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Contribution of Liidia Kiisk to the preparation of the original publications: study design, examination of patients, data collection, statistical data analysis, and writing of the manuscript of all 6 original publications.

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ABBREVIATIONS

ALB	Albumin
BF	Body Fat
BFM	Body Fat Mass
BH	Body Height
B-Hb	Blood Hemoglobin
BIA	Bioimpedance
BLM	Body Lean Mass
BMD	Bone Mineral Density
BMI	Body Mass Index
BSA	Body Surface area
BW	Body Weight
Chol	Cholesterol
CKD	Chronic Kidney Disease
CKD-MBD	Chronic Kidney Disease-Mineral and Bone Disorder
CVD	Cardiovascular Disease
Db	Body Density
DXA	Dual energy X-ray absorptiometry
eGFR	Estimated Glomerular Filtration Rate
e-HL	Electronic-Health computer system
ESKD	End-Stage Kidney Disease
FFM	Fat Free Mass
FFQ	Food Frequency Questionnare
FM	First Measurements
FU	Follow-up Measurements
HC	Hip Circumference
HD	Hemodialysis
HDL	High density lipoprotein
HHCY	Hyperhomocysteinaemia
K/DOQI	Kidney Disease Outcomes Quality Initiative
KDIGO	Kidney Disease: Improving Global Outcomes
KTR	Kidney transplant recipient
KTx	Kidney transplantation
LDL	Low density lipoprotein
LM	Last Measurements
MDRD	The Modification of Diet in Renal Disease
NKF	National Kidney Foundation
PD	Peritoneal dialysis
PTH	Parathyroid Hormone
RRT	Renal Replacement Therapy
SD	Standard Deviation
SGA	Subjective Global Assessment
TG	Triglyceride

TP	Total Protein
WC	Waist Circumference
WHO	World Health Organisation
WHR	Waist to Hip Ratio
WKD	World Kidney Day

1. INTRODUCTION

Chronic kidney disease (CKD) is a disease characterized by a progressive loss of kidney function which develops within years or decades. Kidney diseases are common, harmful, and often treatable. The most common causes of kidney disease are diabetes, hypertension and renal vascular diseases. CKD is a worldwide problem in the modern world, mostly caused by ageing and an unhealthy lifestyle. The first consequence of undetected CKD is the risk of developing progressive loss of the kidney function that can lead to end-stage kidney disease (ESKD) which needs renal replacement therapy (RRT) – either a regular dialysis treatment or a kidney transplant to survive. The second consequence of CKD is that it increases the risk of premature death from associated cardiovascular disease (myocardial infarction or strokes). The individuals who appear to be healthy but are later found to have CKD have an increased risk of dying prematurely from cardiovascular disease regardless of whether or not they ever develop ESKD (Cardiovascular Disease. World Kidney Day 2015). Therefore, the optimal treatment of kidney disease and the management of risk factors (hypertension, smoking, unhealthy diet, overweight) are essential to arrest the progression of kidney disease as well as cardiovascular disease. However, when ESKD develops, kidney transplantation is the most efficient method of treatment in the final stadium of CKD beside dialysis treatment. In conjunction with the development of medical science and a wider choice of treatment, the role of kidney transplantation for the patients of renal replacement therapy (RRT) is increasing from year to year.

During the period from 1968 to 2015, over 1,000 kidneys were transplanted in Estonia. Each year, on average, 30–40 transplantations of cadaveric or live donor kidneys were carried out. The retrospective RRT patients' epidemiological data analysis in Estonian hospitals indicated that in the year 2000 there were only 161 patients with a transplanted kidney, which constituted 58 percent of the patients needing RRT treatment, but by the year 2014 the number of patients with a transplanted kidney had increased thrice: 496 kidney transplant recipients formed 59 percent of all the RRT population (Epidemiological Data Chronic Kidney Disease in Estonia, Annual Report 2014). In Estonia, kidney transplantations are performed at the Tartu University Hospital. After the transplantation of a kidney, the patient gets hospital treatment for a couple of weeks at the Surgical and Internal Medicine Departments. Thereafter, outpatient observation will at first take place two times a month, later at intervals of 1–2 months. A nephrologist carefully monitors the state of the transplanted kidney but many patients need additional counselling.

CKD progression prevention, including kidney transplant nephropathy progression prevention, comprises drug and non-drug treatment where lifestyle modification has special significance. Therefore, it is of essential importance that in every patient with a transplanted kidney, beside drug treatment, sufficient attention is paid to nutritional issues. Having a healthy diet, avoiding weight gain and excessive amounts of alcohol, also regular exercising can reduce the potentiality of developing chronic transplant nephropathy. For this reason, nutrition counselling is usually performed for kidney recipients by a dietitian who considers each patient's age, gender, the stage of chronic kidney damage, body build, eating habits, the twenty-four-hour need for food energy and nutrients.

Over the years, a need arose for more contemporary, profound and internationally recognized diets which consider the needs of hospitals and at the same time are related to the patients' eating habits. In the year 1990, the reorganization of medical nutrition was started at the Tartu University Hospital. The establishment of the system of diets was the first step in the modernization of diets, taking different diseases into consideration. While developing the system of diets, the experience of the dietitians of the Central Hospital of the University of Kuopio and the Meilahti Hospital of the University of Helsinki were taken into account.

Since 3 February 1997, three software programs have been developed: the first computer software program MediC, developed in Tartu, the second computer software program 7+7, and the last electronic-Health computer system (e-HL) in 2008. They have been implemented in the work of organizing nutrition plans for patients. The author of the thesis has been the main consultant in the development and implementation of the system of diets for these programs. Since 14 November 2002, the unified system of diets applied in the hospitals of Tartu was taken into use in all medical institutions of the Republic of Estonia (Regulation no 131, Estonian Ministry of Social Affairs, 2002). The created system allows patient counselling which considers a patient´s disease, the type of body build and the peculiarities of metabolism, the performed clinical analyses. The codified system of ordinary foods and diets has been incorporated in the data base which takes into consideration the specific features of treatment as well as the nutritional needs of the hospital and outpatient departments. Beside inpatient counselling, a dietitian's task is also to inform and carry out further education courses for medical personnel.

Considering the ideas given above, the author of the thesis set herself the aim to assess, in a complex manner, the biochemical analyses of blood, the anthropometrical and nutritional peculiarities of the patients with the transplanted kidney within three years after transplantation when the main changes of body composition and difficulties to maintain body weight take place. According to literature, the main problem after kidney transplantation is the gain of body weight; therefore, we planned to test if intensive nutritional counselling has an effect on patients' nutritional habits in preventing the gain of body weight.

2. REVIEW OF LITERATURE

2.1. Peculiarities of the progression of chronic kidney disease

2.1.1. Chronic kidney disease: epidemiology and classification

Chronic kidney disease (CKD) is an important determinant of the poor health outcome for the major non-communicable diseases that are the leading cause of death worldwide. CKD is a worldwide public health problem in connection with the ageing of the population, changing of eating habits, growth in body weight, the increase in the frequency of diabetes and other reasons.

Between 8–10 percent of adult population have a form of kidney damage, and every year millions die prematurely of the complications related to CKD (Chronic Kidney Disease. World Kidney Day 2015). It has also been noticed that there is a tendency of growth in the number of the patients who have CKD and need kidney replacement treatment (Locatelli et al. 2001, Locatelli 2002). In Europe, the ERA-EDTA Registry study showed that in the data of the renal replacement therapy (RRT), the incidence rate between the periods 1997–2001 and 2002–2006 increased linearly by 2.7% per year. Thereafter, a newer study indicated that the rise in the incidence rate of RRT in several age groups has now stabilized in many countries, including Estonia (Kramer et al. 2009). The prevalence of RRT still has an increasing tendency in all countries because the therapy of RRT patients has improved and the mortality rate has decreased during the last decade.

The main causes of CKD are: chronic glomerulonephritis, hypertension, diabetic nephropathy, chronic pyelonephritis, polycystic kidney disease and other kidney diseases. Kidney transplantation is the most efficient method of treatment in the final stadium of CKD beside dialysis treatment. In conjunction with the development of medical science and a wider choice of treatment, the role of kidney transplantation for renal replacement therapy (RRT) patients is increasing from year to year. However, because of progressive damage during the lifespan of the graft, a patient with a transplanted kidney is also considered to be a CKD patient.

Chronic kidney damage is defined as the presence of structural abnormalities of the kidney that can lead to decreased kidney function (K/DOQI 2002, KDIGO 2012). According to CKD clinical practice guidelines and management, the definition of CKD is abnormalities or a decreased level of kidney function or kidney structure, present for three months or more, with the implications for health. CKD is classified based on the cause, the GFR category, and the albuminuria category (KDIGO 2012). The classification by CKD categories helps to work out strategies to improve outcomes. Marcén and co-authors throughout 5–10 years of investigation of four hundred and forty-seven cadaveric kidney transplant patients diagnosed CKD, and observed the increased risk of the graft loss based on the estimated glomerular filtration rate (e-GFR) in more than 60% of patients. They also found other accompanying changes in connection with GFR decrease in the kidney transplant patients, such as anaemia, hypertension, rejection and dyslipidaemia (Marcén et al. 2005).

2.1.2. Progression of chronic kidney disease

The progression of CKD, including chronic transplant nephropathy, is characterized by the loss of renal cells and their replacement with extracellular matrix and fibroblasts. The progressive loss of renal function is a common phenomenon in renal failure irrespective of the underlying cause of kidney disease (Hayslett 1979, Remuzzi et al. 1997, Ots et al. 2000). Once a critical amount of nephron mass has been lost, the progression of CKD is irreversible and results in end-stage renal disease (ESRD) and the need of renal replacement therapy (Brenner et al. 1982). Among the risk factors for the development of CKD, similar risk factors can be found which influence the development of cardiovascular disease (CVD): high blood pressure, diabetes, overweight, hypercholesterolemia, smoking, age over 50 years and others. Later, in the progression of CKD anaemia, mineral metabolism disorders and bone disease, abnormalities as well as premature atherosclerosis develop which then in turn predispose the development of ESKD. The progression of CKD often lasts for years or decades, and the end stadium kidney disease develops where RRT is needed.

Organ transplantation has always been considered to be the optimal therapeutic intervention in patients with end-stage organ failure but one of the crucial drawbacks in successful renal transplantation is chronic allograft rejection (Khan et al. 2016). Whereas immunological mechanisms dominate the injury that leads to chronic allograft dysfunction and nephropathy, there is circumstantial evidence that non-immunological factors, such as advanced age, hyperfiltration, overweight, delayed graft function, heavy proteinuria, smoking, anaemia, arterial hypertension, hyperlipidaemia also play an important role in the progression (Young et al. 2010).

2.1.3. Prevention of the progression of chronic kidney disease

For the countries in the WHO European region, an action plan has been drawn up to reduce risk factors and control premature deaths from non-communicable diseases (NCD) ”Global action plan for the prevention and control of non-communicable diseases 2013–2020”. In the action plan, global risk factors were noted, such as tobacco use, salt intake, physical inactivity, high blood pressure and the use of alcohol. The report also gives information about NCDs and the guidance how to prevent and control them (WHO 2015). All these general recommendations fit in the management of CKD progression and nutrition modification as well.

Today, the prevention of the progression of CKD is one of the most important tasks among the management of chronic diseases. The growth in the number of CKD patients is an important problem to the health care system because of the cost (Liyanage et al. 2015) and the decline of the patients' life quality (Aggarwal et al. 2016): this is why a lot of capacious experimental and clinical research has been carried out for slowing the progression of kidney diseases. Early recognition with screening programs of CKD and co-morbid conditions, like hypertension, diabetes, or toxic environments, can potentially slow progression to renal failure, improve the quality of life and reduce health-care cost. Prevention, early detection, and proper treatment of CKD help reduce the risk of CKD complications and progression to ESKD. There are effective interventions to prevent or delay the progression of CKD, which result in less ESKD and cardiovascular comorbidity. These interventions focus on risk factor modification and should be initiated as early as possible to be most effective. Persistent albuminuria or proteinuria should always be evaluated and it is an independent marker for the progression of disease and mortality. Angiotensin blockade is a cornerstone of therapy for CKD. The blockade of the renin-angiotensin-aldosterone system preserves the kidney function not only by lowering blood pressure, but also by reducing proteinuria and exerting additional anti-proteinuric, anti-fibrotic, and anti-inflammatory effects (Kato et al. 1999). Kidneys belong to the cardiovascular system and this is why the same essential factors are taken into consideration: hypertension, overweight, hyper-lipidaemia, hyperglycaemia, but also smoking and an unhealthy diet. Additionally, other modifiable risk factors, such as anaemia, metabolic acidosis, dyslipidaemia, and altered bone-mineral homeostasis may also contribute to the progression of CKD. It is recommended to prevent or, if possible, treat all risk factors to avoid kidney disease progression (Chertow et al. 1997, Jardine 2000, Schwenger et al. 2001). The increasing use of treatments to attenuate progressive CKD, most notably glycaemic control in diabetic CKD and blood pressure treatment with ACE inhibitors and ARBs in almost all forms of CKD, have coincided with a plateau in the incidence of ESKD in the United States over the past few years (Turner at al. 2002). Similar tendencies have also been seen in other countries including Estonia (Epidemiology data of CKD in Estonia, 2014).

2.1.4. Role of nutrition in the progression of chronic kidney disease

Patients with CKD have many challenges including the management of multiple medications, major changes in diet, and surgery for dialysis access months before any symptoms of kidney failure occur. Chronic kidney disease (CKD) requires extensive changes regarding food and lifestyle. Poor adherence to diet, medications and treatments has been estimated to vary between 20% and 70%, which in turn can contribute to increased mortality and morbidity. Delivering effective nutritional advice to patients with CKD coordinates multiple diet components including calories, protein, sodium, potassium, calcium, phosphorus, and fluid (Beto et al. 2000). Multidisciplinary CKD programs use patient education, nutrition resources, and guideline-driven nephrology care to achieve the goals of decreasing cardiovascular morbidity and slowing the progression of renal disease (Turner et al. 2002).

Although prevention of the progression of CKD should begin early in the course of CKD with reno- and vasoprotective medications (Laures et al. 2005), the importance of a proper renal individualised diet and physical activity recommendations cannot be underestimated. However, giving proper diet recommendations for CKD patients is not as easy as believed. Before giving any advice, much work should be done with every single individual considering the patient's diagnosis, body measures, laboratory values and other factors. Dietary intake studies have shown difficulties in adhering to the scope and complexity of the diet parameters for CKD. No single educational or clinical strategy has been shown to be consistently effective across CKD populations. The highest adherence has been observed when both diet and education efforts are individualized for each patient and adapted over time to changing lifestyle and CKD variables (Beto et al. 2000).

Thus, in anticipating the progression of CKD, non-drug methods are integrated into the changes of the patient's lifestyle as complex treatment recommendations. The aim of this type of treatment is to keep the lowered kidney function stable to slow down the progression of kidney and heart disease.

2.2. Anthropometrical investigations of the patients with chronic kidney disease

The importance of anthropometrical investigations of CKD patients during the course of the progression of the disease has been appreciated by many authors (Meier-Kriesche et al. 1999, Meier-Kriesche et al. 2002, El Haggan et al. 2002, Moreau et al. 2006, Marcén et al. 2007, Chang and McDonald 2008, Zaydfudim et al. 2010, Hoogeveen et al. 2011, Zrim et al. 2012, Curran et al. 2013). Although basic anthropometry is in use in the clinical routine in nephrological practice, no systematic investigations have been carried out among kidney disease patients in Estonia. Today, anthropometry is an important measurement on the basis of scientific literature and should be used in various categories of CKD patients, including kidney transplant patients for the estimation of body composition before nutritional counselling (NKF-K/DOQI 2002, KDIGO 2012).

Anthropometry is the science of measuring the height, weight and size of component parts of the human body, including skinfold thickness, to study and compare the relative proportions under normal and abnormal conditions for the use in anthropological classification and comparison (Mosby's Medical Dictionary 2009). The first measuring of the proportions of the human body in growth and development was carried out in Italy nearly three centuries ago. The first book about changing proportions was written by an art professor and it was entitled "Anthropometria" (Knussmann 1988). The anthropometric standardization reference manual for anthropometric measurement procedures and over 40 anthropometric dimensions was written by Timothy G. Lohman and co-authors and it was used by researchers or for clinical purposes to measure the human body (Lohman et al. 1991). The measurement technique of skinfold thickness followed the methodology provided in Harrison's handbook "Skinfold thicknesses and measurement technique" (Harrison et al. 1991).

Anthropology became an independent branch of science during the latter half of the 19th century, although its roots extend into the distant past (Kongo 2009). The underlying principles of anthropometric research were derived by R. Martin (1864–1924). His textbook became an authoritative handbook of anthropometric measurement methods and has served as the foundation for measurement methodology until the present time (Martin 1928).

Anthropometrical investigations. Body weight (BW) remains an important anthropometric variable by screening malnutrition or obesity. The accuracy of the study can be improved by paying attention to the details of the techniques of the measurement of body composition as well as to proper terminology for all anthropologists, anthropometrists or medical researchers (Hertzberg 1968, Tesedo et al. 2011).

Other important anthropometrical parameters measured are body height, mid-arm circumferences, waist and hip circumferences, triceps and subscapular skinfold thicknesses as well as calculated mass of body fat. The above-mentioned anthropometrical investigations constitute the main measurements recommended in clinical practice.

2.3. Body composition after kidney transplantation

After kidney transplantation, BW gain in patients generally increases which can be influenced by improved appetite and the reversal of the uremic state. However, in the long run, BW gain may appear an important risk factor for the development of chronic transplant nephropathy. Many authors have indicated the differences in the results of anthropometric measurements between male and female kidney transplant patients in the post-transplant period. In Coroas' study, during the pre-transplant period, male patients displayed undernutrition and female patients had normal BW, but in the post-transplant period the body weight increased both in male and female groups (Coroas et al. 2005). At the Vanderbilt Transplant Centre of Nashville, Tennessee, U.S., the retrospective cohort study included 464 adult kidney transplant patients and demonstrated that pre-transplant overweight and obesity do not affect the survival and physical quality of life after kidney transplantation (Zaydfudim et al. 2010). Obesity does not seem to constitute a major risk factor for adverse outcomes most notable of which are increased incidence of wound infection and continued BW gain through the first post-transplant year (Merion et al. 1991). The new immunosuppressive regimes (cyclosporine, tacrolimus) may reduce post-transplant weight gain. Marcén and co-authors studied one thousand consecutive kidney transplant recipients and indicated that post-transplant weight gain above 5% or 10% did not influence graft or patient outcomes (Marcén et al. 2007). The main post-transplant BW gain after the first year is significantly affected by the cumulative steroid dose and increased 3.9 ± 6.2 kg and after 5 years 6.2 ± 8.6 kg (van den Ham et al. 2000, van den Ham et al. 2003). Chang and co-authors studied a group of kidney patients in post-transplant periods and indicated that stable BW gain (0–4.9%) was associated with better outcomes, but the BW gain of the first year more than 20% and the second year more than 10% was associated with poorer transplant outcomes (Chang et al. 2008). Coroas and co-authors studied the evolution of anthropometrical parameters, and found that BW, body fat mass, triceps and subscapular skinfold thickness increased significantly in female transplant patients, but not in male transplant patients (Coroas et al. 2005). The rational screening of anthropometric variables is easy to use in routine care and helps to assess the nutritional status of kidney transplant patients (Briggs 2005, Moreau et al. 2006, Sezer et al. 2006). Thus, according to literature, BW gain often develops after kidney transplantation and may influence the long-term outcome. The rational use of anthropometric measurements helps to monitor patients and should belong to routine clinical practice.

2.4. Measurements of body composition

The main components of body composition are body density (D_b) and body fat mass, and they were calculated with the help of two regression equations by Jack H. Wilmore and Albert R. Behnke or by Durnin and Rahaman (Wilmore and Behnke 1970, Durnin and Rahaman 1967). The human body build characteristics consist of body fat mass and fat-free mass components. These body composition features can be measured using direct or indirect methods. The most exact measurement results of body mass are based on hydrodensitometric measurements taken under water using the direct method. To estimate the body fat mass and lean body weight in calculation, a variety of anthropometric parameters are measured – fat folds, width and circumferences. The body mass index (BMI), waist to hip ratio (WHR), body surface area (BSA), body density (D_b), relative mass of fat by Siri, the main skinfold thickness at eleven sites and the mass of subcutaneous adipose tissue (kg; %) can be calculated using appropriate equations.

To calculate **body density** (g/cm^3), two components which characterize the body's fat mass and the body's mass without fat or muscle mass are used. The average value of D_b for fat density is 0.9168 g/cm^3 and for lean tissue density 1.0997 g/cm^3 or 0.90 and 1.1 g/cm^3, consequently the density of fat is lower than the density of muscles and bones. The basis of the two models by Brodie has been more often used for calculating body density (Brodie et al. 1998).

To calculate **body fat mass** (BF%) on the basis of the D_b, two-component models by Siri and by Brozek have mostly been used but there is no significant difference between these equations (Durnin and Womersley 1974). The BF mass is calculated from body density using the Siri equation (1956):

$$\text{BF mass (\%)} = [(4.95 / D_b) - 4.50] \times 100$$

Body surface area (BSA) is used in clinical practice to estimate the kidney graft function ratio. Body surface area is calculated with the help of the DuBois and DuBois formula (1916):

$$\text{BSA (m}^2\text{)} = 0.007184 \times (\text{patient's weight, kg})^{0.0425} \times (\text{patient's height, cm})^{0.725}$$

Body Mass Index (BMI) is the most popular index in clinical practice and it is recommended to use it together with other anthropometric features in the complex assessment of the nutrition of patients. The Word Health Organisation classification of BMI (kg/m^2) is divided into seven classes: severe underweight, underweight, normal weight range, overweight, obesity class I, obesity class II and obesity class III. However, very high BMI and very low BMI before kidney transplantation are important risk factors for kidney graft survival in long-term renal transplantation outcome (Meier-Kriesche et al. 1999, Meier-Kriesche et al. 2002, Weissenbacher et al. 2012). In the case of elevated BMI there is a bigger danger for post-operation complications (Zrim et al. 2012). Marks together with co-authors found that 23 morbidly obese kidney transplant patients (BMI 35, range 37 to 56 kg/m^2) had significantly longer hospital stays, higher read-mission rates, a higher wound infection rate, and poorer quality of life after kidney transplantation than 224 not obese recipients (BMI 25 kg/m^2) during the three-year period (Marks et al. 2004).

Waist circumference and hip circumference ratio (WHR) are similarly correlated with the measures of risk factors for coronary heart disease. Waist and hip circumferences represent visceral fat accumulation that causes obesity-related disease. A waist circumference bigger than 1,020 mm in men and 880 mm in women is a risk factor for cardiovascular disease, there is a pre-disposition for obesity (Pi-Sunyer 2000). Waist circumference and hip circum-ference as simple anthropometrical measurements are important to use in clinical practice.

However, much research has been carried out in the world studying the body composition of healthy people but there is little information about the research where all the abovementioned methods would have been used for investigating patients with a transplanted kidney (Meier-Kriesche et al. 1999, Meier-Kriesche et al. 2002, El Haggan et al. 2002, Lee et al. 2011, Weissenbacher et al. 2012).

2.5. Body composition measurements by instrumental methods: bioimpedance and densitometric investigations after kidney transplantation

The bioelectrical impedance analysis (BIA) is a commonly used method for estimating body composition, and in particular body fat. The bioimpedance method is simple, quick and non-invasive, and it is suitable for the assessment of overweight and obesity. It is possible to perform a bioelectrical impedance analysis in the patients with BMI 16–34 kg/m^2, but the method cannot be recommended for routine assessment in the patients with abnormal hydration, extreme body mass and height (Kyle et al. 2004, Kyle et al. 2004).

The bioimpedance analyses in CKD patients, in critical care patients and obese subjects have shown that the vectors falling outside 75% cases indicate abnormal tissue impedance which is combined with the changes in hydration and soft tissue mass. Harada with co-authors indicated in their study that in 37 male and 18 female kidney transplant patients, BMI, body composition by bioelectrical impedance, lipid profile, dietary and exercise protocols can prevent muscle atrophy and fat gain, and significantly decreased body water and the bone mass one year after kidney transplantation (Harada et al. 2012).

Von Düring and co-authors studied 167 patients without diabetes after kidney transplantation and found an association between BMI and 2-hour oral glucose tests. Visceral fat was better related to impaired glucose metabolism than BMI after kidney transplantation (von Düring et al. 2015). The association with central obesity should encourage additional studies on lifestyle interventions to prevent post-transplant diabetes (von Düring et al. 2015).

Dual-energy x-ray absorptiometry (DXA) is used for the measurement of bone mineral density in kidney transplant patients and the observation of skeletal status or total body composition. The DXA method is used for measuring body composition when the body is divided into fat, lean soft tissue and the bone mineral compartment. The DXA method is not for the measurement of body fat. Post-transplant bone disease evolution in kidney transplant patients depends on pre-transplant risk factors: age, gender, malnutrition, history of fractures, peritoneal dialysis or haemodialysis, the status of bone mineral density, the reduction of kidney graft function, secondary hyperparathyroidism, affected calcium and phosphorus metabolism, glucocorticoid therapy (Report of WHO Study Group 1994, London et al. 2010, Govindarajan et al. 2011).

