risk of iron deficiency in all children[20].
Iron deficiency anaemia is a common problem particularly in younger preschool children. The UK National Diet and Nutrition survey of children aged 1 ½ to 4 years also revealed one in eight of the youngest group of children to be anaemic. The average daily intakes of iron were seen to be well below the RNI[21]. Most of the iron in KGM (table 4) came from grain products (59% of total intake). Only 17% was from meat-poultry-fish-egg products which is more bio available. Iron from plant sources is less well absorbed than iron from animal sources[22] but absorption can be improved by consuming vitamin C rich foods or drinks (such as orange juice) with a meal[23]. However as vitamin C levels of KGM were low this is not a resource in these menus.

Average sodium intake from AD was more than 5 g of salt just during the kindergarten day hours. Intake was lower than RDI on only 8 days out of 894 days (1% of AD) with levels mainly between 1500 and 2000 mg. A survey of 5-year old children in Finland showed that their sodium intake was 2200 mg per day and that 43% of total sodium intake was derived from salt added in food preparation[24]. In our surveys also most of the sodium (table 5) came from added salt (45% of total sodium intake). The second largest source was grain products (21%). Surveys show that sodium from processed foods accounts for about 75%[25] however in KGM it was much lower. This suggests that the reduction of sodium can be easily accomplished by reducing the salt added during food preparation.

Conclusions

The rate of growth in preschool children is slower than that during infancy. As a consequence of this diminished growth rate appetites may decrease. For this reason food offered to young children should be of high nutrient density. The preschool period is an excellent time to help children become familiar with the idea that eating a proper diet is part of a healthy lifestyle. From this overview of kindergarten menus it can be seen that although energy levels approach adequacy there was a shortfall in some vital vitamins. All kindergartens should examine their menus critically and make corrections to be able to provide children with high quality food.

References

1. Williams, C.L., Bollella, M.C., Strobino, B.A., Spark, A., Nicklas, T.A., Tolosi, L.B., Pittman, B.P. “Healthy-Start”: Outcome of an Intervention to Promote a Heart Healthy Diet in Preschool Children. *J Am Col. Nutr* 2002, Vol. 21, No. 1: 62-71.
2. Pe´rez-Rodrigo, C., Aranceta, J. Nutrition education in schools: experiences and challenges *Eur J of Clin Nutr* 2003, 57, Suppl 1: 82–S85.
3. Nicklas, T.A., Baranowski, T., Baranowski, J.C., Cullen, K., Rittenberry, L., Olvera, N. Family and child-care provider influences on preschool children's fruit, juice, and vegetable consumption. *Nutr Rev* 2001, Jul; 59(7): 224-35.
4. Ministry of Science Technology and Innovation. Childcare options. http://www.workindenmark.dk/Childcare_options/0/4/0
5. Statistical Yearbook of Estonia 2004. Statistical Office of Estonia. Tallinn, Ofset Ltd, 2004: 64, 214.
6. Regulation on health protection requirements and nutrition in catering facilities in pre-school institutions and schools. Ministry of Social Affairs, Estonia, No. 93, 27.06.2002. RTL 30.07.2002; 84: 1298. (in Estonian.)
7. Knuts, L.-R., Rastas, M., Seppänen, R., Haapala, P. (transl. Süvalep, I., Pitsi, T.) Micro-Nutrica, version 2. Manual. *Food and nutrition II*. Tallinn, 1997. (in Estonian).