The European Best Practice Guidelines for Renal Transplantation (EBPG) have shown that the post-transplant bone disease is a multifactorial disease (EBPG Expert Group on Renal Transplantation 2002). Approximately 7–10% of kidney transplant patients are predisposed to the progressive bone disease, but also to fractures of vertebrae. The fracture frequency is even higher in post-menopausal kidney transplant patients. Sikgenc and co-authors indicated that the bone disease is very common in the region of lumbar vertebra and they found that T-scores were normal in 21.2%, osteopenia in 49.4% and osteoporosis in 29.4% of transplant patients in the first years after kidney transplantation (Sikgenc et al. 2010). Grotz and co-authors studied 115 kidney transplant patients and found the reduction of bone loss (7 ± 10%; 1 ± 9%) in the region of lumbar spine in the first and the second year after kidney transplantation (Grotz et al. 1995). Many investigations have proved the importance of densitometry among other body composition measurement methods, and the need for a complex preventive and individual therapeutic treatment by increase in bone mineral density in kidney transplant patients in the pre- and post-transplant period (Mazzaferro et al. 2006). DXA can be used in clinical care to validate other bioimpedance and anthropometrical methods (Haapala et al. 2002, Leib et al. 2004, and Leib et al. 2006). The guidelines of KDIGO 2012 suggest that bone mineral density testing is not performed routinely in clinical practice in those with eGFR < 45 ml/min/1.73 m^2 as information may be misleading or unhelpful (KDIGO 2012), but in scientific work instrumental body composition investigations are important for the comparison with anthropometrical data and for further understanding of body composition peculiarities.

2.6. Laboratory investigations in kidney transplant patients

Serum creatinine and glomerular filtration rate. Over the years, chronic kidney injury also develops in the transplanted kidney and represents a progressive, irreversible decline of the kidney function assessed by GFR. Elevated serum creatinine in kidney transplant patients has been shown as a strong and independent risk factor for cardiovascular all-cause mortality, but not for a stroke or non-fatal myocardial infarct (Fellström et al. 2005). According to the clinical guidelines recommendations (KDIGO 2012) clinicians should use a glomerular filtration estimating equation (eGFR) in CKD patients to derive GFR from serum creatinine rather than relying on the serum creatinine alone. The Modification of Diet in Renal Disease (MDRD) equation was recommended to classify the stages of chronic kidney disease by the National Kidney Foundation's Kidney Disease Outcomes Quality Initiative (NKF-K/DOQI 2002), and the recommended definition for CKD of a GFR < 60 ml/min per 1.73 m^2 (National Kidney Foundation 2002, Levy et al. 2011). Today, CKD classification has been updated and should be based on a cause, GFR category (6 categories) and albuminuria category (KDIGO 2012). According to KDIGO, the report of $eGFR_{creat}$ in adults should be performed using the CKD-EPI creatinine equation (KDIGO 2012).

C-reactive protein. The inflammatory status and the oxidative stress play a role as aggravation or progression factors of CKD (Locatelli et al. 2004, Annuk et al. 2005, Gluba et al. 2010, Fernández-Fresnedo et al. 2010). A risk for cardiovascular disease and its mortality risk are associated with C-reactive protein level (CRP). Winkelmayer and co-authors studied 438 kidney transplant patients and found that a CRP level over 5 mg/L was associated with an 83% greater mortality risk when compared with the patients of lower serum CRP values (Winkelmayer et al. 2004). After kidney transplantation, most of the patients' inflammatory status with high CRP decreased to the normal level and the serum albumin level increased rapidly to reach normal values by the end of the first month and stabilized thereafter (Moreau et al. 2006).

Proteinuria. The development of proteinuria in kidney transplant patients is a hallmark of kidney damage. Proteinuria after kidney transplantation is significantly associated with cardiovascular disease (CVD) and the decreased kidney function (Ibis et al. 2009, Nauta et al. 2011). Guida and co-authors indicated the role of dietary intervention on metabolic abnormalities in forty-six recipients after kidney transplantation in the first post-transplant year and follow-up of a 12-month period, and in conclusion indicated that an adequate dietary regimen is associated with a reduction in BW and lower plasma levels of cholesterol, triglycerides and glucose, and can reduce the risk of long-term complications (Guida et al. 2007). KDIGO guidelines suggest lowering protein intake to 0.8/kg/day in adults with diabetes or without diabetes a GFR < 30 mL/min/ 1.73m^2 (KDIGO 2012). The same guidelines suggest avoiding high protein intake (> 1.3/kg/day) in adults with CKD at progression (KDIGO 2012). KDIGO guideline recommended measuring serum levels of calcium, phosphate, PTH, and alkaline phosphatase activity at least once in adults with GFR 45 mL/min/1.73 m^2 (KDIGO 2012).

Anaemia. The pathogenesis of anaemia in kidney transplant patients is multifactorial and associated with iron, vitamin B12 and folic acid deficiency, and an inflammatory state induced erythropoietin resistance. Intracellular folate and vitamin B12 deficiency contribute to these complex metabolic defects and may contribute to a worse prognosis in CKD patients by altering gene expression, the synthesis of membrane proteins, phospholipids and neurotransmitters (Herrmann et al. 2007). The retrospective study of 100 anaemic kidney patients (the mean haemoglobin value was 10.2 ± 1.4 g/dL for female and 9.9 ± 1.3 g/dL for male patients) indicated that vitamin B12 and folic acid deficiency were the major causes of nutritional anaemia (Karakus et al. 2004). Sezer and co-authors excluded iron, vitamin B12 and folic acid deficiency in the study of 229 renal patients and found the prevalence of anaemia which increased in parallel with the post-transplant duration: 41.5%, 35.3% and 93.2% at 3, 5, and 10 years (Sezer et al. 2006). Cross-sectional study data from ten European centres were collected from 5,834 renal post-transplant patients, and there were 42% of anaemic patients whereas only 24% of them were getting an erythropoiesis-stimulating agent treatment (Molnar et al. 2011).

Homocysteine. Hyperhomocysteinaemia (HHCY) is a cardiovascular disease risk factor for kidney transplant patients depending on other determinants: age, genetic polymorphisms, B-vitamins and albumin levels, renal function (Frideman et al. 2002, Teplan et al. 2003). HHCY > 17 μmol/L is very common in patients with CKD and is considered an independent risk factor for atherothrombotic vessel cardiovascular disease in these patients. Winkelmayer and co-authors studied 733 kidney transplant patients during a median follow-up of 6.1 years and indicated that an elevated homocysteine level ≥ 12 μmol/L) was associated with the increased risk of kidney allografts loss in 260 patients and 154 patients died (Winkelmayer et al. 2005). Einollahi and co-authors studied 159 kidney transplant patients, and indicated that serum creatinine concentration was the major determinant of increased HCY concentration in renal transplant recipients. Their study found no correlations between the kidney graft function and HCY concentration (Einollahi et al. 2011).

Hyperparathyroidism, calcium and vitamin D deficiencies predispose bone disease progression and increased fracture rates after kidney transplantation. The highest parathyroid hormone (PTH) production was observed in the first post-transplant year, but at the later post-transplantation period it had a tendency to decrease. Parathyroid glands' hyperfunction, negative effects of steroid therapy, disorders of calcium metabolism and lower kidney graft function were the most significant causes for developing osteopenia on average 5 or more years after kidney transplantation or more years after kidney transplantation (Babarykin et al. 1999).

2.7. Scientific methods of the measurement of diet and nutrition

2.7.1. Overview of nutrition history

The investigations of the influence of food on health, the supply of the organism with nutrients, biochemical and anthropometrical indicators are the themes which interest medical specialists. In the case of a particular investigation, the choice of the methods used in the nutrition investigation depends on many aspects. Nutrition investigations are planned at the level of nations or populations (adults, pupils), also at the level of the people with fixed nutrition traditions (vegetarians) or the groups of patients with the certain features of a disease (chronic heart or kidney disease, oncological diseases). Such investigations require much work and are very expensive. This is why the planned investigations and the collected data must be to the point to avoid the misleading influence of food factors. To study and assess the connections between nutrition and health, the choice of investigation methodology should be made according to the aim of the investigation.

For example, in the investigations of high blood pressure it is important to know the consumption of salt, in the case of heart diseases the quality of food fats and the amounts of food, in the case of oncological diseases the proportions of fibre, in the case of kidney diseases food protein and several microelements (potassium, sodium, phosphorus, calcium). There is no ideal methodology for nutritional research (Saava 1997). When comparing the materials of different databases, no important differences have been found in basic nutrients by chemical composition (Saava 1997, Vaask et al. 2004).

During nutrition studies or nutrition surveys, the data of dietary intake and nutritional status are collected. A dietary intake means the food or nutrient intake during which both qualitative and quantitative data are obtained about the food consumption survey and the dietary survey. A nutritional status characterizes the situation of the supply of food and nutrients during which the estimation of the situation is given through the clinical, biochemical and anthropometrical indicators.

The methods to collect the dietary intake data on an individual level can roughly be divided into two categories: short-term and long-term instruments. The short-term dietary assessment methods collect the dietary information on current intake of the previous day from recalling (24-hour recall), or the information based on keeping a record of the intake of food and drinks over one or more days (dietary record). The long-term dietary assessment methods collect information on usual food intake over the previous months or years (dietary history or food frequency questionnaire). The methods for data collection are a food record, food recall or food interview, food history and food frequency.

Food record. A dietary record of 3 days is recommended for gathering information on the mean food consumption. A well-trained professional explains to the person being studied how to write down the time of eating, the title of food, the amount of food in certain measures (a portion, a slice, a piece, a glass, a cup, etc.) or in grams, cooking methods, etc. For the skilled processing of the collected material it is important to take into consideration the amounts of food eaten by a person being studied and the percentage of loss caused in the process of cold or hot preparation (of food in Saava 1997, Biro et al. 2002).

Food recall. The 24-hour dietary recall, originally attributed to Wiehl (1942), is an interview (Biro et al. 2002). The recall period starts with the last eating event and moves 24 hours backwards. The disadvantages of the 24-hour recall include the inability of a single day's intake to describe the typical diet (PEP 6305: Measurement in Health and Physical Education 2015).

Food history. The classic version of a diet history is the Burke Diet History (Burke 1947) which consists of three components: 1) detailed questions about usual patterns of eating, organized by meals (meal pattern interview), 2) a list of foods and beverages for which usual frequency and amount are queried, and 3) a self-administered 3-day food record. The food list and the 3-day food record are used only as cross-checks to modify the information gathered during the meal pattern interview. The traditional Burke Diet History approach has been modified in a variety of ways in different research settings (Dietary Assessment Primer 2015).

Food frequency. Burke created the frequency method in 1947 when he, in addition to the 24-hour method and 3-day written questionnaire, asked questions about the food consumed during the last month (Burke 1947). Later, the correction of questionnaires was developed which can be considered the beginning of the use of the frequency method. The main principle is to learn how often a particular food was eaten (in a week, month, even a year). The respondent independently fills in the variants about the past, what was eaten and how often. In compiling the informative questionnaire, only the names of foods and nutrients, most important for the study, are taken into consideration. FFQs designed to estimate a larger number of nutrients generally include between 50 and 150 or more food items (Saava 1997, Biro et al. 2002). The investigators must be rather careful in making conclusions about the influence of food on the disease and health.

Marking the comparison of the consumption of food obtained with different methods, the results of correlation and regression analysis may not always give equal parameters for giving the estimation (Saava 1997). In addition to that, other environmental factors such as socio-economic food patterns, ethnic factors (eating patterns, meal patterns) and hereditary influence may cause different interpretation of food influence (Saava 1997). Nutrition investigations also study food availability, food consumption, food intake or dietary intake, food use at an individual, family or group level.

2.7.2. Questionnaires of nutritional habits

Guida et al. (2007) indicated the role of dietary intervention after kidney transplantation on the basis of a personal interview by a detailed food-frequency questionnaire (FFQ), including 130 foods. The quality of life and physical activity in CKD patients can be assessed, using FFQ. A special FFQ, compiled by the Centre for Physical Anthropology at the University of Tartu, has been drawn up for socio-economic, physical activity and nutrition research, including 128 foods (Kiisk et al. 2010).

The diet history questionnaire (DHQ) was first described by Bertha Burke in 1947 and it was used in population nutrition studies (Burke 1947). The original Burke questionnaire started with an overview of what was eaten during the past 24 hours and continued with the frequency of foods eaten during the past 28 days (Burke 1947). More researchers have described in their studies a diet history questionnaire (DHQ) that was developed using an audio self-administered computer-assisted interview technique, which was programmed to be self-administered using a computer with a touch screen, and includes 54 main food group questions, specific food items within the main food groups and food preparation as well as questions about general eating practice (Slattery et al. 2008).

The FFQ method is one option among other methods in the development of clinical nutrition guidelines for personal counselling. The FFQ method allows to study nutrition with the purpose of working out clinical guidelines and personal counselling. This questionnaire and adequate dietary counselling can help reduce the risk of metabolic complications in the follow-up period, and prevent significant weight gain after kidney transplantation in the long perspective.

2.7.3. The 3-day menu research

Nutritional counselling is performed by a dietitian who considers the patients' age, gender, stage of chronic kidney damage, body build, eating and meal patterns, food consumption or dietary intake as well as the need for food energy and nutrients. The traditional Burke Diet History (Burke 1947) has been modified in a variety of ways in different research settings; there are no strictly prescribing questionnaires and food diaries. Two major methods have been accepted in nutrition research: 24-hour dietary recalls and dietary records. The 24-hour dietary recall was designed to quantitatively assess current nutrient intake. The method of recall is often used, and the interview can be carried out face-to-face, by telephone or via an internet based computer program. The method is problematic due to the limitations of memory. The dietary recall is a retrospective method of dietary assessment during a determined period of time, typically the previous day or the preceding 24 hours (PEP 6305. Measurement in Health and Physical Education. Topic 15: Measuring Diet and Nutrition).

The dietary record is the main food diary method which can be used in research. The dietary record is typically obtained from 3 or 4 days. However, seven-day records were historically used as the gold standard for validating other methods. CKD patients themselves write down detailed information: food/drink name, the content of sugar and fat, including food quantities consumed.

Relying on scientific literature, no studies based on 3-day dietary records have been performed in Estonia among CKD patients, but Born and co-authors have investigated CVD patients' nutritional peculiarities with the mentioned methodology (Born et al. 2002). The researchers of other countries have studied kidney transplant patients' nutritional habits with the data analysis of only the twenty-four-hour dietary recalls or the records after kidney transplantation.

Dietary intervention plays an important role in determining the effects of the modifications of metabolic abnormalities. The cross-sectional postal Finbalt Health Monitor was carried out in the Baltic Republics and in Finland in the years 1998, 2000, 2002. They studied differences in the consumption of foods that contain fat: meat and meat products, cheese, high-fat milk, butter on bread, vegetable oil for cooking. The results of this study indicated a positive association between the level of education and consumption of vegetable oil used in food preparation. Cheese was the most popular in Finland (Petkeviciene et al. 2007).

An appropriate renal diet in CKD patients has an utmost importance in the management of these patients because they are considered to be at high risk for CVD complications. An individualized hypoenergic-hypolipidemic diet, but with folic acid and vitamin B6 supplementation can help to reduce atherosclerotic processes (Teplan et al. 2003, Teplan et al. 2007). Several authors have demonstrated the association between body weight gain and increased fat mass with energy intake whereas better results were found in males during the first post-transplant year (Guida et al. 2007, El Haggan et al. 2002). The lowering of dietary protein intake in CKD patients will prevent hyperfiltration, albuminuria and histologic changes, but the recommended dietary protein intake must be considered in adults, the level is 0.5 g/kg/day. Guida and other researchers studied the role of dietary intervention on metabolic abnormalities and nutritional status in forty-six recipients after kidney transplantation in the first post-transplant year and follow-up of a 12-month period, and in conclusion, this study indicated that an adequate dietary regimen is associated with a reduction in BW and lower plasma levels of cholesterol, triglycerides and glucose, and can reduce the risk of long-term complications (Guida et al. 2007).

The great difference between the food content of databases depend on regional variations, climatic conditions and agricultural practices. Since 1997, in the Baltic Republics, a profound computer program for the calculation of the nutritional composition menus has been implemented. It was drawn up on the basis of the Finnish Micro-Nutrica Nutritional Analysis program. Vaask with co-authors has found the differences in the observed two food databases used to convert foods into nutrient intakes: the Finnish Micro-Nutrica Nutritional Analysis program and the Russian database (Vaask et al. 2004).

Since 2010, for assessing the nutritional composition of food, a contemporary electronic nutritional program which was designed on the basis of the research data on nutrition by the National Institute for Health Development and other internationally recognized data of nutritional research (NutriData Food composition Database 2014), has been used in Estonia. The program is used for analysing foods and menus in treatment and care centres, also for drawing up personal menus and comparing nutritional recommendations for different gender and age groups. In calculating the menus, beside Estonian data bases, it is also possible to use internationally recognized data bases which contain food values for ready-made foods, fruits and vegetables which our local data bases do not contain (www.calorie-ecount.com, www.fineli.fi). If patients follow a special diet, it is recommended to consult a physician or dietitian before making any changes in the diet (www.fineli.fi; Rastas 1989).

2.8. Basis of nutritional counselling

2.8.1. Rationale of the new system of treatment diets

For several decades, the so-called Nomenclature of Pevzner Diets was used in the Estonian hospitals. Its author was professor Pevzner (1872–1952), medical researcher and gastroenterologist from Moscow University who was also the founder of clinical feeding treatment and the developer of diet treatment in Russia. The use of the system of Pevzner's diets was obligatory in all the hospitals of the Republic of Estonia (Pokrovski et al. 1981). The hospital feeding treatment relied on many legal documents, including the norms of feeding patients and the prescribed costs of daily food. All these documents gave norms to our activities and established a fixed framework with differentiated monetary and nutritional norms. Several diets, in spite of their existence in the Pevzner nomenclature, did not have a reason for such a detailed implementation. The numeration 1–15 in the classification of Pevzner's diets together with subgroups was not rational for practical use and gave no information. The feedback from the doctors of clinics showed that the choice of foods and nutrients in the menus of the patients having acute diseases of digestive tract was too small, which was not justified.

In the Maarjamõisa Hospital, the implementation of the new integrated diet system was started in 1995 to guarantee the optimal and adequate diet treatment. In connection with the formation of the food service at the Tartu University Hospital on 1 May 1999, new important issues of management and organisation beside specific dietology issues have gained importance in patients' nutrition.

The author of the thesis has drawn up a preliminary systematized list of diets (Kiisk 2002) and started to compile a collection of articles which takes the contemporary principles of feeding treatment into consideration in order to finalize the common system of diets for treatment. The updated system was developed during the doctoral studies.

2.8.2. Organization of the counselling of chronic kidney disease patients

Dietology treatment is the foundation stone of the complex treatment of CKD patients and it is the basis for the prognosis. The lifestyle counselling of CKD patients and kidney transplant patients together with dietology guidance is extremely important. According to CKD guidelines a CKD category (KDIGO 2012) should be taken into account at the same time. As already mentioned, nutritional counselling is performed by a dietitian who considers the patients' characteristics: age, gender, body build, eating and meal patterns, food consumption or dietary intake and the need for food energy and nutrients. The patients with a transplanted kidney are also considered CKD patients (KDIGO 2012).

The European Federation of the Associations of Dietitians (EFAD) defines a dietitian as a person with a legally recognised qualification in nutrition and dietetics, who applies the science of nutrition to the feeding and education of groups of people and individuals in health and disease (EDAC 2012. www.efad.org). Within Europe, the EFAD definition of a dietitian has been adopted in two categories: the dietitian and the expert. A dietitian may work in a variety of settings and have a variety of work functions. An expert is a person whose work is based on research and experience in a particular area of study. The European Dietetic Advanced Competences (EDAC) indicators are accepted by EFAD (www.efad.org).

Professional dietitians in the European countries have three main areas of specialization: the administrative dietitian, the clinical dietitian and the public health or community dietitian. The administrative dietitians' competence is food service management and providing nutritionally adequate quality food to individuals or groups in health and disease in an institution or a community setting (EDAC 2012. www.efad.org). A clinical dietitian has the competence for planning, education, supervision and education of a clinically devised eating plan to restore the client or patient to functional nutritional health, and can work in primary care as well as in institutions (EDAC 2012. www.efad.org). Public health or community dietitians are involved in health promotion and policy formulation that is focused on the promotion of food choice amongst individuals and groups to improve or maintain their nutritional health and minimizes the risk of nutritionally derived illnesses (EDAC 2012. www.efad.org).

2.8.3. Individual nutritional counselling of chronic kidney disease patients

The assessment of CKD patients' nutritional status after kidney transplantation should be associated with individual diet therapy. Individual nutritional counselling is carried out by a nephrologist or dietitian or nurse according to a particular need, kidney disease, accompanying diseases and the peculiarities of treatment. Nutritional screening or rescreening is composed of the analysis of a patient's food and nutrition history, socio-economic status, medical diagnosis, body composition, anthropometrical measurements, biochemical monitoring, food nutrient intake; and a dietitian's systematic review is also necessary in complex rehabilitation (KDIGO 2012).

At the present time, doctors in Estonia are guided by the Estonian treatment instructions (Estonian Society of Nephrology), the instructions for the treatment of kidney transplantation: immunosuppressive treatment, the routine monitoring of a patient after kidney transplantation (www.nefro.ee), or internationally recognized treatment instructions (NKF-K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease, 2002; KDIGO. Kidney Disease: Improving Global Outcomes, 2012).

Lowering excess weight is advisable for the patients with CKD and the motivation to change dietary habits should be the result of education. Patel and Nicol (1997) indicated that various renal diets are ethnically oriented, and most consider the nutritional traditions of patients' food selection. According to literature, Patel and co-authors indicated in their study a significant difference in weight gain in two groups of patients in one year after kidney transplantation. The patients with individualized intensive dietary advice had a lower weight gain (mean 5.5 kg) and the patients who had not received any dietary advice had a higher weight gain (mean 11.8 kg) after kidney transplantation (Patel and Nicol 1997, Patel 1998).

The research about the management of progression and complications in CKD patients recommended that people with CKD be encouraged to undertake physical activity compatible with cardiovascular health and tolerance (aiming for at least 30 minutes 5 times per week), achieve a healthy weight (BMI 20 to

25, according to country specific demographics), and stop smoking (KDIGO 2012). BIA is not currently used in routine clinical practice in every nephrology centre.

Intensive nutritional counselling plays an important role during the first years after kidney transplantation, allowing patients to be informed about possible body composition changes and preparing them to follow a healthy diet. Nutritional counselling can be performed according to internationally recognized CKD treatments and complex guidelines which consider socio-economic situation, education, psychosocial factors, body composition, laboratory parameters, nutritional monitoring, physical activity and other lifestyle factors.

2.9. Summary

Optimal nutritional evaluation, the use of biochemical analyses of blood together with anthropometry in clinical practice is of great importance in all chronic kidney disease phases, including the post-transplant period. Body weight gain often develops after kidney transplantation and influences the long-term outcome. Much research has been carried out in the world studying the body composition of healthy people but there are limited data about the research where these methods together with other clinical parameters have been used for investigating patients with a transplanted kidney. Body composition assessments in a complex manner, including the biochemical analyses of blood as well as anthropometrical and nutritional peculiarities of the patients with a transplanted kidney, have not been previously studied in Estonia. According to literature, the main problem after kidney transplantation is the gain of body weight; therefore, we planned to test if intensive nutritional counselling has an effect on patients' nutritional habits in preventing the gain of body weight.

3. AIMS OF THE STUDY

The general aim of the present study was to analyse the body build and nutritional habits of the end-stage chronic kidney disease (CKD) patients. We hypothesised that intense nutritional counselling significantly improves nutritional habits, and, ultimately, the gain of body weight after kidney transplantation will be prevented.

The specific aims of the present study were as follows:

1. To analyse anthropometric measurements data of the end-stage CKD patients and to compare the body composition of the dialysis and transplant patients.
2. To test if intensive nutritional counselling has an effect on body composition of kidney transplant male and female patients.
3. To evaluate the effect of intensive nutritional counselling on the changes of anthropometric, biochemical and nutritional parameters of kidney transplant patients after the follow-up and to describe gender-specific associations between the studied parameters.
4. To estimate the long-term effect of intensive nutritional counselling on anthropometrical measures of kidney transplant patients.
5. To evaluate the follow-up changes of the intake of nutrients of kidney transplant patients on the basis of a 3-day menu.

4. PATIENTS AND METHODS

4.1. Subjects of Study

The prospective long-term study was carried out during the years 2003–2015 at the Department of Internal Medicine at the University of Tartu. Totally, 150 chronic kidney disease patients were studied. The kidney transplant patients had their transplantation at the Transplant Center of the Tartu University Hospital.
The first anthropometric study population consisted of 75 consecutive non-diabetic CKD patients (37 males and 38 females) on renal replacement therapy (HD, 5 males and 6 females; PD, 11 males and 6 females; RT, 21 male and 26 female patients) treated in the nephrology division at the Tartu University Hospital who agreed to participate in the study. Participation was voluntary and all patients signed a written informed consent.

The transplanted patients population was formed from the consecutive stable ambulatory non-diabetic kidney transplant patients (12 males at the age of 42.8 ± 16.1 years and 16 females at the age of 47.0 ± 14.9 years) monitored by nephrologists at the Tartu University Hospital who agreed to participate in the study. Participation was voluntary and all patients signed a written informed consent.

The transplanted patients control population was formed from 47 clinically consecutive stable ambulatory non-diabetic kidney transplant patients (27 males at the age of 45.6 ± 9.4 years and 20 females at the age of 48.7 ± 12.8 years) monitored by nephrologists at the Tartu University Hospital or at the West-Tallinn Central Hospital who agreed to participate in the study. Participation was voluntary and all patients signed a written informed consent.

Population controls consisted of the population measured by an anthropometrist of the Centre for Physical Anthropology at the University of Tartu: 85 males (age range 40–49 years) and 256 females (age range 40–49 years).

All the studied 28 kidney transplant patients' measurements, including anthropometry, densitometry, biochemistry, the food frequency questionnaire (FFQ) and the 3-day dietary records analysis were carried out. The data of anthropometry, biochemistry and the 3-day dietary records analysis were performed in patients twice: one and a half years after the first cadaveric kidney transplantation (the first measurement, FM) and then, three years after the kidney transplantation (follow-up, FU). Densitometry was performed in patients once after the transplantation during three years follow-up (FU).

Preventive nutritional counselling and dietary consultation by a dietitian were carried out for all the kidney transplant patients during one and a half years after the kidney transplantation. Initial data were compared with the results obtained at the end of the study.

Last anthropometric measurements (LM) ten years after the kidney transplantation both in counselled KTx pts and in control KTx patients were carried out.

The study designs can be seen in **Table 1.**

Table 1. Overview of the study time periods, subjects and study designs.

Time period (years)	Study subjects	Methods	Studied parameters	Papers I–VI
2003: **FM**	**RRT patients:** hemodialysis, peritonealdialysis, kidney transplant patients M 37 F 38	Anthropometric measurements	**Profile:** age, body weight, body height. **Circumferences:** midarm relaxed, waist, hip, upper leg. **Scinfolds:** biceps, triceps, subscapular, suprailical, sum 4 skinfolds. **Body compostion characteristics:** BMI, WHR, BMI. **Bioimpedance characteristics:** body fat by Omron (%; kg).	**Paper II**
2003–2005: **FM** 1.5 years after KTx **FU** 3 years after KTx	**Kidney transplant patients:** M 12 F 16	Basic anthropometric measurements	**Profile:** age, body weight, body height. **Breadths and depths:** biacromial, chest, waist, pelvis, wrist, humerus, femur and ankle breadths, chest and abdomen depths. **Circumferences:** head, neck, chest, waist, hip, proximal thigh, middle thigh, calf, ankle, mid-arm relaxed, mid-arm relaxed and tensed, forearm, wrist. **Skinfolds:** chin, chest, side, waist, suprailiac, umbilical, subscapular, biceps, triceps, thigh, calf. **Body compostion characteristics:** BMI, WHR, body surface area, body density, relative fat mass by Siri, mean skinfold, mass of subcutaneous adipose tissue, relative mass of subcutaneous, adipose tissue. **Bioimpedance characteristics:** body fat by Omron (%; kg).	**Paper I** **Paper IV**
	Healthy population controls: M 85; F 256 **KTx controls:** M 27; F 20	Anthropometric data Anthropometric data	**Profile:** age, body weight, body height. **Body compostion characteristics:** BMI **Profile:** age, body weight, body height. **Body compostion characteristics:** BMI	
2003–2005: **FM** 1.5 years after KTx **FU** 3 years after KTx	**Kidney transplant patients:** M 12 F 16	Laboratory investigations	**Laboratory investigations:** serum protein, serum albumin, serum C-reactive protein, serum creatinine, serum urea, serum uric acid, serum alkaline phosphatase, serum calcium ionized, serum phosphate, estimated glomerular filtration rate, parathyroid hormone, homocysteine, cystatin C, serum cholesterol, serum high density lipoprotein, serum low-density lipoprotein, serum triglyceride.	**Papers IV**

Table 1. Continued.

Time period (years)	**Study subjects**	Methods	**Studied parameters**	**Papers I–VI**
2003–2005: **FM** 1.5 years after KTx **FU** 3 years after KTx	**Kidney transplant patients:** M 12 F 16	Nutritional research	**The food-frequency questionnaire** consisted of six parts and 180 variables, and of nine food groups of 128 products. **The 3-day dietary records data collection:** the daily energy and main nutrients content of proteins, fats and carbohydrates, food energy and protein content per kilogram of body weight, food cholesterol content. Vitamins of 12 components: vitamin A, vitamin D, vitamin E, tiamin, riboflavin, niacin, pyridoxine, cyanocobalamin, folic acid, pantothenic acid, biotin, vitamin C. Minerals of 7 components: sodium, potassium, calcium, phosphorus, magnesium, iron, selenium.	**Paper V**
2005: **FU** 3 years after KTx	**Kidney transplant patients:** M 12 F 16	Densitometric measurements	**The dual-energy X-ray absorptiometry:** the total body bone mineral density (BMD) and regional BMD arms, legs, trunks, spine. Normal, osteopenia and osteoporosis in regions of total body and anterior-posterior (AP) Lumbar spine (L2–L4).	**Paper IV**
2003–2005:	**Kidney transplant patients:** M 12 F 16	Intensive individual nutritional counselling	**Intensive counselling** consists of anthropometry, biochemistry, the FFQ and the 3-days dietary records analysis, and densitometry after kidney transplantation. Handbook "Treatment diets. 2002".	**Paper III** **Paper V** **Paper VI**
2015: **LM** 10 years after KTx	**Kidney transplant patients:** M 9 F 11	Anthropometric measurements	**Profile:** age, body weight, body height, BMI.	**Paper VI**
	KTx controls: M 21; F 15	Anthropometric data	**Profile:** age, body weight, body height, BMI.	

Abbreviations: FM, first measurements; FU, follow-up measurements; LM, last measurements; M; males, F, females; RRT, replacement patients; KTx, kidney transplant patients; BMI, body mass index; WHR, waist to hip ratio.

4.2. Methods

4.2.1. Anthropometric measurements

The anthropometric measurement of renal transplant patients was carried out during the years 2003–2015 at the Department of Internal Medicine, the Nephrology Department of the University of Tartu. The anthropometric measurements were carried out on average one and a half years after kidney transplantation (FM, 1.3 ± 0.2 years) and for the second time on average three years later (FU, 2.7 ± 0.3 years). Last anthropometric measurements (LM) were performed ten years after the kidney transplantation.

Measurements were performed in the morning between 9.00 and 12.00. All the patients had had a light breakfast 2 hours before the study. Anthropometrical measurements were performed by a trained anthropometrist.

The methodology of the anthropometric study relied on the long-term research carried out on many populations at the Centre for Physical Anthropology at the University of Tartu (Kaarma 1995, Kaarma 1996, Lintsi et al. 2002, Lintsi et al. 2003).

The studied patients were measured according to the classical method of Martin that considers classical measures (Martin 1928, Knussmann 1988). For measuring the skinfolds, the methodology provided in Knussmann's handbook (Knussmann 1988) was followed. Body height (BH) was measured in centimetres (precision ± 0.10 cm) using a Martin metal anthropometer. Body weight (BW) was weighed in kilograms (precision ± 0.05 kg) on the Soehnle (Germany) electronic medical scales. Depths and breadth measurements were measured with the Martin calipers (precision ± 0.10 cm), circumferences with a metal measuring tape, skinfolds' thicknesses with the Holtain skinfold calipers on the right side of the body.

The RRT patients anthropometric measurements were divided into three groups: hemodialysis patients, peritoneal dialysis patients and kidney transplant patients. A total of 11 body measurements was taken. The measured anthropometric variables were: the body height (cm), the body weight (kg), 4 circumferences (cm), 4 skinfold thicknesses (mm) and the sum of 4 skinfolds (mm). All the data were collected and analyzed in the first follow-up. From these basic anthropometric measurements and indices the body composition characteristics were calculated.

In kidney transplant patients a total of 36 body measurements, including 11 skinfolds, were taken. From these basic measurements, indices and body composition characteristics were calculated. The measured anthropometric variables were: the body height (cm), the body weight (kg), 2 depths (cm), 8 breadths measurements (cm), 13 circumferences (cm) and 11 skinfold thicknesses (mm). The measured anthropometric parameters were:

1) **Length.** The length measurements were of the body height.

2) **Breadth-depth.** The breadth-depth measurements were biacromial, the chest, the waist and the pelvic breadth, the chest and abdomen depths.
3) **Thickness of bones.** To assess the thickness of limb bones, the upper limb humerus and the wrist breadths were measured, and the femur and the ankle breadths were measured in the lower limb.
4) **Circumferences.** The measured circumferences of the trunk included the head, the neck, the chest, the waist and the hip circumference. The measured circumferences of the upper limb included the mid-arm circumference, flexed and tensed, the forearm and the wrist circumference. The measured circumferences of the lower limb included the proximal thigh, the middle thigh, the calf and the ankle circumferences.
5) **Skinfolds.** The measured skinfold thicknesses were the chin, the chest, the side, the waist, the suprailical, the umbilical, the subscapular, the biceps, the triceps, the thigh and the calf skinfold thicknesses.

The healthy population's controls data which were collected by anthropologist Saluste were: mean age, mean BH, mean BW, mean BMI. All these data were compared with kidney transplant patients' mean BH, mean BW and mean BMI in FM.

The second control group consisted of kidney transplant non-diabetic patients. A total of the measured data contained the body height (cm) and the body weight (kg). All the baseline data were collected and analyzed, and the BMI (kg/m^2) were calculated.

Last anthropometric measurements (LM) after the kidney transplantation were performed both in the counselled KTx patients and in the control KTx patients. The measured data were BW, BH and BMI (kg/m^2). All the measured data were calculated and compared with FU anthropometric data.

4.2.2. Body composition characteristics

The structure of the body is determined by a complex of anthropometrical variables. Basic measured anthropometrical variables were calculated on the body composition, characteristics of renal transplant patients 1.5 years (FM) and 3 years (FU) after kidney transplantation. Last anthropometric measurements (LM) were performed ten years after the kidney transplantation.

The calculated body composition characteristics of renal transplant patients were the body mass index (BMI), the waist to hip ratio (WHR), the body surface area (BSA), the body density (D_b), the relative mass of fat by Siri, the mean skinfolds, the mass of the subcutaneous adipose tissue and the relative mass of the subcutaneous adipose tissue. Basic measured anthropometrical and individual data were calculated using the following equations:

1) **BMI** (kg/m^2) = body weight (kg) / body height (m^2)
2) **Waist to Hip Ratio** (WHR, m) = Waist circumference (m) / hip circumference (m)

3) **Body surface area** by DuBois & DuBois (BSA, m^2) = 71.84 x weight (kg) $^{0.425}$ x height (cm)$^{0.725}$ / 10,000
4) **Body density** (D_b, g/cm^3) = 1.06234 - (0.00068 x chin skinfolds thickness) – (0.00039 x biceps skinfold thickness) - (0.00025 x thigh skinfold thikness)
5) **Relative mass of fat by Siri** (%) = 100 x (4.95 / body density) – 4.50
6) **Mean skinfolds' thicknesses** (mm) = (chin + chest + side + waist + suprailical + umbilical + subscapular + biceps + triceps + thigh + calf) / 11
7) **Mass of subcutaneous adipose tissue** (kg) = (mean skinfolds / 2) x body surface area x 0.9 x 10
8) **Relative mass of subcutaneous adipose tissue** (%) = mass of subcutaneous adipose tissue (kg) / body weight (kg) x 100

4.2.3. Bioimpedance measurements

The bioimpedance measurements were carried out at the Department of Internal Medicine of the University of Tartu. The body fat measurements were taken twice: one and a half years (FM), and three years (FU) after kidney transplantation in kidney transplant patients.

To analyse body fat levels, the fat loss or the fat gain, the method for determining bioelectric impedance (BIA) was used in measurements. To assess body fat percentage OMRON® BF 300 the body fat monitor (OMRON/ Matsusaka Co Ltd., Japan) with the new hand-held BIA electrodes for the right and the left hand was used. The data about the subject's age, sex, height and weight was entered into the BIA data collection equipment. After seven seconds after pressing the start button the fat percentage (%) and the fat mass (kg) are shown on the display OMRON® BF 300 Body Fat Monitor (OMRON. Instructional Manual 1998). On the basis of OMRON® BF 300 body fat monitor individual data were calculated: the body fat mass (BF, kg) and the body fat percentage (BF, %), standard deviation (SD), minimum and maximum.

4.2.4. Densitometric measurements

The densitometric study was carried out at the Department of Internal Medicine of the University of Tartu Densitometric Study Centre. In the study the dual-energy X-ray absorptiometry (DXA) method with using GE LUNAR DPX-IQ densitometer (Lunar Corporation, Madison, Wisconsin, US, software version 4.7e) was used by IOF-certified technicans.

The densitometrically studied kidney transplant patients constituted clinically stable consecutive nondiabetic groups: 12 males at the age of 42.8 ± 16.1 years, and 16 females at the age of 47.0 ± 14.9. Densitometric measurements of all kidney transplant patients were carried out once, on average three years afer the kidney transplantation (FU).

To assess bone mineral density (BMD) for the measured anatomical region, the total body (arms, legs, trunks, spine) and the second to the fourth lumbar vertebrae L1 to L4 were used. For the total body and the AP lumbar spine the absolute bone mineral density (BMD) for each site in quantitation (g/cm^2) was calculated. To compare the individual BMD for the total body and the AP lumbar spine, T-score and/or Z-score were calculated. To analyze appropriate measured groups, the reference values were used whereas they were given on the basis of the Reference Population Database of the German population research. The mean male BMD and the mean female BMD absolute values for total body sites and SD g/cm^2 for each site are listed below under the site name (LUNAR DPX-IQ Reference Manual 5.5. Reference Population Database).

These scores were necessary for the comparative assessment of bone density to distinguish whether it was normal or the patient had osteopenia or osteoporosis. On the basis of the densitometric measurement results the bone density of each site for the patient was received both in absolute values (absolute BMD values in g/cm^2) and in T-scores (German AP Spine Reference Population. Young Adult Ages 20–40) and Z-scores (matched for age, weight 25–100 kg).

The World Health Organization definition (Report of WHO Study Group et al. 1994) of the international reference standard and the International Society for Clinical Densitometry (ISCD Official Positions 2005) recommendations have set the values for interpreting. T-scores and Z-scores criteria to distinguish osteopenia (low bone mass or low bone density), osteoporosis and normal bone mineral density. T-scores measured the criteria as follows: above -1: bone density is considered normal; between -1 and -2.5 this T-score is a sign of osteopenia; below -2.5 bone density indicates osteoporosis.

We used the reference population database for the LUNAR DPX-IQ instrumentarium (Lunar Radiation Corporation, Madison, WI, USA), whereas based on ambulatory subjects from the general a German population research, who were free from chronic diseases affecting bone. The dual-energy X-ray absorptiometry (DXA) method for all the BMD parameters was used in the Tartu University Hospital. Other reseachers used for comparison reference values for BMD to different machine-specific databases reference values. In general the DPX software is used. It is supported by a large database from the population research studies in the USA, the UK and Northern Europe (Kroger 1992, Matkovic 1994).

4.2.5. Laboratory research

Laboratory research was carried out at the United Laboratories of the Tartu University Hospital in Tartu. The kidney transplant patients whose blood was biochemically studied constituted clinically stable consecutive nondiabetic groups: 12 males at the age of 42.8 ± 16.1 years, and 16 females at the age of 47.0 ± 14.9. The biochemical analyses were performed twice: firstly one and a half years after the kidney transplantation (FM), and secondly three years after the kidney transplantation (FU).

The following biochemical parameters were studied: serum protein (S-Prot, g/L), serum albumin (S-Alb, g/L), C-reactive protein (S-CRP, mg/L), serum creatinine (S-Crea, µmol/L), serum urea (S-Urea, mmol/L), serum uric acid (S-UA, µmol/L), serum alkaline phosphatase (S-ALP, U/L), serum calcium ionized (S-iCa, mmol/L), serum phosphate (S-P, mmol/L). Also, blood hemoglobin (fB-Hb, g/L) was sudied.

The following lipid profile was studied: serum cholesterol (S-Chol, mmol/L), serum HDL-Cholesterol (S-HDL-Chol, mmol/L), serum LDL-Cholesterol (S-LDL-Chol, mmol/L), serum triglycerides (S-Trigl, mmol/L). The serum parathyroid hormone (S-PTH, pmol/L), serum homocysteine (S-Hcy, µmol/L) and serum cystatin C (S-CysC, mg/L) parameters were studied in FM.

The Modification of Diet in Renal Disease (abbreviated MDRD) equation was used to assess the estimated GFR. The estimated glomerular filtration rate (eGFR, ml/min/1.73m^2) was calculated with the equation of age, S-Crea, S-Urea and S-Alb (Levey et al. 2006, van Biesen et al. 2006). All the studied biochemical parameters FM were compared with the biochemical parameters FU after kidney transplantation and were applied to be compared with different laboratory normal ranges of the United Laboratories of the Tartu University Hospital (Laboratory Manual IV).

4.2.6. Methodology for studying nutrition

4.2.6.1. Development of the new system of treatment diets for health care institutions

The author of the thesis has worked out a preliminary systematized list of diets (Kiisk 2002) and started to compile a collection of articles which takes into consideration contemporary principles of feeding treatment in order to finalize the common system of diets for treatment. The updated system was worked out during the doctoral studies.

The systematization of the nomenclature of treatment diets in the multiprofile health care institution is an important part in patients' care. The whole system of nomenclature of diets consists of ordinary food and of seven groups of diet food which are in turn divided into subgroups: ordinary food, lightened diets with 8 subgroups, diets with strict restrictions with 4 subgroups, lightened liquid diets with 3 subgroups, lightened soft diets with 3 subgroups, diets for diabetics with 4 subgroups, various individual diets. Individual nutritional recommentatons for energy intake are given in respect to the metabolic rate, the body composition, and the degree of physical activity.

We worked out indications of diets for disorders of the circulatory system, the disorders of lipoprotein metabolism, obesity, the disorders of fluid and electrolyte balance, energy malnutrition, lactose intolerance, dialysis, the chronic nephritic syndrome, the acute nephritic syndrome, renal failure, disorders of purine metabolism, food allergy, surgical follow-up care, post organ transplantation, in the case of diabetes and other cases.

The normative values of the energy and of the basic nutrients are in accordance with the Estonian nutritional recommendations and with guidelines for patients' health care. We used for planning a new dietary system on the basis of the development of nutritional recommentations and the normative values of the nutrients which are in accordance with official guidelines:

1) **CINDI.** Countrywide Intergrated Noncommunicable Disease Intervention. Dietary Guide issued by the WHO Regional Office for Europe. Word Health Organization 2000. www.euro.who.int
2) **NKF-K/DOQI.** National Kidney Foundation. K/DOQI Clinical Practice Guidelines for Chronic Kidney Disease: Evaluation, Classification and Stratification. National Kidney Foundation, 2002. www.kidney.org
3) **Nordic Nutrition Recommendations 2004.** 4th edition. Integrating nutrition and physical activity. Nordic Council of Ministers, 2005. www.nnr4.org
4) **Estonian Nutritional Recommendations and Food Based Dietary Guidelines 2006**. www.nutridata.ee

4.2.6.2. Research of nutritional habits on the basis of the Food Frequency Questionnaire

The research of nutritional habits was carried out on the basis of a Food Frequency Questionnaire (FFQ) in male (n = 12) and female (n = 16) kidney transplant patients. The patients filled the FFQ once. The first data of the FM were collected on average 1.5 years after the kidney transplantation. A special food questionnaire "The card of nutritional habits" was worked out by the Centre for Physical Anthropology at the University of Tartu and was used for nutritional research. "The card of nutritional habits" was worked out for kidney transplant patients. A FFQ consisted of six parts and 180 variables which covered the questions:

Part I. Which is your family social-economic situation?

Part II. Which are nutritional traditions of the family?

Part III. Which are your own nutritional habits?

Part IV. How much do you consume drinks, and rye bread-white bread a day?

Part V. Your attitude to eating and movement?

Part VI. How often do you eat the following food? The FFQ of foodstuffs included questions on nine groups of 128 products: 16 milk and dairy products, 12 cereal and flour products, 15 meat products, 8 fish products, 18 vegetables, 15 seasonal fruits and berries, 11 sweets, 19 drinks, 14 ready-made foods. The frequency of consumption of each foodstuff was assessed on a five-grade scale: daily, often (2–3 times a week), sometimes (1–2 times a week), seldom (1–2 times a month), never.

Preventive nutritional counselling and dietary consultation by a dietitian was carried out for all the transplant patients during one and a half years (FM) after the kidney transplantation.

4.2.6.3. The 3-day dietary records data collection

The dietary records for 3 days for the kidney transplant patients who had the transplantation in 2000–2003 at the Department of Internal Medicine, the Nephrology Department of the University of Tartu, were collected and analyzed. The 3-day dietary records data were collected and analyzed twice: firstly one and a half years after kidney transplantation (FM), and secondly, three years after kidney transplantation (FU). The primary menus characterized the patient's ordinary nutrition.

The first menus were immediately analyzed, and all the patients were advised by a dietitian after (FM) concerning diet recommendation. The secondary dietary record for 3 days helped reveal whether the patients had considered nutrition advice and changed their eating habits. The nutritive values of FM and FU of three days were calculated, the dynamics of results were analyzed and statistical analysis was carried out.

The daily intake of food energy and nutrients was calculated and analyzed with the Finnish food composition database Program Micro-Nutrica 2.0, modified and translated into the Estonian language at the Tallinn University of Technology, Department of Food Processing. This adapted version of the Finnish Micro-Nutrica Nutritional Analysis Program in MS Exel, was used in Estonia. This Program includes over 1,150 food items and 66 characteristics of nutrients (Food and nutrition VI. Tallinn 1998, Vaask et al. 2004).

All the data were compared with the Estonian Nutrition Recommendations and Food Based Dietary Guidelines (2006). The Estonian nutrition-related recommendations are based on the Nordic Nutrition Recommendations which were approved in 2004 (Nordic Nutrition Recommendations 2004. www.nnr5.org).

The consumption of energy and main nutrients content in 3-day menus of male and female kidney transplant patients were calculated with the Program Micro-Nutrica in MS Exel. The energy value of each food is given in kilocalories (kcal). The amount of protein, fat, carbohydrate and alcohol using the following conversion factors: protein 4 kcal/g (17kJ/g); fat 9 kcal/g (38 kJ/g); carbohydrates 4 kcal/g (17 kJ/g) and alcohol 7 kcal/g (30kJ/g). If kilojoules (KJ) were given in kilocalories (kcal), then coeficient 0.239 was used. The energy value for dietary fibre is very low and there are no reliable data for the energy content.

The frequency (%) of the consumption of nutrients (proteins, fats, carbohydrates) and food energy content were given in absolute numbers and per kilogram of body weight (energy/body weight, proteins/body weight). The daily cholesterol (mg) intake of food portions was calculated.

Vitamins are given in two forms: fat-soluble vitamins and water-soluble vitamins. The content of vitamins consisted of 12 components: vitamin A, vitamin D, vitamin E, tiamin (B1), riboflavin (B2), niacin (B3), pyridoxine (B6), cyanocobalamin (B12), folic acid (B10), pantothenic acid (B5), biotin (H), and vitamin C.

Minerals are given in 7 components: sodium (Na), potassium (K), calcium (Ca), phosphorus (P), magnesium (Mg), iron (Fe), selenium (Se).

During the 3-day dietary records analysis and counselling of CKD patients, giving answers to their questions about their food and portion sizes, the dietitian used the standards portions book for snacks, drinks, fruit, vegetables, meat and fish with many photographs (Kiisk 2002, Kiisk and Rosenberg 2010, KDIGO 2012).

4.2.7. Counselling of chronic kidney disease patients

We studied 28 clinically stable consecutive non-diabetic kidney transplant patients: 12 males at the age of 42.8 ± 16.1 years, and 16 females at the age of 47.0 ± 14.9 years. The kidney transplantation was performed at the Tartu University Hospital.

Dietary consultations by a dietitian was carried out for all the kidney transplant patients during one and a half years after the kidney transplantation. Initial data were compared with the results obtained at the end of the study.

Intensive individual nutritional counselling was performed by the dietitian who considers the patient's age, gender, the stage of chronic kidney damage, body build, the twenty-four-hour need for food energy and nutrients, the patient's eating habits. During intensive counselling dietitians consider the results of anthropometry, densitometry, biochemistry, the food frequency questionnaire (FFQ) and the 3-day dietary records analysis.

Two main methods have been accepted in nutrition research: the food frequency questionnaire (FFQ) and the 3-day nutrition diary. A special FFQ, compiled by the Centre for Physical Anthropology at the the University of Tartu, was used in the current study for social-economic, physical activity and nutrition research, including 128 foods. The consumption of energy and main nutrients content in 3-day menus of kidney transplant patients was calculated and analyzed with the Finnish food composition database program Micro-Nutrica Nutritional Analysis adapted for use in Estonia (Food and Nutrition VI 1998, FINELI. www.fineli.fi). All the data were compared with the Estonian Nutrition Recommendations.

In CKD patients nutritional counselling must consider also a systematized list of diets. This created system allows achieving individual patient´s counselling which considers the patient´s disease, the type of body build and the peculiarities of metabolism, the made clinical analyses.

Ethics. The study was approved by the University of Tartu Ethics Review Commitee on Human Research (protocol no 141/30, 2005).

4.2.8. Statistical analysis

Statistical comparisons of different anthropometrical, laboratory and nutritional parameters between initial and final measurements were made for the kidney transplant patients. Statistical analysis was performed using the Statistical Package (SAS 1989). Standard statistical methods were used to calculate for the all anthropometric measurements and biochemical blood characteristics basic statistics means x, standard deviations (SD), minimum (min) and maximum (max) for the initial and the final observation period. The mean anthropometric parameters, the BMI, the sum of skinfolds, the glomerular filation rate (e-GFR) and the waist to hip ratio (WHR) were calculated. Statistical comparisons were made using independent t-tests. The Pearson correlation coefficients were used to determine the relationships between dependent variables. The level of significance was accepted at $p \leq 0.05$. Linear correlation coefficients were used to determine the relationship between anthropometric measurements, biochemical blood values for the initial and the final period were calculated. Multiple regression models between anthropometrical and laboratory parameters were calculated. The consultant on data processing and the performer of the statistical analysis Mrs. Säde Koskel M.Sc. is from the Institute of Mathematical Statistics at the University of Tartu.