8. Nordic Nutrition Recommendations, NNR, 2004 – integrating nutrition and physical activity. Nodic Council of Ministers, Copenhagen. Nord 2004:013
9. Maser, M., Pitsi, T. et al. Reference Book for Healthy Eating. The Estonian Society of Nutritional Science, 2001. (in Estonian)
10. Ilves Annunziata, A-R., Veldre, G., Saluste, L., Pitsi, T., Süvalep, I., Vainu, J. Health and nutrition survey of small children in Estonia: I nutrition and socio-economic condition. *Eesti Arst* 2000; 3: 142-147. (in Estonian.)
11. Pitsi T, Liivand P, Ilves Annunziata A-R, Veldre G, Minajeva A. Analysis between kindergarten-aged children nutrition and nutrient intakes from kindergarten menu. *Food and Nutrition XI.* Tallinn, 2003: 52-66. (in Estonian)
12. Vaask, S., Liebert, T., Maser, M., Pappel, K., Pitsi, T., Saava, M., Sooba, E.,
13. Vihalemm, T., Villa, I. Estonian Nutrition and Food Recommendations. Estonian Society of Nutritional Science, National Institute for Health Development, 2006. 117 pp. (in Estonian)
14. Fagt, S., Matthiessen, J., Trolle, E., Lyhne, N., Christensen, T., Hinsch, H-J., Hartkopp, H., Biltoft-Jensen, A., Møller, A., Daae, A-S. The dietary habits of Danes 2000-2001. Developments in Danish diet – consumption, purchasing and habits. Danish Veterinary and Food Administration. (in Danish) Available: http://www.foedevarestyrelsen.dk/FDir/Publications/2002010/Rapport.pdf
15. Optimal Calcium Intake. United States Department of Health and Human Services, Public Health Service, National Institutes of Health. Consensus Development Conference Statement, 1994. June 6-8; 12(4): 1-31.
16. Davies, P.S.W., Bates, C.J., Cole, T.J., Prentice1, A., Clarke, P.C. Vitamin D: seasonal and regional differences in preschool children in Great Britain. *Eur J of Clin Nutr* 1999; 53: 195-198
17. Vokk, R., Liebert, T., Pitsi, T., Ilves, A-R. Consumption of milk products, calcium and Vitamin D by Estonian children in 1996 and 2002. *Scand J Nutr* 2005; Vol. 49 Issue 4: 159-164.
18. Highlights on Health in Estonia. WHO Regional Office for Europe. European Communities and World Health Organization, 2002, p 26.
19. Lamberg-Allardt, C., Kärkkäinen, M., Uotila, T., Natri, A-M. Sprucing up Finnish Situation about Vitamin D – from sun, food or pills? *Suomen lääkärilehti* 2003; 58: 9: 1055-1056. (in Finnish)
20. Food Composition Tables. *Food and nutrition III.* Tallinn, 1997. (in Estonian).
21. Ilves Annunziata, A-R., Veldre, G., Saluste, L., Pitsi, T., Süvalep, I., Viin, L., Vainu, J. Results of the Estonian Toddler Health and Nutrition Survey: II health indicators and growth status. *Eesti Arst* 2000; 7: 389-99. (in Estonian)
22. Wardley, B.L., Puntis, J.W.L., Taitz, L.S. The preschool child. In: *Handbook of Child Nutrition*, Oxford University Press/Books 1997, p 54-72.
Tapiero, H., Gaté, L., Tew, K.D. Iron: deficiencies and requirements *Biomed Pharmacother* 2001; 55: 324-32
23. Michaelsen, K.F., Weaver, L., Branca, F., Robertson, A. Feeding and nutrition of infants and young children. Guidelines for the WHO European

Region, with emphasis on the former Soviet countries. *WHO regional publications. European series* 2003, No. 87.
24. Heino, T., Kallio, K., Jokinen, E., Lagström, H., Seppänen, R., Välimäki, I., Viikari, J., Rönnemaa, T., Simell, O. Sodium intake of 1 to 5-year-old children: the STRIP Project. *Acta Paed*, Apr 2000, Vol. 89 Issue 4: 406-410.
25. James, W.P., Ralph, A., Sanchez-Castillo, C.P. The dominance of salt in manufactured food in the sodium intake of affluent societies. *Lancet* 1987; 1: 426–9