5. RESULTS

5.1. Results of anthropometric research in CKD patients with renal replacement therapy (Paper II)

The results of this study indicate that the anthropometric profile is different in the Estonian CKD patients groups who were in renal replacement therapy (RRT). In the studied RRT patients groups were significantly different by the mean age ($p < 0.05$). A great mean age variety of the subjects was from 18 to 78 years. The subjects were divided into three groups according to renal replacement therapy: HD (5 male and 6 female patients), PD (11 male and 6 female patients), RT (21 male and 26 female patients). All the measured anthropometric variables were: BH (cm), BW (kg), circumferences (cm), skinfolds thicknesses (mm), BF (kg), BF (%), BMI (kg/m^2), WHR (m). The characteristics of anthropometric measurements in the renal replacement therapy of male patients ($n = 37$) and of female patients ($n = 38$) are shown in **Paper II**.

The study indicates that the anthropometric profile was quite similar in the Estonian CKD male and female patients who were in renal replacement therapy (RRT) only. We found two significant differences ($p < 0.05$) in male groups (waist and upper leg circumference HD versus RT), and three significant differences ($p < 0.05$) in female groups (biceps skinfolds HD versus PD; biceps skinfolds PD versus RT; triceps skinfolds PD versus RT). The mean BW for three groups RRT male and female patients indicated no significant differences.

In the group of males only 54% of the subjects with the mean BMI had normal weight (BMI 18.5–24.9 kg/m^2), while another 27% males had overweight (BMI 25–29.9 kg/m^2). One male patient was malnourished, mean BMI < 18.5 kg/m^2 and one patient was of obese class III (BMI ≥ 40 kg/m^2). In the study WHO body mass indices classification was used. The studied RRT male patients' the mean BMI is seen in Figure 1.

In the group of females with the mean BMI 34% of the subjects had normal BMI, while other 24% females were overweight (BMI 25–29.9 kg/m^2). Only three patients had malnutrition with BMI 14.9; 18.4 and 16.2 kg/m^2. Two female patients had the obese class III with the mean BMI 43.8 and 46.1 kg/m^2. The studied RRT female patients' mean BMI is seen in Figure 2.

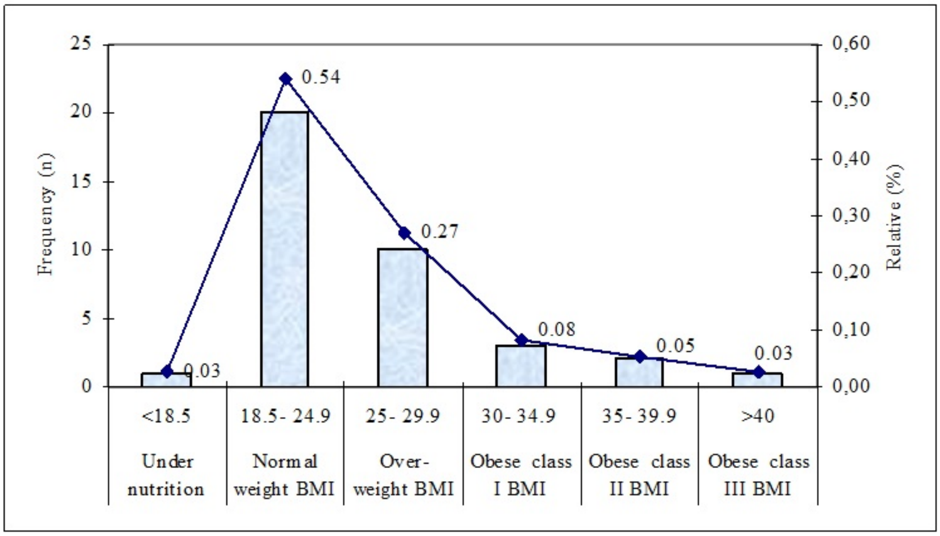


Figure 1. Data of the mean BMI in the renal replacement therapy of male patients (n = 37)

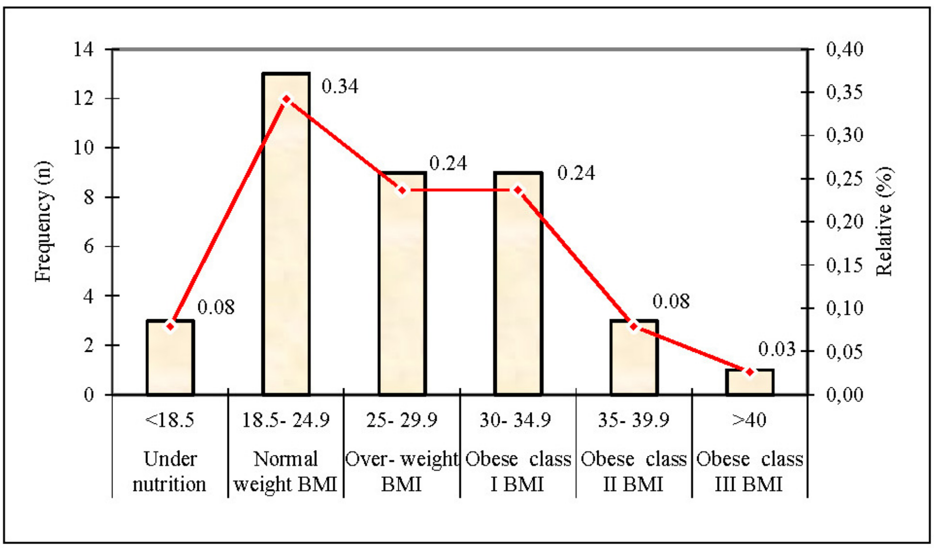


Figure 2. Data of the mean BMI in the renal replacement therapy of female patients (n = 38)

Anthropometric parameters showed overweight and obesity, fat accumulation in the body, especially in the abdominal region of the body in the females group (BF, 34–38%). In the males group the mean body fat is lower than in women (BF, 18.9–20.3%).

5.2. Results of anthropometric research in kidney transplant patients (Paper I, Paper IV, Paper VI)

The results of the anthropometric measurements were analysed twice: 1.5 years after the kidney transplantation (the first measurement, FM) and 3.0 years after the kidney transplantation (follow-up, FU). The data at the beginning of the research were compared with the results at the end of the research. The mean age of the studied male patients was 42.8 ± 16.1 years, and the mean age of female patients was 47.0 ± 14.9 years. The data of basic anthropometric measurements in male and female kidney transplant patients are given in **Paper IV**.

Male patients (n = 12).
Body height. The mean BH of male patients is decreased signifiantly by 1.29 cm which can be caused by the posture or the habitus of the studied male kidney patients. The mean BH at FM, 174.82 cm to FU, 173.53 cm (p-value 0.001). In the studied male patients the minimal BH was at FM, 166.50 cm to FU, 164.00 cm, and the maximal BH was at FM, 190.00 cm to FU, 189.30 cm.

Body weight. The mean BW increased significantly in kidney transplant male patients and the mean difference was 8.21 kg. The mean BW at FM, 75.13 kg to FU, 83.34 kg (p-value 0.001). In the studied male groups the minimal BW at FM, 57.10 kg to FU, 61.15 kg, and the maximal BW was at FM 134.10 to FU, 138.10 kg.

Breadth and depth. In the breadth and the depth measurements significant statistical changes were found only in the measurements of the biacromial breadth, the pelvis breadth and the ankle breadth. The mean biacromial breadth mesurements decreased significantly at FM, 40.76 cm to FU, 40.29 cm (p-value 0.044), and the difference was -0.47 cm. The mean pelvis breadth value increased essentially and the difference was 2.47 cm (at FM, 31.62 cm to FU, 34.09 cm, p-value 0.021) in male patients. In the chest breadth measurements there was a decrease of -0.08 cm (from FM, 30.56 cm to FU, 30.48 cm), and, the waist breadth measurements decreased 0.29 cm (at FM, 30.03 cm to FU, 29.74 cm), but statistically not significantly. In the measurements of the chest depth (at FM, 23.45 cm to FU, 23.78 cm) and the abdomen depth (at FM, 24.75 cm to FU, 25.04 cm) no significant changes were found.

Thickness of bones. The upper limb mean humerus breadth (at FM, 7.30 cm to FU, 7.32 cm), and, the mean wrist breadth (at FM, 5.87 cm to FU, 5.85 cm) measurements did not have statistically significant changes in male patients. In the case of the lower limb femur breadth the measurements were not statistically significant (at FM, 10.14 cm to FU, 10.19 cm). In the case of the lower limb the mean ankle breadth mesurements decreased significantly at the FM 7.35 cm to FU, 6.93 cm (difference -0.42 cm; p-value 0.014).

Circumferences. The hip circumference increased significantly after FU, the difference was 3.85 cm (at FM 99.19 cm to FU, 103.04 cm, p-value 0.012). In the case of the **upper limb circumferences** 2 measurements increased statistically significantly. These were: follow-up the mean mid-arm relaxed circumference difference 1.94 cm (at FM, 30.96 cm to FU, 32.49 cm, p-value 0.035), and, the mean mid-arm circumference flexed and tensed difference 1.92 cm (at FM, 32.81 cm to FU, 34.73 cm, p-value 0.022). Considering the **lower limb circumferences**: the mean proximal thigh (at FM, 56.26 cm to FU, 56.11 cm), the mean middle thigh (at FM, 49.07 cm to FU, 50.44 cm) and the mean ankle circumferences (at FM, 23.10 cm to FU, 23.33 cm) did not have statistically significant changes. Considering the lower limb circumferences: the mean calf circumference increased statistically significantly in FU, and the difference was 2.47 cm (at FM, 34.26 to FU, 36.73 cm, p-value 0.005).

Skinfolds. The measured mean chin (at FM, 7.88 mm to FU, 10.67 mm, p-value 0.008), the mean chest (at FM, 11.17 mm to FU, 14.13 mm, p-value 0.030), the subscapular skinfold difference 3.65 mm (at FM, 10.17 mm to FU, 13.82 mm, p-value 0.011), the biceps skinfold difference is 2.73 mm (at FM, 4.93 mm to FU, 7.66 mm, p-value 0.027) and the triceps skinfolds thicknesses difference 2.46 mm (at FM, 10.67 mm to FU, 13.13 mm, p-value 0.038), and have statistically significant changes in FU. The mean measured 6 skinfolds: side, waist, suprailiac, umbilical, thigh and calf skinfold thicknesses did not reveal statistically significant changes ($p \leq 0.05$).

Female patients (n = 16)

Body height. The mean body standing height of female patients is dynamic and it decreased significantly by 1.38 cm which can be caused by the posture or the habitus of the studied female kidney patients (at FM, 164.88 cm to FU, 163.50 cm, p-value 0.001). In the studied female patients the minimal BH was from FM, 150.00 cm to FU, 147.30 cm, and the maximal BH was from FM, 171.50 cm to FU, 169.50 cm.

Body weight. The body weight in female patients did not change significantly, then the body weight of female patients increased non-significantly. The mean BH difference was 2.23 kg (from 74.35 kg to FU, 76.58 kg). In the studied female goups the minimal body weight was from FM, 40.00 to FU, 46.20 kg, and the maximal body weight was from FM, 126.50 kg to FU, 124.90 kg.

Breadth and depth measurements. In female patients the biacromial, the chest and the waist breadth measurements were without changes. The mean biacromial breadth decreased non-significantly and difference was -0.39 cm (at FM, 35.89 cm to FU, 35.50 cm), the mean chest breadth difference 0.16 cm (at FM, 27.73 cm to FU, 27.89 cm) and the mean waist breadth value difference -1.00 cm (at FM, 28.46 cm to FU, 27.46 cm) in female patients. In the pelvis breadth measurements female patients have significant changes which was evidently caused by the changes in the thickness of the subcutaneous fat tissue, and the difference was 1.43 cm (at FM, 31.58 cm to FU, 33.01 cm, p-value 0.035). The mean abdomen depth and the humerus breadth, the wrist breadth, the femur breadth, and the ankle breadth measurements were insignificantly decreased in female patients. In the chest depth and the abdomen depth no significant changes were found.

Thickness of bones. The upper limb humerus breadth (at FM, 6.56 cm to FU, 6.43 cm) and the wrist breadth (at FM, 5.28 cm to FU, 5.30 cm) measurements had no statistically significant changes in female patients. In the case of the lower limb femur breadth (at FM, 9.53 cm to FU, 9.31 cm) and the ankle breadth measurements statistically insignificant changes were found (at FM, 6.33 cm to FU, 6.11 cm, difference -0.22 cm in female patients).

Circumferences. In the case of the trunk circumferences there were three statistically significant changes. These were: the head circumference, the neck circumference and the waist circumference difference -1.98 cm (the mean 88.55 to 86.57 cm, p-value 0.032) in female patients. In the case of the measurement of **upper limb circumferences** had no statistically significant changes. The upper limb forearm circumference decreased, and a statistically significant change was revealed, the difference -0.48 cm (from FM, 25.28 cm to FU, 24.80 cm, p-value 0.035) in female patients. In the **lower limb circumferences** the mean proximal thigh had a statistically significant difference -1.1 cm (at FM, 59.19 cm to FU, 58.09 cm, p-value 0.045). In the lower limb, the calf circumferences (at FM, 37.28 cm to FU, 37.41 cm), the middle thigh circumference (at FM, 51.74 cm to FU, 50.80 cm) and the ankle circumferences (at FM, 23.58 cm to FU, 23.01 cm) there were no statistically significant changes in female patients.

Skinfolds. In female patients there were no statistically significant changes. The measured chin skinfold (at FM, 9.31 mm to FU, 10.03 mm), the chest (from 12.16 mm to 11.28 mm), the side (at FM, 12.77 mm to FU, 12.83 mm), the waist (at FM, 14.75 mm to FU, 13.94 mm), suprailiac (at FM, 14.55 mm to FU, 15.64 mm), umbilical (at FM, 18.38 mm to FU, 19.00 mm), the subscapular skinfold (at FM, 14.56 mm to FU, 15.48 mm), the biceps (at FM, 8.68 mm to FU, 10.18 mm), the triceps skinfold (from 18.59 mm to 16.94 mm), the thigh skinfold (at FM, 21.59 mm to FU, 20.25 mm) and the calf skinfold thickness (at FM, 15.91 to FU, 15.03 mm) in female patients were obtained as results.

The mean BH decreased signifiantly in male patients by 1.29 cm and in female patients by 1.38 cm, which can be caused by the posture or the habitus of the studied kidney patients.

The mean BW increased much more significantly in men (the mean 8.21 kg) after the follow-up compared with female patients who inreased non-significantly (the mean 2.23 kg).

Biacromial breadth measurement decreased significantly in the follow-up in male patients (p-value 0.044), and decreased non-significantly in the follow-up in female patients. The pelvis breadth and the ankle breadth parameters increased significantly in male patients, and in female patients there was only significant increase in the pelvic breadth parameter (p-value 0.035) in the follow-up. Other breadth or depth measurements: the chest breadth, the waist breadth, the chest depth and the abdomen depth in males compared with females did not differ statistically in the follow-up.

Thickness of bones parameters: the humerus breadth, the wrist breadth and the femur breadth in males compared with females were not significantly different in the follow-up.

The trunk circumferences: head, neck, and waist circumferences decreased significantly only in female patients, and the hip circumference increased significantly only in male patients in the follow-up.

The upper leg arm circumference and the arm flexed-tensed circumference increased significantly in male but not in female patients in the follow-up. Only the forearm circumference decreased significantly in female patients compared with men in the follow-up.

The lower leg calf cicumference increased statistically only in males, and, the proximal thigh circumference decreased statistically only in female patients (p-value 0.045). The middle thigh circumference and the ankle circumference had no statistical differences in male and female patients in the follow-up.

Skinfolds ticknesses: chin, chest, subscapular, biceps and triceps were much more increased in the male patients after the follow-up compared with females ($p \leq 0.050$).

We noticed statistically significant changes in the comparison of KTx male patients BW data with healthy population controls in FM ($n = 86$, $p = 0.008$), but not in FU ($p < 0.470$). In female KTx patients group comparison BW data with healthy population controls ($n = 256$) there were statistically non-significant changes in FM. Overweight was found in 15% of studied male and in 25% of female patients. Only two female patients had malnutrition with BMI 14.9 and 16.2 kg/m^2 (**Paper I**).

The comparison of kidney transplant patient's mean BW data with the control group kidney transplant patients were given in Paper IV. The mean BW gain in the control group kidney transplant patients was significant both in the male and in female groups. BW was significantly lower in males at FM compared with the population controls but at FU body weight was not different. In females, BW did not differ significantly from the population control group at FM or FU. BMI was significantly lower in males at FM compared with the population controls but at FU BMI was not different. In females, BMI did not differ significantly from the population controls at FM or FU (**Paper IV**).

Ten years after the kidney transplantation BW data in KTx patients and control kidney transplant patients were compared with BW data ten years after kidney transplantation and were given in Paper VI. We noticed BW gain in all KTx patients both in males and females as follows: in standard care group males the mean BW gain was 6.4 kg, females 7.0 kg and among intensively counselled males 4.6 kg, females 1.1 kg. But, we demonstrate statistically non-significant weight change among counselled living KTx patients with long-term graft survival both in males ($n = 9$, $p = 0.068$) and females ($n = 11$, $p = 0.317$) which was registered ten years after the KTx. Among standard care control KTx patients weight change was statistically significant in both genders (males: $n = 21$, $p = 0.002$; females: $n = 15$, $p = 0.004$) ten years after the KTx (**Paper VI**).

Table 2. Comparison of kidney transplant patient's mean body weight data with healthy population control groups

Groups		Age	BW (kg) FM	BW (kg) FU	Comparison kidney transplant patients FM vs FU	Comparison FM kidney transplant patients vs healthy population	Comparison FU kidney transplant patients vs healthy population
	No	mean ± SD	mean ± SD	mean ± SD	*P*-value	*P*-value	*P*-value
Males							
Kidney transplant patients	N = 12	42.8 ± 16.1	75.1 ± 20.7	83.3 ± 19.9	< 0.001*	< 0.009*	< 0.470
Kidney transplant controls	N = 27	45.6 ± 9.4	75.7 ± 11.1	81.0 ± 13.3	< 0.001*		
Healthy population	N = 86	45.0 ± 4.0	87.3 ± 14.2				
Females							
Kidney transplant patients	N = 16	47.0 ± 14.9	74.4 ± 22.3	76.6 ± 22.7	< 0.101	< 0.851	< 0.593
Kidney transplant controls	N = 20	48.7 ± 12.8	68.3 ± 12.8	71.2 ± 12.6	< 0.010*		
Healthy population	N = 256	45.0 ± 4.0	72.8 ± 14.5				

*Statistically significant difference $P \leq 0.05$

Abbreviations: SD, standard deviation; BW, body weight; FM, first measurements; FU, follow-up measurements.

5.3. Results of body composition characteristics (Paper IV)

The results of the body composition characteristic of the renal transplant patients were analysed twice: 1.5 years (the first measurement, FM) and 3 years (follow-up, FU) after kidney transplantation. The calculated body composition characteristics of the renal transplant patients were the body mass index (BMI), the waist to hip ratio (WHR), the body surface area (m^2), the body density (g/cm^3), the relative mass of fat by Siri (%), the mean skinfolds (mm), the mass of subcutaneous adipose tissue (kg) and the relative mass of subcutaneous adipose tissue (%). The structure of the body composition in kidney transplant male and female patients, which is determined on the basis of anthropometric variables and was calculated using classical formulas and methods, is shown in **Table 3**, and the comparison of kidney transplant patients' mean BMI data with healthy control groups is shown in **Table 4**.

The body composition characteristics indicated systematic differences between renal transplant male and female patients. The calculated mean body surface area, the mean body density, the mean relative mass of fat by Siri, the mean skinfolds, the mean mass of subcutaneous adipose tissue and the mean relative mass of subcutaneous adipose tissue in male patients inreased significantly in the follow-up ($p \leq 0.050$), but not in female patients. The mean BMI characteristics of kidney transplant patients increased significantly in both patients groups: in males the FM mean 24.66 ± 7.19 kg/m^2, and the FU mean 27.73 ± 6.77; in females the FM mean 27.26 ± 7.48 kg/m^2 and the FU mean 28.53 ± 7.71 kg/m^2 (male, $p < 0.001$ and female $p > 0.013$). The mean WHR in male patients increased little non-significantly, but in female patients decreased significantly (p-value 0.037).

Male patients (n = 12)

Body surface area. Male patients' mean body surface area (m^2) increased significantly from FM, 1.89 ± 0.21 m^2 to FU, 1.97 ± 0.20 m^2 ($p < 0.005$).

Body density. The calculated mean body density (g/cm^3) in kidney transplant male patients increased significantly from FM, 1.05 ± 0.01 g/cm^3 to FU, 1.05 ± 0.006 g/cm^3 ($p < 0.003$).

Relative mass of fat by Siri. The calculated mean relative mass of fat by Siri (%) was significantly increased in the observation period from FM, 21.02 ± 3.03% to FU, 22.56 ± 2.86% ($p < 0.003$).

Mean skinfolds thicknesses. The calculated mean skinfolds thicknesses (mm) were increased significantly from FM, 11.43 ± 6.78 mm to FU, 13.33 ± 5.74 mm ($p < 0.003$).

Mass of subcutaneous adipose tissue. The calculated mean mass of subcutaneous adipose tissue (kg) was increased significantly from FM, 9.98 ± 6.69 kg to FU, 12.04 ± 6.55 kg (p-value 0.002).

Relative mass of subcutaneous adipose tissue. The calculated mean relative mass of subcutaneous adipose tissue (%) was increased significantly from FM, 11.57 ± 4.79% to FU, 14.05 ± 4.44% (p-value 0.032).

Table 3. Body composition characteristics in kidney transplant patients

Measurements period	**FM** after kidney transplantation					**FU** after kidney transplantation					*P*-value FM vs. FU
	Mean	±	SD	Min	Max	Mean	±	SD	Min	Max	
Male (n = 12)											
Body surface area (m^2)	1.89	±	0.21	1.66	2.39	1.97	±	0.20	1.67	2.42	0.005*
Body density (g/cm^3)	1.05	±	0.01	1.03	1.06	1.05	±	0.006	1.03	1.05	0.003*
Relative mass of fat by Siri (%)	21.02	±	3.03	10.13	29.33	22.56	±	2.86	19.80	28.78	0.003*
Mean skinfold (mm)	11.43	±	6.79	4.28	27.29	13.33	±	5.74	7.64	28.27	0.003*
Mass of subcutaneous adipose tissue (kg)	9.98	±	6.69	5.16	29.36	12.04	±	6.55	7.07	30.80	0.002*
Relative mass of subcutaneous adipose tissue (%)	11.57	±	4.79	6.25	21.26	14.05	±	4.44	8.97	22.30	0.032*
BMI (kg/m^2)	24.66	±	7.19	19.40	46.10	27.73	±	6.77	22.00	47.50	0.001*
WHR (m)	0.90	±	0.06	0.81	1.03	0.91	±	0.09	0.80	1.13	0.281
Female (n = 16)											
Body surface area (m^2)	1.80	±	0.25	1.39	2.33	1.81	±	0.25	1.48	2.29	0.345
Body density (g/cm^3)	1.05	±	0.01	1.04	1.06	1.05	±	0.01	1.04	1.06	0.204
Relative mass of fat by Siri (%)	22.69	±	2.93	18.41	28.25	23.03	±	2.87	18.63	27.78	0.209
Mean skinfold (mm)	13.33	±	6.69	5.23	28.91	14.60	±	6.26	5.57	30.27	0.907
Mass of subcutaneous adipose tissue (kg)	12.51	±	7.18	3.58	29.94	12.49	±	6.95	3.94	31.19	0.965
Relative mass of subcutaneous adipose tissue (%)	15.21	±	5.09	7.25	23.97	15.28	±	4.55	7.81	24.98	0.481
BMI (kg/m^2)	27.26	±	7.48	14.90	43.80	28.53	±	7.71	17.20	44.50	0.013*
WHR (m)	0.82	±	0.10	0.70	0.96	0.80	±	0.10	0.67	0.93	0.037*

*Statistically significant difference $P \leq 0.05$

Abbreviations: SD, standard deviation; FM, the first measurements; FU, follow-up; BMI, Body Mass Index; WHR, Waist to Hip Ratio.

Table 4. Comparison of kidney transplant patients' mean BMI data with healthy population control groups

Groups		Age	BMI (kg/m^2)	BMI (kg/m^2)	Comparison	Comparison FM	Comparison FU
			FM	FU	kidney transplant patients FM vs. FU	kidney transplant patients vs healthy population	kidney transplant patients vs healthy population
	No	mean ± SD	mean ± SD	mean ± SD	*P*-value	*P*-value	*P*-value
Males							
Kidney transplant patients	N=12	42.8 ± 16.1	24.7 ± 7.2	27.7 ± 6.8	< 0.001*	< 0.009*	< 0.935
Kidney transplant controls	N=27	45.6 ± 9.4	24.4 ± 3.5	26.0 ± 4.3	< 0.001*		
Healthy population	N=86	45.0 ± 4.0	26.7 ± 4.2				
Females							
Kidney transplant patients	N=16	47.0 ± 14.9	27.3 ± 7.5	28.5± 7.7	< 0.013*	< 0.941	< 0.552
Kidney transplant controls	N=20	48.7 ± 12.8	25.0 ± 4.0	26.0 ± 4.2	< 0.010*		
Healthy population	N=256	45.0 ± 4.0	27.5 ± 5.5				

Statistically significant difference $P \leq 0.05$
Abbreviations: SD, standard deviation; BMI, bodu mass index; FM, first measurements; FU, follow-up measurements.