Table 1. Energy and nutrient intakes from kindergarten meals

	Menus			Days, average			
	KGM *n*=58	Period I average *n*=51	Period II average *n*=7	AD *n*=894	Period I *n*=747	Period II *n*=147	RDI[6]
Energy, kcal	1227±46... 2101±49	1467	1352	1438	1457	1345**	1390
Breakfast, kcal	179±7... 626±36	404	344	403	416	340**	500
Lunch, kcal	477±3... 992±115	665	618	641	646	615*	640
Snack, kcal	237±14... 788±58	400	389	394	395	389	280
Breakfast, %E	12.0±0.9... 34.7±2.4	27.9	25.9	28.2	28.7	25.7**	
Lunch, %E	34.7±2.2... 66.1±5.4	45.2	45.8	44.6	44.4	45.7	
Snack, %E	18.8±2.1... 37.5±1.9	26.9	28.4	27.2	26.9	28.6*	
Proteins, %E	10.3±0.4... 17.2±0.9	13.7	13.1	13.6	13.7	13.1*	10...15
Fats, %E***	25.9±1.9... 39.4±4.8	32.6	32.1	32.5	32.6	32.1	30...35
Carbohydrates, %E	45.2±2.8... 59.7±1.7	53.7	55.0	53.9	53.7	54.7	56...60
Saturated fatty acids, %E	11.2±0.8... 20.8±2.7	15.0	15.2	14.5	14.4	15.1*	10...12
Monouns.fatty acids, %E	7.7±0.3... 12.9±0.4	9.9	9.1	9.9	10.0	9.1*	10
Polyuns. fatty acids, %E	2.2±0.3... 8.9±0.4	5.3	5.2	5.7	5.8	5.2*	10
Other fats, %E	2.1±0.1... 2.9±0.2	2.4	2.6	2.4	2.4	2.6**	
Cholesterol, mg***	126±9... 308±105	196	177	190	193	176	255
Fiber, g	10.4±0.6... 25.5±2.9	14.6	12.1	14.0	14.4	11.9**	8.5

Table 1. Energy and nutrient intakes from kindergarten meals - Continued

	Menus			Days, average			
	KGM *n*=58	Period I average *n*=51	Period II average *n*=7	AD *n*=894	Period I *n*=747	Period II *n*=147	RDI[6]
Vitamin A, µg-ekv	379±36... 4735±4350	1313	1566	1364	1322	1581	425
Vitamin D, µg	0.5±0.1... 3.1±1.3	1.5	1.1	1.4	1.4	1.1*	4.25
Vitamin E, mg	2.6±0.1... 13.6±0.9	6.2	5.6	6.6	6.8	5.7*	5.1
Vitamin B1, mg	0.5±0.0... 1.1±0.1	0.6	0.6	0.6	0.6	0.6	0.7
Vitamin B2, mg	0.7±0.1... 1.7±0.3	1.0	1.0	1.0	1.0	1.0	0.9
Niacin, mg-ekv	11.9±0.4... 25.4±3.7	15.4	14.3	14.9	15.1	13.9*	9.4
Vitamin B6, mg	0.6±0.0... 1.4±0.1	0.9	0.9	0.9	0.9	0.9	0.8
Vitamin B12, µg	2.3±0.3... 23.4±21.6	6.5	7.4	6.9	6.8	7.5	0.7
Folic acid, µg	85±.13… 186±26	127	112	121	123	112*	111
Vitamin C, mg	12.3±2.2... 54.0±11.0	28.7	29.1	29.0	28.9	29.9	38.3
Sodium, mg***	903±74... 3906±198	2110	1372	2005	2119	1427**	595
Potassium, mg	1783±89... 4215±21	2303	2013	2180	2216	2000**	935
Calcium, mg	446±15... 1268±107	686	593	668	681	597**	510
Magnesium, mg	166±6... 394±63	217	184	211	216	184**	102
Phosphorus, mg	781±47... 1896±176	1038	891	1003	1026	889**	383
Iron, mg	6.4±0.2... 14.7±2.7	9.3	8.1	9.1	9.3	8.1**	4.7
Zinc, mg	5.9±0.4... 14.0±1.6	8.0	6.7	7.7	7.9	6.7**	5.5
Copper, mg	621±30... 2279±1292	1091	1047	1108	1120	1050	485
Iodine, µg	110±7... 364±83	203	150	194	202	153**	77
Selenium, µg	37.4±6.0... 91.5±9.5	50.0	41.6	47.5	48.7	41.4**	20.4

* $p<0.05$ ** $p<0.0001$ significant difference between the first and the second period's micronutrient intake *** RDI is for maximum intake

Table 2. Distribution of energy intake by various meals

	RDI[6]	All menus (*n*=57)	Energy intake <1290 kcal (*n*=5)	Energy intake 1390±100 kcal (*n*=35)	Energy intake >1490 kcal (*n*=17)
Breakfast, kcal	500	396	358	385	432
Lunch, kcal	640	659	617	626	741
Snack, kcal	280	401	282	375	490
Breakfast, %E	35	27.5	28.5	27.8	26.0
Lunch, %E	45	45.3	49.1	45.2	44.7
Snack, %E	20	27.2	22.4	27.0	29.2
Breakfast below 500 kcal		54	5	35	14
Lunch below 640 kcal		13	2	10	1
Lunch over 640 kcal		44	3	24	17
Snack over 280 kcal		51	2	31	18

Table 3. Contribution of macronutrients and fatty acids to daily total energy (for kindergarten menus and all kindergarten days)

		Average energy intake (kcal) from KGM			Intake from AD (n=894)				
	RDI[6]	<1290 *n*=5	1390±100 *n*=34	>1490 *n*=18	Mean	Med	Min	Max	RI[8]
Proteins, %E	10-15	13.2	13.9	13.4	13.6 ± 0.1	13.5	7.5	22.4	10-15
Fats, %E	30-35	31.9	32.3	33.3	32.5 ± 0.2	32.0	13.7	54.0	25-30
Carbohydrates, %E	56-60	54.8	53.8	53.3	53.9 ± 0.2	54.2	34.4	72.7	55-60
Saturated fatty acids, %E	10-12	15.1	15.0	14.8	14.5 ± 0.1	14.4	4.0	23.6	10
Mono-unsaturated fatty acids, %E	10	9.2	9.8	10.2	9.9 ± 0.1	9.5	3.6	18.9	10-15
Polyunsaturated fatty acids, %E	10	5.1	5.1	5.8	5.7 ± 0.1	5.2	1.5	17.4	5-10
Other fats, %E	-	2.5	2.4	2.4	2.4 ± 0.0	2.4	1.2	5.9	-

Table 4. Vitamin D and C, calcium, iron and sodium intakes (% of total intake) from different food groups from kindergarten menus

	Vitamin D	Vitamin C	Calcium	Iron	Sodium
Grain products	0.9	0.0	4.4	59.4	20.7
Vegetables	0.0	30.4	4.8	7.0	6.1
Potatoes	0.0	17.6	1.1	8.8	0.1
Fruits, berries	0.0	15.9	1.1	2.0	0.3
Milk products	20.9	13.3	82.9	2.4	11.5
Meat-fish-poultry-egg	54.9	0.9	3.6	16.9	10.3
Added fats	23.2	0.0	0.5	0.4	5.8
Sugar etc	0.1	0.0	0.1	0.4	0.0
Beverages, salt, other foods	0.0	21.9	1.6	2.7	45.3

ELULOOKIRJELDUS

1. Isikuandmed

Ees- ja perekonnanimi	Tagli Pitsi
Sünniaeg ja –koht	20.03.1972, Tallinn
Kodakondsus	Eesti
Perekonnaseis	vabaabielus
Lapsed	Sarah Marion Mikk (12), Emil Marvin Mikk (6), Nils Marten Mikk (4), Jens Martin Mikk (2)

2. Kontaktandmed

Aadress	Toiduainete instituut, Tallinna Tehnikaülikool, Ehitajate tee 5, Tallinn 19086, Eesti
Telefon	+372 5185960
E-posti aadress	tagli@hot.ee

3. Hariduskäik

Tallinna Tehnikaülikool	2001-2006	Toiduainete töötlemise õppesuund/ doktorant
Tallinna Tehnikaülikool	1995-1997	Toiduainete töötlemise õppesuund/ magister
Tallinna Tehnikaülikool	1990-1995	Toitlustamise tehnoloogia/insener
Tallinna 21. Keskkool	1979-1990	