Female patients (n = 16)

Body surface area. Female patients' mean body surface area (m^2) increased non-significantly from FM, 1.80 ± 0.25 m^2 to FU, 1.81 ± 0.25 m^2.

Body density. The mean body density (g/cm^3) in kidney transplant female patients was non-significantly different from FM, 1.05 ± 0.01 g/cm^3 to FU, 1.05 ± 0.01 g/cm^3.

Relative mass of fat by Siri. In female patients the mean relative mass of fat by Siri (%) was non-significantly increased in the observation period from FM, 22.69 ± 2.93% to FU, 23.03 ± 2.87%.

Mean skinfolds thicknesses. The calculated mean skinfolds thicknesses (mm) were increased non-significantly from FM, 13.33 ± 6.69 mm to FU, 14.60 ± 6.26 mm.

Mass of subcutaneous adipose tissue. The calculated mean mass of subcutaneous adipose tissue (kg) decreased non-significantly in female patients from FM, 12.51 ± 7.18 kg to FU, 12.49 ± 6.95 kg.

Relative mass of subcutaneous adipose tissue. The calculated mean relative mass of subcutaneous adipose tissue (%) in female patients increased non-significantly from FM, 15.21 ± 5.09% to FU, 15.28 ± 4.55 kg.

We noticed statistically significant changes in the comparison of KTx male patients' BMI data with healthy control group in FM ($n = 86$, $p = 0.008$), but not in FU ($p < 0.935$). In female KTx patients group the comparison of mean BMI data with healthy control groups ($n = 256$) were statistically non-significant in FM and in FU. In the control group individuals' BMI was lower in males ($p < 0.001$), and female groups ($p < 0.01$). The mean BMI was significantly lower in males and the first measurements compared with the population controls ($p < 0.009$) but at FU the BMI was not different ($p < 0.935$). In females, the BMI did not differ significantly from population controls at the first measurement ($p < 0.941$) either FU ($p < 0.552$). The comparison of KTx male patients' mean BMI data with the healthy control group were statistically significant in FM, but not in FU. In female KTx patients group the comparison of the mean BMI data with the healthy control population was statistically non-significant.

5.4. Results of bioimpedance measurement (Paper IV)

The results of the bioimpedance characteristics of kidney transplant patients were analysed twice: 1.5 years (first measurements, FM) and 3 years (follow-up, FU) after kidney transplantation. The bioimpedance characteristics in kidney transplant male and female patients after renal transplantation are shown in **Table 5.**

Table 5. Bioimpedance characteristics in kidney transplant patients

Measurements period	FM after kidney transplantation				FU after kidney transplantation				*P*-value FM vs FU
	Mean	SD	Min	Max	Mean	SD	Min	Max	
Male (n = 12)									
Body fat by OMRON (%)	18.19	8.68	7.80	39.40	23.50	8.09	8.40	39.40	0.003*
Body fat by OMRON (kg)	14.92	12.75	5.30	52.80	20.44	12.10	6.60	54.40	0.002*
Female (n = 16)									
Body fat by OMRON (%)	33.06	10.80	9.90	44.80	34.80	11.11	10.50	48.00	0.005*
Body fat by OMRON (kg)	25.74	12.57	4.20	46.50	28.36	14.99	4.90	60.00	0.040*

*Statistically significant difference $P \leq 0.050$
Abbreviations: SD, standard deviation; FM, the first measurements; FU, follow-up measurements.

Male patients (n = 12)
Body fat by Omron (%). In male patients the mean body fat content by OMRON (%) increased significantly, the mean difference was 5.31% (FM, the mean 18.19%, and the mean FU is 23.50%, p-value 0.003). **Body fat by Omron (kg)**. The mean body fat content by OMRON (kg) increased significantly in male patients and the mean difference was 5.52 kg (the mean 14.92 kg to 20.44 kg, (p-value 0.002).

Female patients (n = 16)
Body fat by Omron (%). The mean body fat (%) in female patients, which was measured by OMRON, increased significantly. The mean difference was 1.74% (the mean 33.06% to 34.80%, p-value 0.005). **Body fat by Omron (kg)**. The mean body fat (kg) was measured by OMRON. The mean BF content increased significantly in female patients and the mean difference was 2.62 kg (the mean 25.74 kg to 28.36 kg, p-value 0.040).

The body fat characteristics, measured by bioimpedance in kidney transplant patients in percentage by OMRON (%), indicated that the mean body fat content increased significantly in both patients' groups (males 5.31%; females 1.74%). The body fat characteristics, measured by bioimpedance in kidney transplant patients in kilograms by OMRON (kg), indicated that the mean body fat in kilograms increased significantly in both patients' groups (males 5.52 kg, females 2.62 kg).

5.5. Results of densitometric investigations (Paper IV)

The densitometric measuring was carried out at the Department of Internal Medicine of the University of Tartu in the Densitometric Study Centre. Densitometric measurement was carried out on average three years after kidney transplantation (FU). We present the results of the bone mineral density (BMD) measurements which were measured with the machine a GE LUNAR DPX-IQ densitometer (Madison, WI, US, software version 4.7e) by IOF-certified technicans. The studied renal transplant patients were clinically stable consecutive nondiabetic groups: 12 males, the age of 42.8 ± 16.1 (min 18, max 70) years, and 16 females, the age of 47.0 ± 14.9 (min 21, max 71). Individual densitometric measurement results have been statistically summarized in our thesis. The data of densitometric measurement in kidney transplant male and female patients are given in **Table 6** and the characteristics of body composition parameters by DXA in KTx patients in the follow-up are given in **Table 7**.

We present the characteristics of densitometric parameters of the studied contingent, the numerical data of the total and regional bone density which have been measured in different anatomical regions: the total body, arms, legs, trunks, spine and the region of anterior-posterior (AP) of lumbar spine (L1–L4). All the presented mean numerical values: the bone mineral density (BMD) in grams per centimeter squared (g/cm^2) for a selected region, T-scores and Z-scores, also SD, the minimal and the maximal values. The results of DXA measurements after kidney transplantation are compared with the reference values in the LUNAR DPX- IQ densitometer data basis and the WHO criteria.

Total body bone mineral density. The mean total body BMD (g/cm^2) after the second follow-up both in male (BMD = 1.151 ± 0.12 g/cm^2, min 1.028, max 1.336 g/cm^2) and female (BMD = 1.117 ± 0.10 g/cm^2; min 0.941, max 1.296 g/cm^2) renal transplant patient groups were lower than the normal range, which does not significantly differ from the BMD reference value for male (BMD = 1.210 ± 0.08 g/cm^2) and for female (BMD = 1.123 ± 0.08 g/cm^2) in population.

Regional body bone mineral density. The regional body bone mineral density (BMD) anterior-posterior (AP) spine L2–L4 after the second follow-up both in male (BMD = 1.122 ± 0.17 g/cm^2, min 0.893, max 1.344 g/cm^2) and in female (BMD = 1.046 ± 0.16 g/cm^2; min 0.774, max 1.395 g/cm^2) kidney transplant patient groups were BMD lower than the normal range, which does not significantly differ from the BMD reference value for males (BMD = 1.180 ± 0.12 g/cm^2) and for females (BMD = 1.180 ± 0.12 g/cm^2) in population.

Table 6. Total and regional body bone mineral density by dual energy x-ray absorptiometry in kidney transplant patients

Variable	Follow-up BMD (g/cm^2)					T-score					Z-score					Comparison data* BMD (g/cm^2)		
	Mean	±	SD	Min	Max	Mean	±	SD	Min	Max	Mean	±	SD	Min	Max	Mean	±	SD
Male (n = 12)																		
Total Body	1.151	±	0.12	1.028	1.336	-0.9	±	1.5	-2.4	1.5	-0.6	±	1.2	-2.3	1.2	1.210	±	0.08
Arms	0.951	±	0.11	0.766	1.192	-0.7	±	1.1	-2.7	1.0	-0.5	±	1.0	-2.7	1.2	0.995	±	0.08
Legs	1.218	±	0.17	1.012	1.507	-2.1	±	1.7	-4.1	0.2	-1.7	±	1.5	-3.5	0.5	1.339	±	0.09
Trunks	0.957	±	0.10	0.831	1.084	-0.8	±	1.3	-2.4	1.1	-0.5	±	1.0	-2.1	1.3	0.990	±	0.07
Spine	1.207	±	0.15	1.023	1.393	ND					ND					1.166	±	0.14
AP spine L2–L4	1.122	±	0.17	0.893	1.344	-0.9	±	1.4	-2.9	1.0	-0.7	±	1.2	-2.5	1.3	1.180	±	0.12
L1	1.039	±	0.16	0.818	1.260	-0.9	±	1.2	-2.4	1.0	-0.8	±	1.1	-2.3	1.0	ND		
L2	1.138	±	0.17	0.907	1.445	-0.8	±	1.4	-2.8	1.7	-0.7	±	1.3	-2.2	2.1	ND		
L3	1.145	±	0.21	0.849	1.450	-0.8	±	1.8	-3.3	1.8	-0.6	±	1.6	-3.0	1.5	ND		
L4	1.134	±	0.17	0.908	1.330	-0.9	±	1.4	-2.8	0.8	-0.8	±	1.3	-2.7	1.0	ND		
Female (n = 16)																		
Total Body	1.117	±	0.10	0.941	1.296	-0.1	±	1.2	-2.3	2.1	0.1	±	0.8	-1.9	1.3	1.123	±	0.08
Arms	0.872	±	0.08	0.760	1.018	0.4	±	1.0	-1.1	2.2	-0.6	±	2.0	-0.6	2.0	0.822	±	0.08
Legs	1.108	±	0.13	0.875	1.315	-0.5	±	1.5	-3.1	1.8	-0.4	±	1.0	-1.8	1.2	1.136	±	0.09
Trunks	0.932	±	0.12	0.747	1.146	0.2	±	1.7	-2.5	3.2	0.1	±	1.4	-3.1	2.0	0.911	±	0.07
Spine	1.216	±	0.27	0.876	1.633	0.5	±	1.9	-1.9	3.5	0.6	±	1.7	-2.7	3.2	1.137	±	0.14
AP spine L2–L4	1.046	±	0.16	0.774	1.395	-1.2	±	1.4	-3.5	1.8	0.5	±	1.4	-3.7	3.4	1.180	±	0.12
L1	0.949	±	0.13	0.719	1.148	-1.5	±	1.1	-3.4	0.2	-0.8	±	0.9	-2.9	0.8	ND		
L2	1.059	±	0.18	0.730	1.340	-1.2	±	1.5	-3.9	1.2	-0.5	±	1.4	-3.3	1.8	ND		
L3	1.064	±	0.16	0.804	1.480	-1.1	±	1.3	-3.3	2.3	-0.4	±	1.4	-3.4	3.9	ND		
L4	0.984	±	0.15	0.724	1.177	-1.3	±	2.0	-4.0	4.7	-0.6	±	2.1	-4.1	6.3	ND		

Abbreviations: BMD, body bone mineral density (g/cm^2); AP, anterior-posterior; T-score, German AP Spine Reference Population, Young Adult Ages 20–45; Z-score, Matched for Age, Weight 25–100 kg, Ethnic; ND, no data.
*Lunar DPX-IQ Reference Manual.

In **Paper IV** we present the individualized data in kidney transplant patients in absolute figures and percentages (%) by three T-score categories: normal, osteopenia and osteoporosis. Individual measures of the total body BMD after the second follow-up revealed low mineral density (osteopenia) in 50% of males and 18% of females but anterior-posterior (AP) lumbar spine (L2–L4) measured T-scores showed osteopeny in 33% of males and in 25% of females. Osteoporosis was not found using total body measurements but in the region AP lumbar spine (L2–L4) osteoporosis was found in 8% of male and 25% of female patients. The received data we compare with the WHO criteria which were used to distinguish normal bone mineral density, osteopenia (low bone mass) and osteoporosis: T-scores measured criteria as follows: above -1: bone density is considered normal; between -1 and -2.5 this T-score is a sign of osteopenia; below -2.5 bone density indicated osteoporosis. (Report of the WHO Study Group 1994).

Male patients (n = 12)
On the basis of the total body bone mineral density by T-score in the group of male patients with the transplanted kidney the normal BMD in male patients was 50% (6 male patients), osteopenia was in 50% male patients (6 male patients) and osteoporosis was not found. On the basis of AP Lumbar spine bone mineral density by T-score in the group of male patients with the transplanted kidney the normal BMD in male patients was 58% (7 male patients), osteopenia was in 33% (4 male patients) and osteoporosis was in 8% (1 male patient).

Female patients (n = 16)
On the basis of the total body bone mineral density by T-score in the group of female patients with the transplanted kidney the normal BMD in female patients was in 81% (13 female patients), osteopenia in 18% (3 female patients) and osteoporosis was not found. On the basis of the AP Lumbar spine bone mineral density by T-score in the group of female patients with the transplanted kidney the normal BMD in female patients was in 50% (8 female patients), osteopenia in 25% (4 female patients) and osteoporosis was in 25% (4 female patients).

Table 7. The characteristics of body composition parameters by DXA in kidney transplant patients in the follow-up

Variables	FU **Male** (n = 12)				FU **Female** (n = 16)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Fat Mass								
Total Fat Mass (kg)	19.6	13.9	6.1	60.1	31.4	14.5	8.6	60.0
Total Fat Mass (%)	23.8	10.2	8.0	49.2	39.9	10.2	19.2	51.8
Fat Free Mass								
Total Lean Mass (kg)	55.6	8.3	44.3	70.6	40.9	7.1	33.3	57.7
Total bone mineral content (kg)	3.0	0.6	2.3	3.9	2.6	0.6	1.6	3.6
Body Tissu Mass								
Total Tissue Mass (kg)	74.9	16.7	58.6	118.6	72.3	20.2	42.9	114.2

Abbreviations: SD, standard deviation; DXA, dual energy x-ray absorptiometry; FU, follow-up measurements.

We have presented the characteristics of measured body composition parameters by DXA in the studied contingent: total fat mass (kg; %), total lean mass (kg), total tissue mass (kg)

Male patients (n = 12)

Body fat mass by DXA (kg). The mean total fat mass content (kg) by DXA in male patients was 19.6 kg ± 13.9 kg in FU.

Body fat mass by DXA (%). The mean total fat mass content (%) by DXA in male patients was 23.8% ± 10.2% in FU.

Total lean mass by DXA (kg). The mean total lean mass content (kg) by DXA in male patients was 55.6 kg ± 8.3 kg in FU.

Total tissue mass by DXA (kg). The mean total tissue mass content (kg) by DXA in male patients was 74.9 ± 16.7 kg in FU.

Female patients (n = 16)

Body fat mass by DXA (kg). The mean total fat mass content (kg) by DXA in female patients was 31.4 kg ± 14.5 kg in FU. The minimal total fat mass by DXA was 8.6 kg and maximal content was 60 kg in female patients.

Body fat mass by DXA (%). The mean total fat mass content (%) by DXA in female patients was 39.9% ± 10.2% in FU.

Total lean mass by DXA (kg). The mean total lean mass content (kg) by DXA in female patients was 40.9 kg ± 7.1 kg in FU.

Total tissue mass by DXA (kg). The mean total tissue mass content (kg) by DXA in female patients was 72.3 ± 20.2 kg in FU.

The total body BMD after the second follow-up both in male and female kidney transplant patient groups was lower than the normal range, which does not significantly differ from the BMD reference value for males and for females in population.

The regional body bone mineral density (BMD) AP spine L2–L4 after the second follow-up both in male and in female kidney transplant patient groups was lower than the normal range, which does not significantly differ from the BMD reference value for males and for females in population.

The results of individualized data by T-score in kidney transplant patients mainly in the region AP Lumbar in absolute figures and percentages (%) by three T-score categories indicated a higher number of osteoporosis in the female group. In the region AP Lumbar the normal bone tissue density was in 7 male patients and in 8 female patients, ostoepenia was in 4 male patients and 4 female patients.

The results of body composition parameters by DXA in kidney transplant male patients in the follow-up indicated that the total fat mass (kg; %) was lower compared with female patients, and the total lean mass (kg) was higher in male patients compared with female patients.

5.6. Results of laboratory investigations (Paper IV)

Laboratory analyses were carried out in the studied patients at the beginning (FM) of the investigation one and half years, and then three years after the kidney transplantation (FU). All the laboratory results were compared with Tartu University United Laboratories reference ranges (Laboratory Manual IV, 2012). Biochemical changes in kidney transplant patients after kidney transplantation are demonstrated in **Table 8.**

S-Alb mean level significantly improved after transplantation in comparison with the first and the FU measurements both in males (p-value 0.008) and females (p-value 0.011). S-Prot level was significantly increased in female patients at FU compared with the first data, and increased non-significantly in male patients.

S-CRP mean level non-significantly increased in male patients but not in female patients and remained at lower levels of the normal range (< 5.0 mg/L) after the transplantation.

S-Crea mean level was non-signifigantly increased in male patients and in female patients after the post-transplantation, but the mean S-Urea level was non-signifigantly decreased in male patients and little non-signifigantly increased in female patients (8.00 ± 2.39 mmol/L and at FU, 8.99 ± 3.36 mmol/L) in FM compared with FU.

S-UA mean level was little significantly increased in male (p-value 0.014) and in female patients (p-value 0.017) at the beginning of the observation after kidney transplantation.

S-ALP mean level during the study was non-significantly decreased in male (114.50 ± 60.59 U/L and FU, 110.14 ± 32.91 U/L) and in female patients (86.19 ± 32.35 U/L and FU, 83.75 ± 31.07 U/L) and was in the normal range for male (40–130 U/L) and female patients (35–105 U/L).

S-iCa mean level was non-significantly little increased in male and female patients and was in the normal range for a male and a female (1.16–1.32 mmol/L).

S-P mean level in male and female patients non-significantly decreased and was in the normal range (0.87–1.45 mmol/L) after kidney transplanation.

fB-Hb mean level showed a growth tendency and significantly increased in male (116.92 ± 14.60 g/L and FU, 137.50 ± 27.61 g/L, p-value 0.005) and female patients (116.69 ± 11.96 g/L and FU, 127.63 ± 13.61 g/L, p-value 0.009) but was in the normal range.

Table 8. Biochemical changes in renal transplant patients after kidney transplantation

Variables	**FM** after renal transplantation				**FU** after renal transplantation					Laboratory reference
	Mean	SD	Min	Max	Mean	SD	Min	Max	*P*-value	Normal range
Male (n = 12)										
S-Prot (g/L)	69.42	6.46	58.00	83.00	73.42	4.80	63.00	83.00	0.084	64–83
S-Alb (g/L)	40.83	3.59	35.00	46.00	44.75	3.17	41.00	50.00	0.008*	35–52
S-CRP (mg/L)	4.99	3.40	0.85	11.00	6.66	7.91	1.00	25.00	0.444	< 5.0
S-Crea (μmol/L)	138.08	51.64	81.00	270.00	142.00	51.88	87.00	260.00	0.626	62–106
S-Urea (mmol/L)	11.08	4.24	6.00	17.40	9.69	3.50	6.10	16.30	0.146	< 8.1
S-UA (μmol/L)	362.67	70.89	250.00	486.00	431.08	64.31	298.00	561.00	0.014*	202–417
S-ALP (U/L)	114.50	60.59	45.00	221.00	110.14	32.91	74.00	183.00	0.773	40–130
S-iCa (mmol/L)	1.33	0.10	1.12	1.49	1.35	0.08	1.24	1.47	0.379	1.16–1.32
S-P (mmol/L)	1.04	0.52	0.49	2.09	0.98	0.30	0.49	1.47	0.717	0.87–1.45
fB-Hb (g/L)	116.92	14.60	96.00	136.00	137.50	27.61	93.00	184.00	0.005*	134–170
e-GFR (mL/min/1.73 m^2)	57.03	21.17	20.31	96.05	57.67	21.06	23.09	97.85	0.907	≥ 90
S-Chol (mmol/L)	5.84	1.14	4.20	7.60	5.92	1.28	3.80	8.90	0.772	< 5.0
S-HDL-Chol (mmol/L)	1.45	0.38	0.85	2.19	1.49	0.42	0.72	2.20	0.848	> 1.0
S.LDL-Chol (mmol/L)	3.63	0.91	2.16	4.72	3.85	1.27	1.22	6.17	0.655	< 3.0
S-Trigl (mmol/L)	1.58	0.51	0.95	2.55	1.80	0.89	0.54	3.48	0.224	< 2.3
Female (n = 16)										
S-Prot (g/L)	66.44	7.16	55.00	77.00	70.19	5.74	56.00	80.00	0.026*	64–83
S-Alb (g/L)	39.56	3.71	34.00	45.00	42.75	2.79	36.00	48.00	0.011*	35–52
S-CRP (mg/L)	3.75	3.11	1.00	11.00	3.72	2.58	0.21	8.90	0.974	< 5.0
S-Crea (μmol/L)	116.06	34.67	72.00	189.00	116.38	34.81	79.00	196.00	0.946	44–80
S-Urea (mmol/L)	8.00	2.39	4.70	11.80	8.99	3.36	3.60	15.80	0.070	< 8.1
S-UA (μmol/L)	320.75	86.83	164.00	434.00	370.31	82.81	219.00	474.00	0.017*	143–339
S-ALP (U/L)	86.19	32.35	44.00	153.00	83.75	31.07	51.00	146.00	0.722	35–105
S-iCa (mmol/L)	1.37	0.18	1.09	1.76	1.40	0.10	1.25	1.61	0.531	1.16–1.32
S-P (mmol/L)	1.13	0.39	0.60	1.98	1.05	0.28	0.45	1.65	0.381	0.87–1.45
fB-Hb (g/L)	116.69	11.96	91.00	135.00	127.63	13.61	95.00	151.00	0.009*	117–153
e-GFR (ml/min/1.73 m^2)	49.77	16.31	24.79	79.56	50.05	17.00	22.67	80.12	0.915	≥ 90
S-Chol (mmol/L)	6.26	1.36	3.70	8.40	6.50	1.20	4.40	8.30	0.188	< 5.0
S-HDL-Chol (mmol/L)	1.44	0.39	0.85	2.04	1.62	0.36	1.11	2.28	0.106	> 1.0
S-LDL-Chol (mmol/L)	3.98	1.22	2.15	6.07	4.44	0.92	2.67	6.07	0.066	< 3.0
S-Trigl (mmol/L)	2.31	1.36	0.53	5.02	1.69	1.13	0.53	5.52	0.034*	< 2.3

*Statistically significant difference $P \leq 0.05$

Abbreviations: SD, standard deviation; FM, the first measurements; FU, follow-up measurements; S-Prot, serum protein; S-Alb, serum albumin; S-CRP, serum C-reactive protein; S-Crea, serum creatinine; S-Urea, serum urea; S-UA, serum uric acid; S-ALP, serum alkaline phosphatase; S-iCa, serum calcium ionized; S-P, serum phosphate; e-GFR, estimated glomerular filtration rate; S-Chol, serum cholesterol; S-HDL-Chol, serum high density lipoprotein; S-LDL-Chol, serum low density lipoprotein; S-Trigl, serum triglyceride.

S-Chol mean level in male (5.84 mmol/L and FU, 5.92 mmol/L) and in female patients (6.26 mmol/L and FU, 6.50 mmol/L) was non-significantly little increased from the beginning to the end of the observation after the kidney transplantation (S-Chol recommended level is < 5.0 mmol/L).

S-HDL-Chol mean level in male (1.45 ± 0.38 mmol/L and FU, 1.49 ± 0.42 mmol/L) and female patients (1.44 ± 0.39 mmol/L and FU, 1.62 ± 0.36 mmol/L) was non-significantly little increased, compared at the recommended levels S-HDL-Chol normal range (> 1.0 mg/L), from the beginning to the end of the observation after the kidney transplantation.

S-LDL-Chol mean level in male (3.63 ± 0.91 mmol/L and FU, 3.85 ± 1.27 mmol/L) and female patients (3.98 ± 1.22 mmol/L and FU, 4.44 ± 0.92 mmol/L) was non-significantly little increased at the recommended levels (< 3.0 mmol/L) from the beginning to the end of the observation after the kidney transplantation.S-Trigl mean level in male patients was non-significantly increased (1.58 ± 0.51 mmol/L and at FU, 1.80 ± 0.89 mmol/L) and, on the other hand, in females S-Trigl mean level showed a significantly lowering tendency (2.31 ± 1.36 mmol/L and at FU, 1.69 ± 1.13 mmol/L, p-value 0.034).

Glomerular filtration rate (GFR) raised a little, and non-significantly both in male (57.03 ± 21.17 mL/min to 57.67 ± 21.06 mL/min) and in female (49.77 ± 16.31 mL/min to 50.05 ± 17.00 mL/min) patients groups after the kidney transplantation (reference value e-GFR ≥ 90 mL/min).

Serum parathyroid hormone (S-PTH, pmol/L), serum homocysteine (S-Hcy, µmol/L) and serum cystatin C (S-CysC, mg/L) were measured at the follow-up, and laboratory data from parathyroid hormone, homocysteine and cystatin C in kidney transplant male and female patients are demonstrated in **Table 9**.