4. Keelteoskus

Eesti keel	emakeel
Inglise keel	hea
Soome keel	hea
Vene keel	rahuldav
Rootsi keel	algteadmised

5. Täiendõpe

märts-aprill 2003	TTÜ, Pedagoogika ja andragoogika

6. Teenistuskäik

2006 - …	Tervise Arengu Instituut, toitumise ekspert
1998 - …	Tallinna Tehnikaülikool, toiduainete instituut, assistent
1995 - 1997	Tallinna Tehnikaülikool, toiduainete instituut, insener

7. Kaitstud lõputööd

Magistritöö	Koolitoidu menüüde tasakaalustamine
Diplomitöö	Micro-Nutrica kasutamine tervisliku lastetoidu programmis

8. Teadustöö põhisuunad: laste toitumine

9. Teised uurimisprojektid: toitumine, toitumise andmebaasid

APPENDIX 2

CURRICULUM VITAE

1. Personal particulars

First name and surname	Tagli Pitsi
Date and Place of birth	20.03.1972, Tallinn
Citizenship	Estonian
Marital status	cohabitation
Children	Sarah Marion Mikk (12), Emil Marvin Mikk (6), Nils Marten Mikk (4), Jens Martin Mikk (2)

2. Contact data

Address	Department of Food Processing, Tallinn University of Technology, Ehitajate tee 5, Tallinn 19086, Estonia
Telephone	+372 5185960
e-mail	tagli@hot.ee

3. Education

Tallinn University of Technology	2001-2006	Food Processing/Ph.D.
Tallinn Technical University	1995-1997	Food Processing /MSc.
Tallinn Technical University	1990-1995	Catering Technology/ graduate engineer
Tallinn Secondary School No 21.	1979-1990	

4. Languages

Estonian	native language
English	good
Finnish	good
Russian	satisfactory
Swedish	basic knowledge

5. Additional studies

March-April 2003 Pedagogy and androgogy, TUT

6. Professional Experiences

2006 - …	National Institute for Health Development, nutrition expert
1998 - …	Tallinn Technical University, Department of Food Processing, assistant worker
1995 - 1997	Tallinn Technical University, Department of Food Processing, engineer

7. Defended theses

Master Degree thesis	Balancing of School Menus
Diploma work	Using Micro-Nutrica in Healthy Child Food Programme

8. Current research program: children nutrition

9. Other research programs: nutrition in general, food composition databases

PUBLICATIONS RELATED TO THE TOPIC

1. Knuts, L-R., Rastas, M., Seppänen, R., Haapala, P. Micro-Nutrica: version 2,0 Manual of Nutrition programme Micro-Nutrica. – *Toit ja Toitumine. Food and Nutrition* II/ Süvalep, I., **Pitsi, T**. Department of Food Processing. Tallinn: Tallinn University of Technology, 1996. 96 pp (in Estonian)
2. Chemical Composition Tables. – *Toit ja Toitumine III. Food and Nutrition* IV/Department of Food Processing. Tallinn: Tallinn University of Technology 1997, 86 pp. (in Estonian).
3. Children' food I & II. Department of Food Processing. Tallinn University of Technology. Quickprint. Tallinn, 1999. 99 pp, 91 pp.
4. **Pitsi, T.**, Vokk, R. Kindergarten nutrition surveys 1995-1996. – *Toit ja Toitumine. Food and Nutrition* VII/Department of Food Processing. Tallinn: Tallinn University of Technology 1999, p 24-40.
5. **Pitsi, T.**, Liivand, P., Ilves Annunziata, A-R., Veldre, G., Minajeva, A. Analysis between kindergarten-aged children nutrition and nutrient intakes from kindergarten menu. – *Toit ja Toitumine. Food and Nutrition* XI/Department of Food Processing. Tallinn: Tallinn University of Technology 2003, p 52-66. (in Estonian)
6. **Pitsi, T**., Ilves Annunziata, A-R. Dietary surveys of children – brief overview of the related methods, analysis software, institutions under survey and resulting recommendations. – *Toit ja Toitumine. Food and Nutrition* XIII/Department of Food Processing. Tallinn: Tallinn University of Technology, 2005, p 12-15.
7. Vokk, R., Liebert, T., **Pitsi, T.**, Pappel, K. School Lunch Program. In: *The Health of Children and Youth – 10 years of the National Health Programme for Children and Youth.* National Institute for Health Development, 2005, p 28-30, 57. (in Estonian)