Table 9. Parathyroid hormone, homocysteine and cystatin C in kidney transplant male and female patients in the follow-up

Variables	Mean	SD	Min	Max	Laboratory reference Normal range
Male (n = 12)					
S-PTH (pmol/L)	8.92	4.77	4.00	17.70	1.60–6.90
S-Hcys (µmol/L)	19.83	13.38	10.20	57.95	< 12
S-CysC (mg/L)	1.18	0.55	0.72	2.42	0.47–1.09
Female (n = 16)					
S-PTH (pmol/L)	21.35	13.29	8.20	44.00	1.60–6.90
S-Hcys (µmol/L	16.14	3.46	10.60	22.60	< 12
S-CysC (mg/L)	0.98	0.27	0.66	1.42	0.47–1.09

Abbreviations: SD, standard deviation; S-PTH, serum parathyroid hormone; S-Hcys, serum homocysteine; S-CysC, serum cystatin C.

S-PTH mean levels in male patients was little above the normal range (the mean S-PTH, 8.92 ± 4.77 pmol/L), but the mean S-PTH for a female is 21.35 ± 13.29 pmol/L in the follow-up. The normal range for S-PTH is 1.60–6.90 pmol/L.

S-Hcy mean levels in the studied patients groups were a little above the normal range (< 12 μmol/L) both in male (the mean 19.83 ± 13.38 μmol/L), and female patients (the mean 16.14 ± 3.46 μmol/L). S-CysC mean level of males was a little higher compared with the normal range (the mean 1.18 ± 0.55 mg/L). The laboratory normal range S-CysC is 0.47–1.09 mg/L. But in females the mean S-CysC remained in the normal range and was 0.98 ± 0.27 mg/L.

The mean S-PTH level in male patients was little above the normal range, but in female patients S-PTH mean level was increased, and was higher from the laboratory recommended normal range for an adult (1.60–6.90 pmol/L). S-Hcys mean levels in the studied patients groups were a little above the normal range for male and female patients (12 mmol/L). The mean S-CysC level in male patients was a little higher, but in female patients remained in the normal range (0.47–1.09 mg/L).

5.7. Correlation analysis between anthropometric and laboratory variables (Paper IV)

The correlation analysis of medium anthropometric indicators with medium laboratory parameters was carried out separately for males (n = 12) and females (n = 16). The results of the correlations analysis between selected anthropometric and laboratory parameters in male and female kidney transplant patients after the first measurements (FM) and the follow-up (FU) are given for male patients and for female patients in **Paper IV.**

The correlation analysis showed in male kidney transplant patients that the mean inflammatory indicators (CRP) were significantly correlated with different body circumferences (waist, hip, mid arm relaxed, mid-arm flexed and tensed), and skinfolds thicknesses (suprailiac, subscapular, triceps). In males, no clear associations were found between lipid (Chol, S-HDL-Chol, S-LDL-Chol, S-Trigl) and anthropometric parameters.

The correlation analysis showed in females that no clear associations were found between the inflammation status and anthropometric parameters.We found more associations between lipid parameters (Chol, S-HDL-Chol, S-LDL-Chol, S-Trigl) and anthropometrical variables (BW, breadth-depth, circumferences, skinfolds thicknesses, BF, WHR) in FM and in FU. In female patients at the beginning and at the end of observations only certain features deserve attention; the connection between anthropometrical parameters (circumferences, skinfolds, body fat by OMRON) and lipid parameters (Chol, S-LDL-Chol, S-Trigl).

Male patients (n = 12)

Correlation analysis between selected anthropometric and laboratory variables in kidney transplant male patients after FM and FU. We found at the beginning of observation (FM) no reliable correlations between blood hemoglobin, serum albumin, serum creatinine, serum urea, serum alkaline phosphatase, serum calcium ionized, serum phosphate and anthropometric indicators (body weight, waist and hip circumferences, skinfolds, indices).

In males at the beginning of observation the mean serum C-reactive protein (**S-CRP**) was significantly correlated with different body circumferences and skinfolds thicknesses, there were seven statistically significant correlations: waist circumferences (r = 0.835), hip circumferences (r = 0.735), mid-arm circumferences (r = 0.790), mid-arm circumferences flexed and tensed (r = 0.737), suprailiac skinfolds thicknesses (r = 0.724), subscapular skinfolds (r = 0.687), triceps skinfolds (r = 0.616), and no reliable correlation with body weight (r = 0.256).

We found at the end (FU) of observation in male patients statistically significant positive correlation between nine anthropometric parameters and **S-CRP**: mean waist circumferences (r = 0.710), mean hip circumferences (r = 0.770), mean mid-arm relaxed (r = 0.790), mid arm flexed-tensed circumferences (r = 0.737), suprailiac skinfolds thicknesses (r = 0.614), subscapular skinfolds (r = 0.727), and no reliable correlations with biceps and triceps skinfolds. At the end (FU) of observation there was a significant positive correlation with the mean BF by Omron (kg) (r = 0.723), with the mean BMI (r = 0.779) and with body weight (r = 0.747).

Correlation analysis between anthropometric variables and lipid parameters in kidney transplant male patients after FM and FU. We found at the beginning (FM) of observation positive significant correlations in male kidney transplant patients between three anthropometric parameters and **S-LDL-Chol**: the mean chin skinfolds (r = 0.747), the mean triceps skinfolds (r = 0.679) and the mean WHR (r = 0.710). The mean **S-HDL-Chol** correlated significantly with umbilical skinfolds (r = 0.636). In males at the end (FU) of observation there were no reliable correlations between anthropometric variables and blood lipid parameters in KTx male patients.

Female patients (n = 16)

Correlation analysis between selected anthropometric and laboratory variables in kidney transplant female patients after FM and FU. We found at the beginning (FM) of observation statistically significant correlations in female kidney transplant patients between eight anthropometric parameters and S-ALP: body weight (r = 0.501), waist circumference (r = 0.742), mid-arm relaxed (r = 0.532), mid-arm flexed and tensed (r = 0.579), suprailiac skinfolds (r = 0.601), subscapular skinfolds (r = 0.553), biceps skinfolds (r = 0.640), triceps skinfolds (r = 0.682).

In females, at the end (FU) of observation similar correlations stayed between nine anthropometric parameters and S-ALP: body weight (r = 0.644), waist circumference (r = 0.522), hip circumference (r = 0.664), mid-arm relaxed (r = 0.531), mid-arm flexed and tensed (r = 0.560), suprailiac skinfolds (r = 0.505), subscapular skinfolds (r = 0.521), biceps skinfolds (r = 0.449), body fat (kg) by OMRON (r = 0.617), body fat (%) by OMRON (r = 0.616). We found at the end (FU) of observation statistically significant negative correlations between nine anthropometric parameters and serum phosphate (S-P): body weight, four body circumferences, subscapular skinfold thicknesses, body fat (kg; %) by OMRON, and BMI. The mean serum calciun ionized (S-iCa) correlated significantly with different body circumferences and skinfolds thicknesses: waist circumference, suprailiac skinfolds, biceps skinfolds, body fat, BMI. Serum creatinine (S-Crea) and urea (S-Urea) were not significantly correlated with body measurements at the beginning or at the end of observation.

Correlation analysis between selected anthropometric and lipid parameters in kidney transplant female patients after FM and FU. We found at the beginning (FM) of observation statistically significant strongest positive correlations in female kidney transplant patients between twenty-three anthropometric parameters and S-Trigl: body weight (r = 0.571), six breadth and depth parameters, neck circumference (r = 0.655), chest circumference (r = 0.573), waist circumference (r = 0.626), forearm circumference (r = 0.621), wrist circumference (r = 0.702), chest skinfolds (r = 0.561), side skinfolds (r = 0.653), waist skinfolds (r = 0.648), supriliac skinfolds (r = 0.542), umbilcal skinfolds (r = 0.603), subscapular skinfolds (r = 0.524), biceps skinfolds (r = 0.587), triceps skinfolds (r = 0.520), body fat (kg) by OMRON (r = 0.518) and BMI (r = 0.563) parameters.

At the beginning the mean Chol was significantly positively correlated only with the mean BF (%) by OMRON (r = 0.614) parameters and at the end (FU) of observation correlated positively with the mean BF (%) by OMRON (r = 0.597) parameters. Cholesterol of fat indicators was not significantly correlated with other anthropometric features in female patients in the follow-up. At the beginning the mean S-LDL-Chol was significantly correlated with the mean BF (%) by OMRON (r = 0.517) parameters but at FU there were only significantly correlated: body fat (%) by OMRON (r = 0.676) and waist to hip ratio (r = 0.545) parameters. We found at the end of observation statistically significant correlations in female kidney transplant patients between six anthropometric parameters and S-LDL-Chol.

In females, at the end (FU) of observation similar correlations stayed between twenty-one anthropometric parameters and S-Trigl: body weight (r = 0.622), five breadth and depth parameters, neck circumference (r = 0.602), chest circumference (r = 0.679), waist circumference (r = 0.559), hip circumference (r = 0.567), ankle circumference (r = 0.492), mid-arm flexed and tensed circumference (r = 0.499), forearm circumference (r = 0.568), wrist circumference (r = 0.594), chin skinfolds (r = 0.638), waist skinfolds (r = 0.580), chin umbilical skinfolds (r = 0.630), subscapular skinfolds (r = 0.534), body fat in (kg) by OMRON (r = 0.653), body fat (%) by OMRON (r = 0.504), BMI (r = 0.650) parameters. We found at the beginning statistically non-significant correlations between anthropometric parameters and S-HDL-Chol, but at the end we found thirteen negative significant correlations.

5.8. Multiple regression models between anthropometric and laboratory variables

The results of the multiple regression analysis which were used to evaluate associations among different anthropometric and lipid variables. Four models were analysed and the results between anthropometric and laboratory variables with R-Square components in male (n = 12) and in female (n = 16) kidney transplant patients are given in **Table 10**.

Table 10. Multiple regression models between the anthropometrical and the laboratory variables in kidney transplant patients

Model No	Dependent variable	Intercept	Coefficent	Independent variable	R-Square
Male (n = 12)					
Model 1.	S-TG (mmol/L)	-1.384	-0.068	Hip circumference (cm)	0.6761
FM			0.211	MAC, tensed (cm)	
Model 2.	S-LDL-Chol (mmol/L)	-1.914	-0.402	Biceps' skinfolds (mm)	0.7204
FM			0.399	Triceps' skinfolds (mm)	
Female (n = 16)					
Model 3.	S-LDL-Chol (mmol/L)	-1.010	-0.073	Body weight (kg)	0.6854
FU			0.271	Body fat (kg)	
			-0.271	BMI (kg/m^2)	
Model 4.	S-LDL-Chol (mmol/L)	-0.920	0.131	Hip circumference (cm)	0.4633
FM			0.533	MAC, relaxed (cm)	
			0.769	MAC, tensed (cm)	

Abbreviations: MAC, mid-arm circumference; S-LDL-Chol, serum low-density lipoprotein; S-TG, serum triglyceride; FM, the first measurements; FU, follow-up.

Four models were analysed and the results revealed the following:

1) multiple regression model 1 components FM analysis indicated that triglycerides (S-Tg) content was associated negatively with hip circumference and positively with mid-arm circumference (MAC) in male patients (Intercept -1.384, R-Square 0.6761);
2) multiple regression model 2 components FM analysis indicated that S-LDL Cholesterol was associated negatively with Biceps' skinfolds and positively with Triceps' skinfolds in male patients (Intercept -1.914, R-Square 0.7204);
3) multiple regression model 3 components FU analysis indicated that S-LDL Cholesterol was associated negatively with body weight, positively with

body fat and negatively with BMI in female patients (Intercept -1.101, R-Square 0.6854);

4) multiple regression model 4 components FM analysis indicated that S-LDL Cholesterol was associated positively with hip circumference, with MAC, relaxed or tensed in female patients (Intercept -0.920, R-Square 0.4633).

5.9. Results of the implementation of treatment diets for patients (Paper III)

The establishment of the system of treatment diets to support the patients' complex treatment has taken place on three levels: at the Tartu University Hospital, in the Estonian Health Care and Social Welfare Institutions and the Ministry of Social Affairs by adopting a specific regulation. The system of diets developed and used in practice at the Tartu University Hospital was implemented in clinical practice at the hospital's nephrology division, also in other Estonian health care institutions.

On 12 November 2002 the handbook for treatment diets worked out by the author of the thesis ”Treatment diets” was published (Kiisk 2002). It is used at the Tartu University Hospital and other hospitals in Estonia. The handbook is helpful for doctors and nurses when counselling their patients. The handbook consists of five chapters. In the first part of the handbook a detailed description of the nomenclature of treatment diets for patients is given together with a historical overview of the development of treatment diets. In the nomenclature of the diets an ordinary food and eight groups of diet foods are given. Each group is supplied with the detailed characteristics of the diet, the average content of basic nutrients and their indications for the use by groups of diseases. A special overview of the four variants of diets recommended for diabetics is given. Patients with special needs are recommended to use liquid and soft diet foods. There are diets with strict limitations. Also, an overview of the system of standardized food probe is given. In the second half of the handbook the author has presented a summarizing table of the nomenclature of diets with recommendations for the daily consumption of energy and basic nutrients taking into consideration the Estonian nutrition recommendations and instructions for treatment (Estonian Nutrition Recommendation and Food Based Dietary Guidelines 2006). In the third part of the book the division of foodstuffs into groups is given: the group of cereals, milk, meat, potato and vegetables; the group of berries and fruits; the group of fat and sweet things; the group of drinks; also the group of spices and additives. To cover all the variants of diets, there are 25 summarizing tables which contain a list of the recommended, non-recommended and prohibited foodstuffs by groups. In the fourth part of the book the choice of diet foods is presented: soups, fried meat and fish, sauces, pot dishes, stews, porridges, desserts, bakeries, salads, fruits, sandwiches, additives and drinks. The handbook includes 227 recipes with their composition of foodstuffs and basic nutrients. In the fifth part of the handbook there are different daily specimen menus for ordinary food and they are provided for 20-day periods, and for diet foods daily specimen menus have been composed for five different days. All the dietetic dishes in the handbook have been presented as sets of daily menus that meet the needs for dietary nutrition in the case of different medical conditions.

In the handbook ”Treatment diets” (Kiisk 2002) the nomenclature of diets with recommendations for the consumption of the daily food energy and basic nutrients has been presented and it serves as the part which was taken into consideration in working out the new regulation. The author of the handbook participated in the working group of the people producing the regulation. At the present the Regulation of the Ministry of Social Affairs ”Health Protection Requirements for the Nutrition in Hospitals and Health Care Institutions” which was adopted on 14 November 2002 and entered into force on 1 January 2003 provides the requirements for the food for patients concerning the composition of the food, the content of energy and nutrients (RTL 2002, 131, 1918). A summarizing table titled ”The content of food energy and nutrients” is presented in Supplement 3 of the regulation. The **systematizised** nomenclature of treatment diets for a multiprofile health care institution is essential in patients' care, and has been used for patients' nutrition in the Tartu University Hospital, and in all Estonian Health Care and Social Welfare Institutions (**Regulation no. 131**, Health Protection Requirements for Nutrition in Health Care and Social Welfare Institutions, issued on 14 November 2002 by the Estonian Minister of Social Affairs). Treatment diets are in use for the normative values of the basic nutrients in accordance with the Estonian nutritional recommendations.

In the years 2008–2009 the autor finished producing a big-amount data base for ordinary and diet nutrition with planned menus, the titles of diets and codes, the titles of foods and codes which have been entered into the hospitals' electronic-Health computer system (the implication of documentation, e-HL). All the data of the nutrition of patients, the title of the indicated diet, the weight of the portion and the real daily menu are connected with the case history of the particular patient and can be seen by the medical staff. The programme also allows to draw personal menus for the special needs patients. The system of diets developed and used in practice at the Tartu University Hospital together with its implementation in the electronic-Health computer system is used in the nephrological division and all the 16 clinics of the Tartu Univertsity Hospital and in other Estonian hospitals and care institutions.

5.10. Results of the analyses of Food Frequency Questionnaire

We analyse nutritional habits in 12 male and 16 female consecutive kidney transplant patients 1.5 years after the transplantation. The data on individual nutritional habits were obtained by a Food Frequency Questionnaire in **Table**

11. Results of nutritional habits based on the food-frequency questionnaire. Part I–VI.

Table 11. Results of nutritional habits based on the Food Frequency Questionnaire
Part I. The frequency table (percentage) of social-economic situation for the patients with the transplanted kidney

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
1.	Your family status		
	single	41.7	31.3
	married	41.7	37.5
	cohabitation	16.7	6.3
	divorced	0.0	25.0
2.	Your education		
	primary	33.3	6.3
	secondary	41.7	50.0
	secondary special	16.7	31.3
	unfinished higher	8.3	0.0
	higher	0.0	12.5
3.	Do you work		
	no work	75.0	75.0
	constantly	16.7	12.5
	temporarily	8.3	12.5
4.	How big is your working load		
	full load	8.3	12.5
	part time	16.7	12.5
	freed, disability group	75.0	75.0
5.	How do you assess the family's economic status		
	bad	16.7	12.5
	satisfactory	75.0	68.8
	good	8.3	18.8
6.	Does your economic situation allow you to eat at your free choice		
	no opportunities	16.7	6.3
	meets the elementary (one-sided) basic needs	25.0	6.3
	freely provides basic food (bread, milk, potato, vegetables)	25.0	37.5
	freely provides many-sided food	25.0	43.8
	no limitations in the choice of food	8.3	6.3

Patients' marital status. The majority of male and female patients were married or cohabited (58.4% of males and 43.8% of females), 25% of female patients were divorced, 41.7% of males and 31.3% of females were single. Patients' family status is shown in Figure 3.

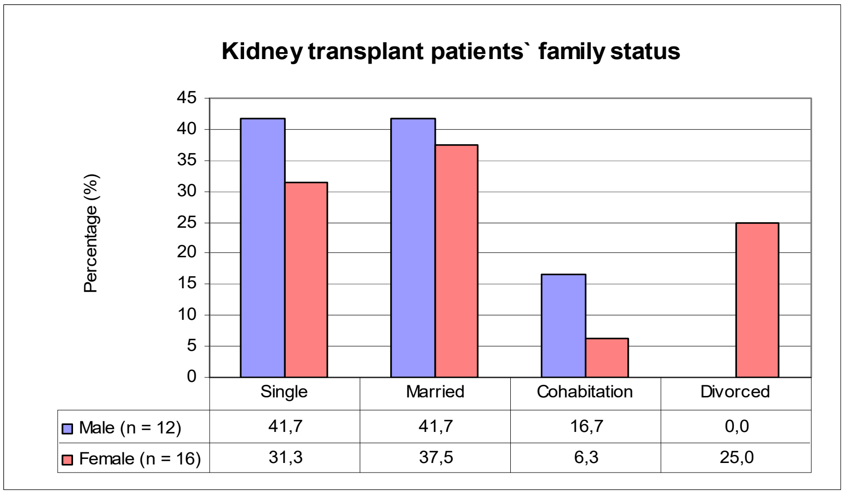


Figure 3. Kidney transplant patients' family status based on the food-frequency questionnaire (FFQ). All the data of the frequency table are given in percentage (%).

Patients' education. Patients with higher education were only among females (12.5%) and 91.7% of males and 87.6% of female patients had primary, secondary or specialized secondary education. Patients' education is shown in Figure 4.

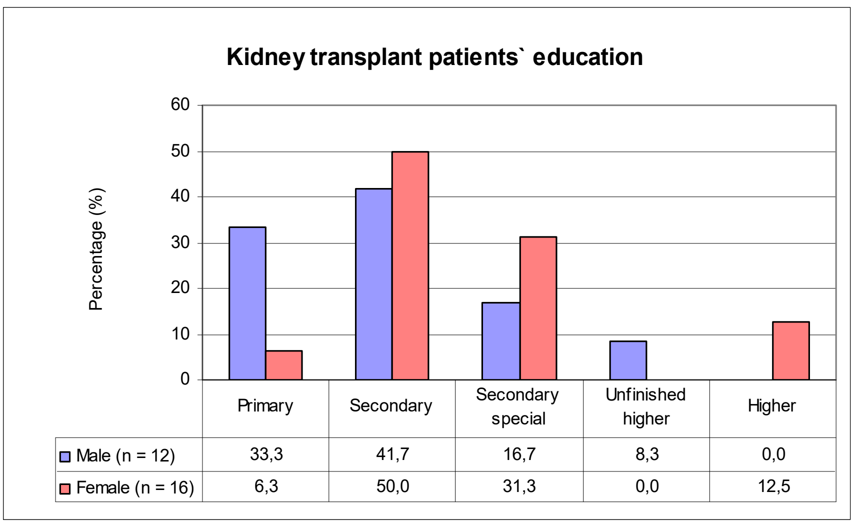


Figure 4. Kidney transplant patients' education data based on the food-frequency questionnaire (FFQ). All the data of the frequency table are given in percentage (%).

Patients' working status. 2/3 of male and 2/3 of female patients did not work as they were categorized as disabled, 1/3 of subjects worked either constantly or sometimes, either full- or part-time. The studied patients' working status is shown in Figure 5.

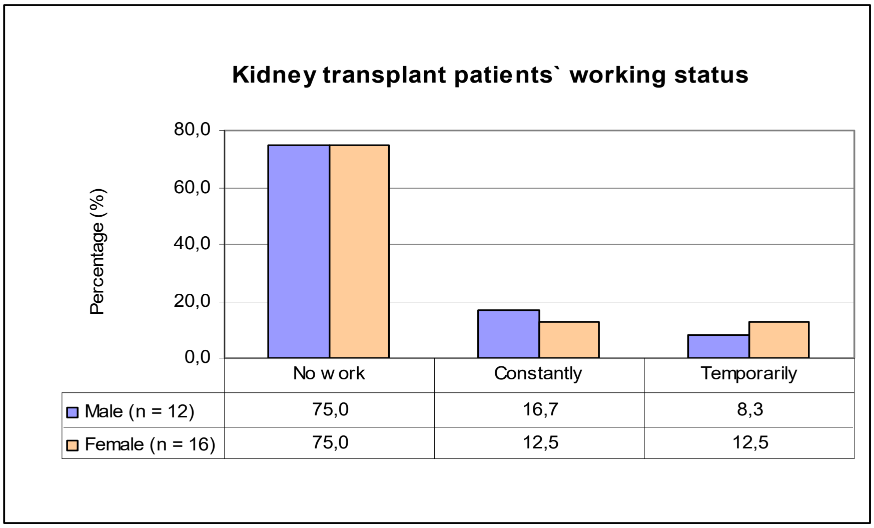


Figure 5. Kidney transplant patients' working status based on the food-frequency questionnaire (FFQ). All the data of the frequency table are given in percentage (%).

Patients' assessment of their families' economic situation. The economic situation of the family was considered poor by 16.7% of males and 12.5% of females, satisfactory by 75% of males and 68.8% of females, and only 8.3% of male and 18.8% of female patients considered their economic status good.

Patients' economic situation. For 25% of males and 6.3% of females the choice of food was limited: they were able to afford only indispensable and unbalanced food (for basic needs). 25% of male and 43.8% of female patients could choose satisfactory and varied basic food (potato, bread, milk, vegetables), 8.3% of males and 6.3% of females did not have any limitations in choosing their food.

Table 11. The nutritional habits based on the food-frequency questionnaire
Part II. The frequency table of the nutrititional traditions of the family

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
1.	Which attention to eating is given in the family		
	no special	16.7	6.3
	moderate	75.0	87.5
	big	8.3	6.3
2.	How many meal-times a day		
	no regularity	25.0	6.3
	one time a regular meal a day	16.7	6.3
	two times	0.0	25.0
	three times	50.0	56.3
	four times and more	8.3	6.3
3.	The richest meal in your family		
	breakfast	0.0	0.0
	lunch	58.3	62.5
	supper	33.3	25.0
	irregular	8.3	12.5
4.	Breakfast's regularity and character		
	little and irregular food	8.3	0.0
	always but little (sandwich, juice, milk, coffee, etc.)	75.0	93.8
	hot meal (porridges, stews, fried potatoes, etc.)	16.7	6.3
5.	Lunch's regularity and character		
	regular lunch at midday, at 12.00–16.00	66.7	87.5
	at 16.00–18.00	8.3	6.3
	after 18.00	0.0	6.3
	irregular	25.0	0.0
6.	Supper's regularity and character		
	coincides with later lunch, no more food later	0.0	12.5
	at 18.00–20.00	66.7	75.0
	after 20.00	8.3	0.0
	irregular	25.0	12.5
7.	How many times does the familly eat together		
	never, everybody has his/her times for food	0.0	37.5
	in the morning	33.3	6.3
	at midday	16.7	6.3
	in the evenings	25.0	31.3
	two or more times together	25.0	18.8
8.	Who prepares most often		
	mother	25.0	37.5
	father	8.3	0.0
	all the family members	66.7	62.5
9.	Are there many parties in your family (guests, relatives)		
	no	33.3	12.5
	seldom (once a month)	33.3	62.5
	sometimes (once a week)	25.0	12.5
	often (2-3 times a week)	8.3	12.5
10.	Are your family gatherings or other parties with alcohol		
	never	25.0	18.8
	seldom	8.3	43.8
	sometimes	50.0	31.3
	often	16.7	6.3

Attention to eating in the family. The great attention was paid to eating in the families of 8.3% of male and 12.5% of female patients.

Number of mealtimes a day. The greatest percentage of families had four or more meals a day (8.3% of males and 12.5% of females), 25% of male and 6.3% of female patients did not keep to regular meals.

Regularity and character of breakfast. The majority of male (75%) and female (93.8%) patients preferred a light meal (sandwiches, coffee, milk, juice). Hot breakfast was eaten in few families (16.7% of males and 6.3% of females). The richest meals in the family were lunch and supper, 25% of males and 6.3% of females did not keep to regular mealtimes.

Family gatherings or other parties with alcohol. 16.7% of males and 6.3% of females consumed alcoholic drinks frequently, 58.3% of males and 85.1% of females did it seldom; 25% of males and 18.8% of females did not consume any alcoholic drinks at all.

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part III. The frequency table (percentage) of the own nutrititional habits for the patients with the transplanted kidney

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
1.	How many times a day do you usually eat		
	two times	0.0	6.3
	three times	50.0	62.5
	four times	41.7	31.3
	five times	8.3	0.0
2.	How many times a day do you have a hot meal		
	once	33.3	25.0
	two times	33.3	68.8
	three times	33.3	6.3
3.	In the morning the first meal time		
	at 5	8.3	0.0
	at 7	25.0	31.3
	at 8	41.7	31.3
	at 9	25.0	31.3
	at 10	0.0	6.3
4.	Character of breakfast		
	only drink (water, juice, coffee, tea, etc.)	0.0	6.3
	eat vegetables and fruits	83.3	81.3
	eat a rich hot meal	16.7	12.5
5.	Morning appetite		
	not at all	0.0	6.3
	no appetite but I can eat	8.3	31.3
	I have appetite but being in a hurry no time	16.7	0.0
	good appetite	75.0	62.5
6.	Character of lunch		
	some snacks	8.3	6.3
	have a hot meal	91.7	93.8
7.	Character of supper		
	do not eat	0.0	6.3
	some snacks	0.0	6.3
	dry meal (sandwiches, chips, etc.)	33.3	6.3
	have a hot meal	66.7	81.3

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part III. The frequency table (percentage) of the own nutrititional habits for the patients with the transplanted kidney (continued)

No	Subjects Frequency (%)	Male (n = 12) %	Female (n = 16) %
8.	Do you eat something in the evening before going to bed		
	no	33.3	25.0
	seldom	33.3	18.8
	sometimes	16.7	31.3
	often	8.3	12.5
	always	8.3	12.5
9.	Do you eat sweets, fruits, berries, etc. between meals		
	no	8.3	6.3
	seldom	25.0	25.0
	sometimes	50.0	56.3
	often	16.7	12.5
10.	Do you have an unpleasant feeling after some meal		
	no	83.3	62.5
	seldom	16.7	18.8
	always	0.0	18.8
11.	The complaints connected with food		
	no complaints	91.7	56.3
	flatulence	8.3	12.6
	nausea	0.0	12.5
	heartburn	0.0	6.3
	belching	0.0	6.3
	other complaints	0.0	6.3
12.	Do you like to eat sweet things		
	no	16.7	6.3
	seldom	0.0	25.0
	sometimes	58.3	25.0
	often	25.0	43.8
13.	Do you add salt to ready-made food		
	no	5.0	43.8
	seldom	33.3	25.0
	sometimes	16.7	12.5
	often	0.0	18.8
14.	Do you add pepper and other hot spices to your ready-made food		
	no	16.7	50.0
	seldom	33.3	12.5
	sometimes	41.7	18.8
	often	8.3	12.5
	always	0.0	6.3
15.	Frequency of stool		
	once a day	91.7	50.0
	every other day	8.3	43.8
	after several days	0.0	6.3

The number of meals: the patients ate 3-4 times a day, seldom twice a day. The usual number of warm meals: 68% of female patients cooked a hot meal at least twice a day. Among male patients, 33.3% had a hot meal once a day, 33.3% twice a day and 33.3% three times a day.

The time of the first meal in the morning: 66.7% of males and 62.6% of females had a meal between 7–8 o'clock, 6.3% of females ate after 10 o'clock.

Morning appetite: 75% of male and 62.5% of female patients had a good appetite. Some subjects (8.3% of males and 31.3% of females) had no appetite but still forced themselves to eat. The complete lack of appetite was mentioned by 6.3% of females. The nutritional habits for the kidney transplant patients are shown in **Figure 6**.

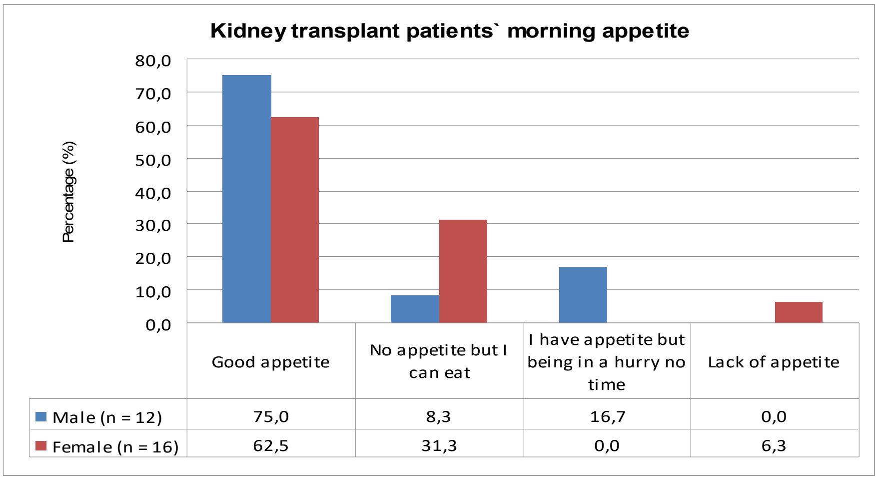


Figure 6. The nutritional habits for the kidney transplant patients based on the food-frequency questionnaire (FFQ). All the data of the frequency table are given in percentage (%).

The character of lunch and of supper: hot lunch was eaten by the majority of subjects (91.7% of males and 93.8% of females). Hot supper was eaten by 66.7% of males and 81.3% of females.

Eating in the evening before going to bed: a part of males (8.3%) and females (12.5%) ate before going to bed, 33.3% of males and 25% of females never did it.

Eating sweets, fruit, berries, etc. between meals: sweets, fruit, berries, etc. were eaten between meals seldom by 75% of males and 81.3% of females.

An unpleasant feeling after a meal. The majority of male and female patients did not experience an unpleasant feeling after eating certain foodstuffs. An unpleasant feeling after a meal was experienced seldom by 16.7% of male and 18.8% of female patients.

Complaints connected with a food: 37.7% of female patients complained of nausea, heartburn, belching or flatulence, 91.7% of males and 56.3% of females did not have any food-related complaints. Males (8.3%) complained only of flatulence.

Eating sweet foods. Sweet foods were eaten mostly by females, less by males (25% of males and 43.8% of females). 16.7% of males and 6.3% of females did not consume any sweet foods at all.

Adding salt to a ready-made food: 5% of males and 43.8% of females did not add salt to a ready-made food. Salt was seldom added to a ready-made food by 50% of males and 37.5% of females. Salt was often added by 18.8% of female patients.

Adding pepper and other hot spices to a ready-made food: 6.3% of females added pepper or spices to ready-made foods. Hot spices were often consumed by 8.3% of males and 12.5% of females.

Frequency of stool. Frequency of stool in all the subjects was once daily or every other day.

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part IV. The frequency table (percentage) of kidney transplant patients' daily consumption of drinks and rye bread-white bread

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
1.	How many glasses of milk drinks do you consume a day (number)		
	not at all	0.0	6.3
	one glass	50.0	62.6
	two to three glasses	50.0	25.0
	more	0.0	6.3
2.	How many glasses of juice do you drink a day (number)		
	not at all	16.7	18.8
	one glass	16.6	25.1
	two to three glasses	58.3	50.0
	more	8.3	6.3
3.	How many cups of bean coffee do you drink a day (number)		
	not at all	16.7	0.0
	one cup	41.7	37.5
	two to three cups	33.3	56.3
	more	8.3	6.25
4.	How many slices of rye bread do you eat a day (number)		
	not at all	0.0	0.0
	one to two slices	8.3	37.5
	three to four slices	66.7	50.1
	five to six slices	16.6	6.3
	more	8.3	6.3
5.	How many slices of white bread do you eat a day (number)		
	not at all	25.0	12.5
	one to two slices	8.33	43.8
	three to four slices	50.0	31.3
	five to six slices	8.3	6.3
	more	8.3	6.3

Daily consumption of milk, milk drinks, juice and bean coffee. Two or three glasses of milk and other milk drinks were daily consumed by 50% of males and 25% of females. Two or three glasses of juice were daily consumed by 58.3% of males and 50% of females. One cup of bean coffee was daily consumed by 41.7% of males and 37.5% of females. Two or three cups of bean coffee were daily consumed by 33.3% of males and 56.3% of females, 8.3% of males and 6.3% of females drank more than three cups of bean coffee a day.

Daily consumption of black and white bread: 66.7% of males consumed 3–4 slices of rye bread daily; 3–4 slices of white bread were consumed by 50% of males; 43.8% of female patients consumed 1–2 slices of rye bread and 50% 2–3 slices of rye bread daily. White bread and products made of it were not eaten by 25% of males and 12.5% of females. Some subjects consumed larger quantities of bread, 5–6 slices daily (8.3% of males and 6.3% of females).

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part V. The frequency table (percentage) of the kidney patients'attitude to eating and movement

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
1.	I like to eat together with others		
	always	25.0	31.3
	often	50.0	25.0
	seldom	16.6	37.5
	never	8.3	6.3
2.	I am afreid to be overweight		
	always	8.3	31.3
	often	8.3	6.3
	seldom	33.3	37.5
	never	50.0	25.0
3.	Avoid eating although I am hungry		
	always	8.3	0.0
	often	0.0	6.3
	seldom	33.3	50.0
	never	58.3	43.8
4.	Avoid drinking although I am thirsty		
	always	8.3	0.0
	often	0.0	0.0
	seldom	8.3	6.3
	never	83.3	93.8
5.	I have pangs of eating which I can not control		
	always	0.0	0.0
	often	0.0	0.0
	seldom	25.0	43.8
	never	75.0	56.3
6.	I am aware of the nutritional value of the food I eat		
	always	25.0	50.0
	often	16.7	0.0
	seldom	25.0	43.8
	never	33.3	6.3

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part V. The frequency table (percentage) of the kidney patients'attitude to eating and movement (continued)

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
7.	I especially avoid the food rich in carbohydrates (white bread, pasta)		
	always	8.3	18.8
	often	0.0	18.8
	seldom	41.7	31.3
	never	50.0	31.3
8.	I especially avoid fatty food (pork fat, margarines, fried food)		
	always	16.7	25.0
	often	33.3	31.3
	seldom	25.0	25.0
	never	25.0	18.8
9.	I especially avoid protein-rich in protein (meat, fish, curds, cheese)		
	always	0.0	6.3
	often	0.0	18.8
	seldom	50.0	37.5
	never	50.0	37.5
10.	I eat the same food several times a day		
	always	0.0	6.3
	often	0.0	12.5
	seldom	58.3	56.3
	never	41,7	25.0
11.	I eat diet food, I keep to the diet		
	always	0.0	6.3
	often	8.3	12.5
	seldom	41.7	31.3
	never	50.0	50.0
12.	Other people force me to eat		
	always	0.0	0.0
	often	0.0	6.3
	seldom	16.6	31.3
	never	83.3	62.5
13.	I suffer from constipation		
	always	0.0	6.3
	often	0.0	6.3
	seldom	41.7	62.5
	never	58.3	25.0
14.	I suffer from diarrhoea		
	always	0.0	0.0
	often	0.0	12.5
	seldom	8.3	31.3
	never	91.7	56.3

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part V. The frequency table (percentage) of the kidney patients'attitude to eating and movement (continued)

No	Subjects	Male (n = 12)	Female (n = 16)
	Frequency (%)	%	%
15.	I control my body weight and weigh myself		
	always	0.0	6.3
	often	0.0	6.3
	seldom	50.0	43.8
	never	50.0	43.8
16.	I try to move much to spend excessive calories		
	always	16.7	0.0
	often	41.6	43.8
	seldom	33.3	37.5
	never	8.3	18.8

Fear of being overweight: 50% of male patients and 25% of female patients were not afraid of being overweight; 16.6% of males and 37.6% females watched their body weight.

Control of body weight and weighing oneself: 50% of males and 43.8% of females did not watch their body weight. Only 6.3% of females always watched their body weight.

Awareness of the nutritional value of the food: 25% of males and 50% of females were aware of the nutritional value of the food they consumed; 33.3% of males and 6.3% of females did not have this knowledge.

Keeping to diet. Consumption of dietary food was not needed by 50% of males and 50% of females. Only 6.3% of females kept to a diet.

Constipation and diarrhoea: 6.3% of females had constipation and 6.3% had diarrhoea. Males and most females did not have any digestive complaints.

Moving much to spend excessive calories. Male and female patients tried to move a lot to spend excessive calories (58.3% of males and 43.8% of females); 41.6% of males and 66.3% of females did not get much exercise.

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part VI. The frequency table (percentage) of consumption of foodstuffs by the kidney transplant patients

	Frequency of consumption of main food groups (%)	Daily	Often, 2-3 times a week	Some-times, 1-2 times a week	Seldom, 1-2 times a month	Never	Daily	Often, 2-3 times a week	Some-times, 1-2 times a week	Seldom, 1-2 times a month	Never
		4	3	2	1	0	4	3	2	1	0
No	Subjects	Males (n = 12)					Females (n = 16)				
	Milk and dairy products										
1	Whole milk 4.5%	8.3	16.7	16.7	8.3	50.0	6.3	18.8	12.5	12.5	50.0
2	Milk 2.5%	16.7	25.0	25.0	8.3	25.0	25.0	12.5	18.8	25.0	18.8
3	Milk 1%	8.3	16.7	0.0	75.0	0.0	0.0	0.0	18.8	81.3	0.0
4	Kephir 1%	8.3	0.0	0.0	16.7	75.0	6.3	6.3	18.8	18.8	50.0
5	Kephir 2.5%	0.0	0.0	16.7	16.7	66.7	0.0	0.0	12.5	18.8	68.8
6	Buttermilk	8.3	8.3	8.3	16.7	58.3	6.3	6.3	18.8	12.5	56.3
7	Sour cream 20%	0.0	16.7	16.7	25.0	41.7	18.8	31.3	18.8	12.5	18.8
8	Sour cream 10%	8.3	8.3	25.0	25.0	33.3	0.0	25.0	18.8	18.8	37.5
9	Coffee cream 10%	16.7	0.0	25.0	16.7	41.7	12.5	18.8	6.3	50.0	12.5
10	Whipping cream 35%	0.0	0.0	0.0	41.7	58.3	0.0	0.0	12.5	31.3	56.3
11	Bioyoghurt 2.5%	8.3	16.7	8.3	16.7	50.0	12.5	6.3	18.8	18.8	43.8
12	Yoghurt 2.5%	0.0	16.7	16.7	16.7	50.0	6.3	12.5	25.0	18.8	37.5
13	Butter 80%	16.7	16.7	8.3	0.0	58.3	18.8	18.8	6.3	18.8	37.5
14	Butter margarine 40%	41.7	8.3	25.0	0.0	25.0	37.5	18.8	12.5	0.0	31.3
15	Cottage cheese	0.0	16.7	58.3	16.7	8.3	12.5	12.5	50.0	18.8	6.3
16	Cheese	8.3	33.3	33.3	8.3	16.7	6.3	31.3	31.3	25.0	6.3
	Cereal and flour products										
17	Rye bread	41.7	16.7	0.0	0.0	41.7	18.8	18.8	25.0	18.8	18.8
18	Fine rye bread	0.0	16.7	25.0	0.0	58.3	18.8	25.0	6.3	18.8	31.3
19	Whole meal seed bread	33.3	16.7	16.7	0.0	33.3	25.0	12.5	6.3	18.8	37.5
20	White bread	50.0	16.7	0.0	16.7	16.7	68.8	6.3	6.3	18.8	0.0
21	Muesli	0.0	0.0	18.7	25.0	58.3	0.0	6.3	0.0	31.3	62.5
22	Rolls, buns	0.0	8.3	41.7	16.7	33.3	6.3	12.5	37.5	31.3	12.5
23	Pasta	0.0	0.0	88.7	16.7	16.7	0.0	12.5	56.3	25.0	6.3
24	Corn and rice flakes	0.0	0.0	16.7	33.3	50.0	0.0	6.3	6.3	56.3	31.3
25	Popcorn	0.0	0.0	0.0	33.3	66.7	0.0	0.0	0.0	6.3	93.8
26	Kama	0.0	0.0	8.3	16.7	75.0	0.0	0.0	6.3	37.5	56.3
27	Bran	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	12.5	87.5
28	Cereal sprouts	8.3	0.0	0.0	0.0	91.7	0.0	0.0	0.0	18.8	68.8
	Meat products										
29	Pork	0.0	25.0	50.0	16.7	8.3	6.3	31.3	43.8	18.8	0.0
30	Beef	0.0	8.3	25.0	33.3	33.3	0.0	6.3	18.8	37.5	37.5
31	Mutton	0.0	0.0	16.7	16.7	66.7	0.0	0.0	0.0	6.3	93.8
32	Poultry	0.0	8.3	66.7	0.0	25.0	0.0	18.8	37.5	37.5	6.3
33	Rabbit	0.0	0.0	8.3	25.0	66.7	0.0	0.0	0.0	6.3	93.8
34	Game	0.0	0.0	0.0	25.0	75.0	0.0	0.0	0.0	12.5	87.5
35	Liver	0.0	0.0	16.7	41.7	41.7	0.0	0.0	18.8	56.3	25.0
36	Offal (heart, lungs)	0.0	0.0	16.7	33.3	50.0	0.0	0.0	0.0	18.8	81.3
37	Sausage	16.7	50.0	16.7	0.0	16.7	25.0	25.0	18.8	18.8	12.5
38	Wiener	0.0	41.7	50.0	8.3	0.0	0.0	43.8	25.0	25.0	6.3
39	Smoked sausage, ham	8.3	25.0	25.0	25.0	16.7	12.5	37.5	25.0	18.8	6.3
40	Meat paste	0.0	8.3	16.7	50.0	25.0	0.0	6.3	37.5	50.0	6.3
41	Black sausage	0.0	0.0	0.0	58.3	41.7	0.0	0.0	6.3	56.3	37.5
42	Meat balls	0.0	0.0	50.0	33.3	16.7	0.0	12.5	43.8	37.5	6.3
43	Tinned meat	0.0	0.0	8.3	41.7	50.0	0.0	0.0	6.3	37.5	56.3

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part VI. The frequency table (percentage) of consumption of foodstuffs by the kidney transplant patients (continued)

	Frequency of consumption of main food groups	Daily	Often, 2-3 times a week	Some-times, 1-2 times a week	Seldom, 1-2 times a month	Never	Daily	Often, 2-3 times a week	Some-times, 1-2 times a week	Seldom, 1-2 times a month	Never
		4	3	2	1	0	4	3	2	1	0
No	Subjects	Males (n = 12)					Females(n = 16)				
	Fish products										
44	Freshwater fish	0.0	8.3	33.3	33.3	25.0	0.0	0.0	25.0	62.5	12.5
45	Small herring	0.0	8.3	41.7	25.0	25.0	0.0	12.5	37.5	31.3	18.8
46	Seawater fish	0.0	0.0	41.7	33.3	25.0	0.0	0.0	18.8	68.8	12.5
47	Salted fish (herring)	0.0	0.0	0.0	25.0	75.0	0.0	12.5	31.3	25.0	31.3
48	Smoked fish	0.0	8.3	8.3	41.7	41.7	0.0	6.3	18.8	56.3	18.8
49	Dried fish	0.0	0.0	0.0	25.0	75.0	0.0	0.0	0.0	0.0	100.0
50	Fish burgers	0.0	0.0	16.7	50.0	33.3	0.0	0.0	25.0	43.8	31.3
51	Tinned fish	0.0	8.3	8.3	33.3	50.0	0.0	0.0	18.8	43.8	37.5
	Vegetables										
52	Potato	33.3	58.3	8.3	0.0	0.0	50.0	50.0	0.0	0.0	0.0
53	Fresh cabbage	16.7	25.0	33.3	0.0	25.0	0.0	31.3	56.3	6.3	6.3
54	Sauerkraut	8.3	8.3	16.7	25.0	41.7	0.0	0.0	37.5	56.3	6.3
55	Swede	8.3	8.3	0.0	41.7	41.7	0.0	0.0	37.5	37.5	25.0
56	Carrot	8.3	41.7	41.7	0.0	8.3	18.8	31.3	43.8	6.3	0.0
57	Red beet	8.3	8.3	50.0	16.7	16.7	6.3	12.5	43.8	37.5	0.0
58	Radish	0.0	0.0	0.0	25.0	75.0	0.0	0.0	0.0	25.0	75.0
59	Celery	0.0	0.0	0.0	25.0	75.0	0.0	6.3	18.8	12.5	62.5
60	Parsley	0.0	16.7	8.3	33.3	41.7	6.3	6.3	31.3	43.8	12.5
61	Onion	0.0	33.3	41.7	0.0	25.0	37.5	31.3	18.8	12.5	0.0
62	Garlic	16.7	0.0	50.0	16.7	16.7	18.8	25.0	18.8	31.3	6.3
63	Pumpkin, zucchini	0.0	0.0	16.7	41.7	41.7	0.0	6.3	18.8	37.5	37.5
64	Fresh cucumber	8.3	16.7	41.7	16.7	16.7	25.0	25.0	31.3	18.8	0.0
65	Tomato	8.3	16.7	50.0	0.0	25.0	25.0	18.8	25.0	25.0	6.3
66	Pepper	0.0	16.7	25.0	8.3	50.0	6.3	18.8	6.3	43.8	25.0
67	Garden beans	0.0	8.3	16.7	25.0	50.0	0.0	6.3	0.0	37.5	56.3
68	Lettuce	0.0	25.0	16.7	33.3	25.0	0.0	6.3	37.5	37.5	18.8
69	Dill	8.3	0.0	33.3	25.0	33.3	12.5	18.8	31.3	25.0	12.5
	Fruits, berries (seasonal)										
70	Apples	8.3	33.3	33.3	16.7	8.3	6.3	56.3	12.5	12.5	12.5
71	Plums	0.0	16.7	8.3	41.7	33.3	0.0	18.8	12.5	50.0	18.8
72	Pears	0.0	16.7	16.7	25.0	41.7	0.0	25.0	12.5	37.5	25.0
73	Cherries	0.0	0.0	33.3	25.0	41.7	0.0	6.3	18.8	31.3	43.8
74	Strawberries	0.0	8.3	16.7	33.3	41.7	0.0	25.0	18.8	37.5	18.8
75	Raspberries	0.0	0.0	25.0	25.0	50.0	0.0	18.8	12.5	31.3	37.5
76	Currants	0.0	0.0	16.7	41.7	41.7	0.0	18.8	12.5	37.5	31.3
77	Gooseberries	0.0	0.0	16.7	33.3	50.0	0.0	18.8	12.5	18.8	50.0
78	Wild berries	0.0	0.0	16.7	25.0	58.3	0.0	18.8	12.5	31.3	37.5
79	Bananas	0.0	0.0	33.3	16.7	50.0	0.0	12.5	18.8	37.5	31.3
80	Citrus fruits (orange)	0.0	8.3	16.7	33.3	41.7	0.0	12.5	25.0	43.8	18.8
81	Grapes	0.0	0.0	16.7	41.7	41.7	0.0	12.5	0.0	68.8	18.8

Table 11. Results of nutritional habits based on the food-frequency questionnaire
Part VI. The frequency table (percentage) of consumption of foodstuffs by the kidney transplant patients (continued)