OTHER PUBLICATIONS

1. **Pitsi, T.**, Liivand, P., Ilves Annunziata, A-R., Veldre, G. The consumption of calcium and dairy products in 1996 and 2002 in a sample of children in central Tallinn and Viljandi County. – *Toit ja Toitumine. Food and Nutrition XII/* Department of Food Processing. Tallinn: Tallinn University of Technology, 2004, p 17-33.
2. Jaansoo, S., **Pitsi, T**. Menu planning for Estonian prisons. – *Toit ja Toitumine Food and Nutrition XII/* Department of Food Processing. Tallinn: Tallinn University of Technology, 2004, p 34-40.
3. **Pitsi, T**., Liivand, P., Ilves Annunziata, A-R., Veldre, G., Minajeva, A. Analysis between kindergarten-aged children nutrition and nutrient intakes

from kindergarten menu. Poster presentation in Science Conference of XXVIII Estonian Chemistry Days, 2002 (in Estonian)

4. Liebert, T., **Pitsi, T**., Vokk, R. Analyses of school lunch menus. – *Toit ja Toitumine. Food and Nutrition* X/Department of Food Processing. Tallinn: Tallinn University of Technology 2002, p 93-104.
5. Vokk, R., Liebert, T., Pappel, K., **Pitsi, T.**, Lipre, E. School lunch in Estonia: dietary habits and food preferences of schoolschildren. – *Toit ja Toitumine. Food and Nutrition* X/Department of Food Processing. Tallinn: Tallinn University of Technology, 2002, p 78-92.
6. Peterson, J., Koskel, S., **Pitsi, T**., Thetloff, M. Epidemiology of eating behaviour and body build in 17-to-o23-year-old Estonian students. *Papers on Anthropology VIII*, *Eesti Antropomeetria Aastaraamat VIII*, Tartu: University of Tartu, 1999, p 146-158.
7. Vokk, R., Liebert, T., Tedersoo, E., **Pitsi, T.**, Pappel, K. The dietary habits and school lunch quality of Estonian schoolchildren. NJF XXI Congress, June, 28 – July, 1.1999, Jordbruk og samfunn, Congress Rapport Nordisk Jordbrugsforskning, 1999, Nr.2. argang 81, p. 249.
8. Vokk, R., **Pitsi, T**. School Nutrition Surveys 1996-1997. – *Toit ja Toitumine. Food and Nutrition* X/Department of Food Processing. Tallinn: Tallinn University of Technology, 1999, p 53-64.
9. School food. Department of Food Processing. Tallinn University of Technology. Quickprint. Tallinn, 1998. 88pp. (in Estonian)
10. **Pitsi, T**., Vokk, R., Liebert, T. Chemical Composition of Food Analyses of School Lunches, 23rd Estonian Chemistry days, Abstracts of Chemical Conference, Tallinn, 1997.
11. **Pitsi, T**., Vokk, R., Liebert, T. Chemical Composition of Food Analyses of School Lunches, 1st Conference of the European Network of Health Promoting Schools, 1997, Halkidiki/Thessalonoki, Greece.
12. Vokk, R., Liebert, T., **Pitsi, T**., Süvalep, I. About nutrition surveys in Estonia. Conference of Estonian Scientists, August 11-15, 1996. Tallinn, TA kirjastus, 1996, p 289. (in Estonian)
13. **Pitsi, T.**, Süvalep, I., Vokk, R., Liebert, T. The monitoring of children nutrition and nutrition information in Estonia. The Conference of Health Protection Project Reports, June 11, 1996. Tallinn, 1996, p 7. (in Estonian)