	Frequency of consumption of main food groups	Daily	Often 2-3 times a week	Some-times, 1-2 times a week	Seldom, 1-2 times a month	Never	Daily	Often, 2-3 times a week	Some-times, 1-2 times a week	Seldom, 1-2 times a month	Never
		4	3	2	1	0	4	3	2	1	0
No	Subjects	Male (n = 12)					Female (n = 16)				
	Sweets										
82	Raisins	0.0	0.0	0.0	58.3	41.7	6.3	12.5	12.5	43.8	25.0
83	Water melons	0.0	0.0	8.3	33.3	58.3	0.0	12.5	6.3	50.0	31.3
84	Dried fruits	0.0	0.0	0.0	41.7	58.3	0.0	6.3	6.3	25.0	62.5
85	Ice-cream	0.0	0.0	25.0	58.3	16.7	0.0	6.3	31.3	43.8	18.8
86	Sherbet, zephyr	0.0	0.0	0.0	33.3	66.7	0.0	0.0	6.3	18.8	75.0
87	Halvah	0.0	0.0	0.0	41.7	58.3	0.0	0.0	6.3	25.0	68.8
88	Chocolate	0.0	8.3	16.7	33.3	41.7	0.0	6.3	31.3	43.8	18.8
89	Caramel sweets	0.0	8.3	25.0	16.7	50.0	0.0	18.8	12.5	31.3	37.5
90	Marmalade, jellies	0.0	0.0	8.3	16.7	75.0	0.0	6.3	0.0	37.5	56.3
91	Jam, compote	0.0	8.3	25.0	16.7	50.0	0.0	12.5	25.0	37.5	25.0
92	Nuts	0.0	0.0	16.7	25.0	58.3	0.0	0.0	18.8	31.3	50.0
93	Cream cakes	0.0	0.0	0.0	41.7	58.3	0.0	6.3	12.5	50.0	31.3
94	Short pastry products	0.0	0.0	16.7	41.7	41.7	0.0	6.3	31.3	43.8	18.8
95	Creams, puddings	0.0	0.0	8.3	33.3	58.3	0.0	18.8	12.5	31.3	37.5
	Drinks										
96	Apple juices (natural)	0.0	0.0	41.7	16.7	41.7	0.0	6.3	18.8	25.0	50.0
97	Citrus fruit juices	0.0	8.3	16.7	16.7	58.3	0.0	6.3	25.0	31.3	37.5
98	Fruit juices	0.0	8.3	33.3	25.0	33.3	0.0	12.5	50.0	18.8	18.8
99	Berry juices, fruit water	0.0	0.0	25.0	8.3	66.7	0.0	18.8	25.0	25.0	31.3
100	Fresh fruit juices	0.0	8.3	16.7	16.7	58.3	0.0	0.0	0.0	18.8	81.3
101	Lemonade	0.0	0.0	8.3	25.0	66.7	0.0	12.5	6.3	18.8	62.5
102	Tea	33.3	25.0	8.3	8.3	25.0	43.8	18.8	12.5	6.3	18.8
103	Herb tea	16.7	25.0	8.3	16.7	33.3	12.5	18.8	6.3	18.8	43.8
104	Pure coffee	0.0	33.3	8.3	16.7	41.7	0.0	75.0	12.5	6.3	6.3
105	Grain coffee	0.0	0.0	0.0	0.0	100.0	0.0	6.3	0.0	0.0	93.8
106	Cocoa	0.0	0.0	8.3	33.3	58.3	0.0	0.0	25.0	18.8	56.3
107	Mineral water	25.0	33.3	16.7	8.3	16.7	12.5	12.5	25.0	18.8	31.3
108	Coca-cola	0.0	0.0	16.7	16.7	66.7	0.0	0.0	0.0	12.5	87.5
109	Tonics	0.0	0.0	0.0	8.3	91.7	0.0	0.0	0.0	6.3	93.8
110	Beer	0.0	0.0	8.3	8.3	83.3	0.0	0.0	0.0	0.0	100.0
111	Wine	0.0	0.0	0.0	8.3	91.7	0.0	0.0	0.0	25.0	75.0
112	Strong alcoholic drinks	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	87.5
113	Liqueur	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	100.0
114	Gin long drink	0.0	0.0	0.0	8.3	91.7	0.0	0.0	0.0	6.3	93.8
	Ready-made foods										
115	Meat soups	0.0	25.0	50.0	8.3	16.7	12.5	37.5	31.3	12.5	6.3
116	Milk soups	0.0	25.0	16.7	25.0	33.3	0.0	18.8	18.8	37.5	25.0
117	Porridges	33.3	16.7	41.7	0.0	8.3	6.3	43.8	18.8	25.0	6.3
118	Meat dishes	0.0	33.3	33.3	8.3	25.0	25.0	37.5	25.0	6.3	6.3
119	Fish dishes	8.3	8.3	50.0	0.0	33.3	0.0	12.5	50.0	25.0	12.5
120	Vegetable dishes	8.3	33.3	33.3	0.0	25.0	18.8	18.8	50.0	0.0	12.5
121	Mushroom dishes	0.0	0.0	8.3	41.7	50.0	0.0	0.0	12.5	56.3	31.3
122	Egg dishes	0.0	0.0	50.0	16.7	33.3	0.0	25.0	25.0	43.8	6.3
123	Mixed salads	0.0	0.0	8.3	58.3	33.3	0.0	6.3	37.5	50.0	6.3
124	Salad dressing	0.0	8.3	16.7	8.3	66.7	0.0	6.3	31.3	31.3	31.3
125	Mayonnaise	0.0	0.0	25.0	25.0	50.0	0.0	25.0	31.3	31.3	12.5
126	Ketchup	0.0	0.0	33.3	33.3	33.3	6.3	6.3	18.8	37.5	31.3
127	Desserts, kissels	0.0	8.3	33.3	33.3	25.0	0.0	6.3	50.0	31.3	12.5
128	Bakings	0.0	8.3	41.7	8.3	41.7	0.0	12.5	37.5	50.0	0.0

From cereal and flour products patients consumed more often rye bread daily 41.7% or 2–3 times a week: 16.7% by males, and by females white bread products (68.8%) were preferred. Rye bread was consumed more often by males; females preferred white bread products. Buns, pasta, muesli, kama (mixture of rye-, oat-, barley- and peasemeal) and cereal sprouts were not consumed daily. Buns, pasta, muesli, kama and cereal sprouts were not consumed daily.

Butter was consumed daily by fewer patients (16.7% of males and 18.8% of females) than margarines (41.7% of males and 37.5% of females).

Milk and dairy products. Consumption of milk products depended on the fat content of milk. Kephir and low-fat milk were consumed every day by 16.6% of males and 6.3% of females. Milk was not consumed by 25% of males and 18.8% of females. Drinking yoghurt was consumed seldom. No yoghurts were consumed at all by 50% of males and 43.8% of females.

Cottage cheese was consumed seldom, once or twice a week (males 58.3%, females 50%). **Cheese** products were consumed by 1/3 of subjects 2–3 times a week or more seldom. Cheese was consumed daily by 8.3% of males and 6.3% of females. Consumption of cheese, cottage cheese and milk products for male and female kidney transplant patients are presented in Figure 7 and Figure 8.

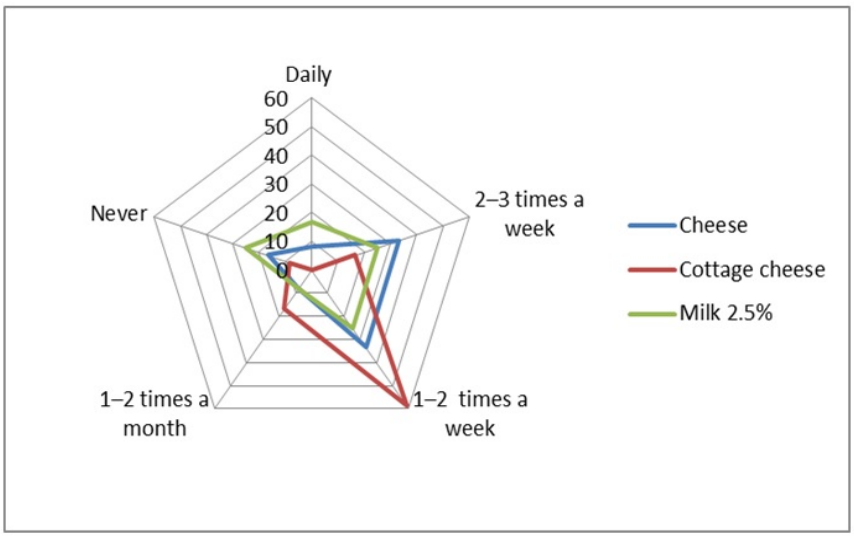


Figure 7. The consumption of foodstuffs by the kidney transplant male patients based on the food-frequency questionnaire (FFQ). All the data of the frequency table are given in percentage (%).

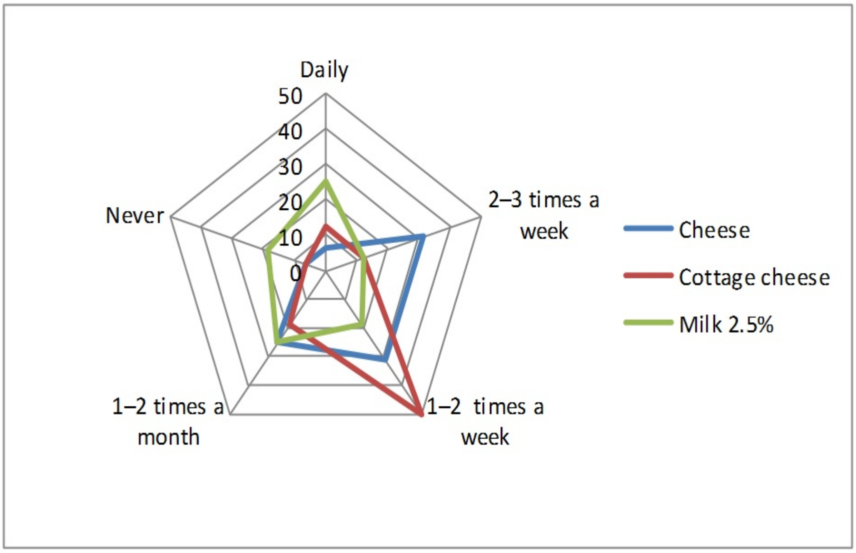


Figure 8. The consumption of foodstuffs by the kidney transplant female patients based on the food-frequency questionnaire (FFQ). All the data of the frequency table are given in percentage (%).

Meat products. Male and female patients consumed mostly pork once or twice a week (50% of males and 43.8% of females). Wieners were consumed daily by 6.7% of males and 25% of females. Tinned meat, meat paste, meat balls and black sausage were not consumed daily.

Fish products. Fish and different fish products were consumed mostly once or twice a month. Tinned fish was not consumed by 50% of males and 37.5% of females. 1/3 of subjects did not consume fish burghers.

Vegetables. Potatoes were consumed with great frequency, daily by 33.3% of males and 50% of females. Cabbage, carrots, swede and beet were consumed daily by 8.3% of males and 18.8% of females. Tomatoes and fresh cucumbers were consumed daily by 8.3% of males and 25% of females.

Fruits, berries (seasonal): 8.3% of males and 12.5% females did not eat apples. Consumption frequency of locally grown fruit and berries depended on the season.

Sweets. Sweets were not consumed daily. Ice-cream, zephyr, halvah, chocolate, jam and nuts were consumed once or twice a week or month. Ice-cream was not consumed by 16.7% of males and 43.8% of females.

Drinks. Apple juice was not consumed by 41.7% of males and 50% of females. Tea was consumed daily by 33.3% of males and 43.8% of females. Mineral water was consumed by 25% of males and 12.5% of females.

Ready-made foods. Ready-made foods were consumed at different frequencies. Porridge was consumed every day by 33.3% of males and 6.3% of females, while 8.3% of males and 6.3% of females did not eat porridge.

The questionnaire revealed that the patients consumed different foodstuffs at different frequencies, but there was a tendency to excessive consumption of foodstuffs rich in proteins and carbohydrates. To the consumption of fat-rich foodstuffs a tendency of decrease was shown. The consumption of vegetables and fruit was modest compared to Estonian food and nutrition recommendations. The same tendency could be noticed in literature.

5.11. Results of the 3-day menu analysis in dynamics

The results of the 3-day menu analysis in male (n = 12) and female (n = 16) kidney transplant patients were collected twice: for the first time at the beginning of the investigation one and half year (the first measurements, FM), and, secondly three years after the kidney transplantation (follow-up, FU). The data of FM characterize kidney patients' nutrition before, and, the results of FU the dietary intake after nutritional counselling. In the data the average energy intake (kcal) and the average data of 24 nutrients, SD, the minimal and maximal values both in absolute numbers and also in percentage have been presented for the 3-day menus. All the FM and FU nutritional data of the studied kidney transplant patients were compared with each other, and with the normative values of the basic nutrients in the Estonian Nutrition Recommendations and Food-based Dietary Guidelines (Tallinn, 2006). The comparison of energy and the main nutrient content in 3-day menus of kidney transplant patients was shown in Table 12.

Male patients (n = 12)
Daily energy content. The daily average energy content (kcal) in the male patients group was decreased non-significantly (from baseline 2,689.7 ± 467.5 kcal, and to FU 2,424.9 ± 291.4 kcal) and remains in the limits of the recommended daily consumption of food energy (the Estonian Nutrition Recommendations: 2,700 ± 200 kcal). The energy content per kg of body weight (kcal/kgBW/day) in male patients decreased significantly, and was from the first measurements 37.2 kcal/kgBW/day, and to FU 30.2 kcal/kgBW/day ($p = 0.0143$).

Dietary protein. The mean consumption dietary proteins intake (g) in male patients in 3-day menus decreased non-significantly, and was in FM, 106.7 ± 22.4 g, and in FU, 91.6 ± 10.7 g. (the Estonian Nutrition Recommendations range for men 50–90 g). The percentage of proteins in food energy (%) in male patients was in FM, 15.9%, and in FU, 15.2% (the Estonian Nutrition Recommendations range 10–15%). The mean consumption of dietary proteins (g/kg/day) in male patients decreased statistically significantly ($p = 0.0093$), and was between 1.5 to 1.1 g/kg in day.

Table 12. Comparison of energy and main nutrients content in 3-day menus in kidney transplant patients after kidney transplantation

Variables	Reference nutrient intake**	The first measurements (FM)				Follow-up (FU)				P-value
		Mean	SD	Min	Max	Mean	SD	Min	Max	
Male (n = 12)										
Energy content (kcal)	2,700 ±200	2,689.7	467.5	2,030.4	3,675.7	2,424.9	291.4	1,966.4	2,910.2	0.1380
Energy/body weight (kcal/kg)	25–35	37.2	8.9	21.2	55.7	30.2	6.2	18.6	38.2	0.0143*
Proteins/body weight (g/kg)	1.0	1.5	0.4	1.0	2.3	1.1	0.3	0.6	1.6	0.0093*
Proteins (kcal)	200–360	426.8	89.4	299.6	612.5	366.5	42.9	288.2	431.6	0.0610
Fats (kcal)	450–810	912.1	192.4	622.5	1,304.0	794.5	131.8	560.3	1,035.5	0.0836
Carbohydrates (kcal)	1,000–1,400	1,317.0	295.8	953.2	1,964.7	1,247.2	197.8	793.9	1,499.6	0.4093
Proteins (g)	50–90	106.7	22.4	74.9	153.1	91.6	10.7	72.0	107.9	0.0610
Fats (g)	50–90	101.3	21.4	69.2	144.9	88.3	14.6	62.3	115.1	0.0836
Carbohydrates (g)	250–350	329.3	74.0	238.3	491.2	311.8	49.4	198.5	374.9	0.4093
% of proteins in food energy	10–15%	15.9	1.5	13.6	18.0	15.2	1.5	13.3	18.0	0.2357
% of fats in food energy	25–30%	34.1	5.3	25.6	45.3	32.8	4.2	24.1	40.4	0.2430
% of carbohydrates in food energy	55–60%	48.9	5.5	35.7	58.3	51.4	5.4	40.4	60.5	0.0001*
Cholesterol (mg)	200–300	356.1	88.4	221.1	557.8	337.4	96.9	175.0	478.0	0.6028
Dietary fibres (g)	25–35	30.5	6.1	20.2	37.3	32.0	7.7	20.6	46.4	0.6275
Vitamins										
Retinol (µg-equiv)	900	1,449.2	1,749.3	404.5	6,685.7	2,719.2	3,806.5	436.5	11,844.7	0.3300
Vitamin D (µg)	7.5	4.4	5.9	1.1	21.7	3.5	3.3	0.7	9.7	0.5345
Vitamin E (mg)	10	10.8	4.1	4.4	19.0	9.3	2.7	4.6	13.0	0.2222
Tiamin, B1 (mg)	1.4	2.0	0.4	1.4	2.6	1.7	0.4	1.2	2.3	0.1049
Riboflavin, B2 (mg)	1.7	2.0	0.6	0.9	3.0	2.1	0.8	1.2	3.5	0.7216
Niacin, B3 (mg-equiv)	19	41.4	7.5	30.1	51.8	37.9	5.0	28.2	45.2	0.2337
Pyridoxine, B6 (mg)	1.6	2.4	0.6	1.7	3.8	2.3	0.4	1.8	3.1	0.3590
Cyanocobalamin, B12 (µg)	2.0	8.0	5.8	3.5	22.7	10.3	11.6	2.9	42.5	0.4819
Folic acid, B10 (µg)	350–500	275.0	69.3	136.2	389.7	285.6	65.3	229.7	455.4	0.7241
Pantothenic acid, B5 (mg)	5–10	7.6	1.8	3.7	10.5	6.9	1.7	5.1	10.8	0.4079
Biotin, H (µg)	100–200	30.0	10.6	13.6	50.8	27.7	7.1	17.6	38.4	0.5637
Vitamin C (mg)	75	72.4	34.6	10.4	128.0	84.6	27.6	39.0	128.6	0.2971
Minerals										
Sodium (mg)	2,000–3,000	2,751.6	753.6	1,887.0	4,241.8	2,299.9	602.1	1,488.0	3,178.6	0.1249
Potassium (mg)	3,500	3,921.9	676.0	2,525.7	4,671.7	3,842.5	636.2	3,095.5	5,384.9	0.7676
Calcium (mg)	800	1,221.1	545.3	491.0	2,706.1	1,022.4	204.5	781.9	1,348.2	0.2570
Phosphorus (mg)	600	2,046.4	455.7	1,091.9	2,957.0	1,789.4	250.1	1,471.2	2,377.9	0.1333
Magnesium (mg)	350	454.7	73.3	284.5	530.2	397.7	63.1	332.1	553.1	0.0473*
Iron (mg)	9	22.0	6.3	14.6	32.7	19.8	4.9	14.6	30.2	0.3425
Selenium (µg)	50	111.0	25.1	73.6	154.5	94.4	14.0	64.8	109.5	0.0913

Table 12. Comparison of energy and main nutrients content in 3-day menus in kidney transplant patients (continued)

Variables	Reference nutrient intake**	The first measurements				Follow-up				P-value
		Mean	SD	Min	Max	Mean	SD	Min	Max	
Female (n = 16)										
Energy content (kcal)	2,000 ±150	2,028.0	465.5	1,128.3	2,974.3	2,352.9	487.0	1,380.2	3,266.7	0.0018*
Energy/body weight (kcal/kg)	25–35	29.2	9.2	13.2	45.5	32.9	10.4	15.5	51.1	0.0114*
Proteins/body weight (g/kg)	1.0	1.2	0.4	0.5	2.2	1.2	0.4	0.5	1.8	0.2828
Proteins (kcal)	200–360	318.6	78.6	196.9	492.6	356.8	78.2	246.4	524.1	0.0384*
Fats (kcal)	450–810	683.9	207.0	198.5	1,071.7	792.0	244.0	451.2	1,462.3	0.0521
Carbohydrates (kcal)	1,000–1,400	1,011.1	233.4	715.7	1,449.2	1,172.8	243.9	664.2	1,656.2	0.0033*
Proteins (g)	50–90	79.6	19.7	49.2	123.1	89.2	19.5	61.6	131.0	0.0384*
Fats (g)	50–90	76.0	23.0	22.1	119.1	88.0	27.1	50.1	162.5	0.0521
Carbohydrates (g)	250–350	252.8	58.3	178.9	362.3	293.2	61.0	166.0	414.1	0.0033*
% of proteins in food energy	10–15%	15.8	2.2	11.7	20.3	15.2	1.7	12.1	18.1	0.3817
% of fats in food energy	25–30%	33.2	5.6	17.6	41.4	33.4	4.7	27.2	44.8	0.9175
% of carbohydrates in food energy	55–60%	50.2	5.3	42.5	63.4	50.0	5.3	39.3	59.6	0.0001*
Cholesterol (mg)	200–300	271.0	106.2	82.8	469.0	359.6	146.4	139.9	728.1	0.0130*
Dietary fibres (g)	25–35	25.9	11.0	13.0	55.6	27.2	5.7	17.4	38.1	0.6417
Vitamins										
Retinol (µg-equiv)	700	1,420.2	1,387.9	283.4	4,860.3	1,369.3	1,285.6	345.7	5,641.0	0.9038
Vitamin D (µg)	7.5	2.1	1.7	0.6	5.7	4.0	2.2	1.0	8.3	0.0037*
Vitamin E (mg)	8	8.2	3.1	2.8	14.7	8.9	4.4	6.0	21.1	0.5434
Tiamin, B1 (mg)	1.1	1.6	0.4	1.2	2.9	1.8	0.5	1.1	3.0	0.0343*
Riboflavin, B2 (mg)	1.3	1.5	0.5	0.8	2.4	1.7	0.5	1.0	2.5	0.1789
Niacin, B3 (mg-equiv)	15	30.6	8.2	18.0	52.7	36.1	7.9	23.9	49.6	0.0178*
Pyridoxine, B6 (mg)	1.2	1.7	0.4	1.0	2.3	2.2	0.6	1.3	3.0	0.0057*
Cyanocobalamin, B12 (µg)	2.0	6.1	6.7	1.2	27.8	7.2	5.4	3.3	24.0	0.5161
Folic acid, B10 (µg)	300–500	217.6	46.3	120.1	272.4	272.2	69.9	157.7	403.0	0.0045*
Pantothenic acid, B5 (mg)	4–9	5.3	1.5	2.9	8.1	6.2	1.3	4.1	8.3	0.0080*
Biotin, H (µg)	100–200	21.2	6.5	8.8	30.9	27.0	6.1	18.1	40.4	0.0142*
Vitamin C (mg)	75	54.6	32.4	17.4	134.2	87.2	53.0	4.7	173.2	0.0827
Minerals										
Sodium (mg)	2,000–3,000	2,240.1	759.1	951.9	3,595.8	2,494.2	628.7	1,642.2	4,050.1	0.2206
Potassium (mg)	3,100	2,988.6	814.1	1,898.0	5,194.3	3,578.5	965.8	1,804.7	5,095.9	0.0593
Calcium (mg)	800	731.9	325.6	247.9	1,480.8	915.0	326.1	375.0	1,468.7	0.0267*
Phosphorus (mg)	600	1,433.3	408.6	839.5	2,162.2	1,616.2	328.3	1,129.7	2,320.5	0.0373*
Magnesium (mg)	280	325.8	108.2	187.1	648.6	346.1	66.5	223.2	485.9	0.4975
Iron (mg)	15/9***	16.8	5.0	9.5	31.0	17.4	3.6	11.0	23.6	0.4978
Selenium (µg)	40	84.6	19.7	53.3	132.9	98.3	23.9	60.2	149.1	0.0130*

*Statistically significant difference ($P \leq 0.05$)

** by the Estonian Nutrition Recommendations and Food Based Dietary Quidelines (Tallinn, 2006)

*** The need for iron depends on iron loss during menstruation. The recommended daily iron intake for postmenopausal women is 9 mg.

Dietary fats. The amount of food fats (g) decreased non-significantly in FU (FM, 101.3 ± 21.4 g; FU 88.3 ± 14.6 g), but still remained higher than the recommended norm (the Estonian Nutrition Recommendations range 50–90 g/day). The percentage of fats in food energy did not change from FM, 34.1 ± 5.3% to FU, 32.8 ± 4.2%, and remained within the norm of the Estonian Nutrition Recommendations range of food fats 25–30%. **Cholesterol in food.** The amount of cholesterol (mg/day) in food decreased non-significantly exceeding the upper limit of the Estonian Nutrition Recommendations (see in Table 12) norm from FM, 356.1 ± 88.4 mg, and to FU, 337.4 ± 96.9 mg.

Dietary carbohydrates. The amount of dietary carbohydrates in food (g) decreased statistically non-significantly from FM, 329.3 ± 74.0 g, and to FU, 311.8 ± 49.4 g. but remained within the range of the norm of dietary carbohydrates 250–350 g per day. The percentage of carbohydrates in food energy increased significantly from FM, 48.9 ± 5.5%, and to FU, 51.4 ± 5.4% ($p = 0.001$). The Estonian Nutrition Recommendations range of carbohydrates in food energy is 55–60%.

Fat-soluble vitamins. Retinol content in food (μg-equiv) in male patients exceeded higher from the recommended norm (norm 900 μg-equiv). **Vitamin D** content in food (μg) was statistically non-significantly lower during the whole period, constituting 50% of the norm (norm 7.5 μg). **Vitamin E** content (mg) diminished during the change being at FM 10.8 mg, and at FU 9.3 mg, and remained within the range of recommendations (mean 10 mg).

Water-soluble vitamins. Thiamine, niacin, pyridoxine and pantothenic acid content in food in male patients did not change and remained within the normal range. **Biotin** values in food were lower than the recommended norm 100–200 μg. **Riboflavin** (FM, 2.0 ± 0.6 mg; FU, 2.1 ± 0.8 mg) and **cyanocobalamin** intake (FM, 8.0 ± 5.8 μg; FU, 10.3 ± 11.6 μg) in kidney transplant patients was non-significant but higher compared within the normal range at 2.0 μg. **Vitamin C** content increased but not significantly (FM, 72.4 ± 34.6 mg; FU, 84.6 ± 27.6 mg), and was in the range of the norm 75 mg.

Minerals. Sodium content (mg) in the consumed food did not differ statistically in male patients, and remained within the normal level (2,751.6 mg–2,299.9 mg). Salt content was calculated from the amount of sodium in the food. **Potassium** daily intake somewhat exceeded the norm (FM, 3,921.9 ± 676.0 mg; FU, 3,842.5 ± 636.2 mg). The mean calcium content in food exceeded statistically significantly the norm at 800 mg, and had a tendency to increase (FM, 1,221.1 mg; FU, 1,022 mg). **Phosphate** intake from the food (mg) exceeded statistically significantly the norm at FM, 2,046.4 ± 455.7 mg to FU 1,789.4 ± 250.1 mg and had a tendency to decrease. **Magnesium** content was also increased significantly ($p = 0.0473$) but remained within the norm. **Iron** content in food (mg) was within the range of the norm for men (9 mg). **Selenium** content in food was non-significantly higher (111.0–94.4 mg) than the recommended norm at range 50 mg.

Female patients (n = 16)

Daily energy intake. The daily average energy content (kcal) in the female patients group significantly increased (p = 0.0018), and was in FM, 2,028.0 ± 465.5 kcal and in FU, 2,352.9 ± 487.0 kcal (the Estonian Nutrition Recommendations range 2,000 ± 150 kcal/day). The energy content per kg of body weight (kcal/kgBW/day) in female patients increased significantly, and was from FM 29.2 ± 9.2 kcal/kgBW/day, and to FU 32.9 ± 10.4 kcal/kgBW/day (p = 0.0114).

Dietary protein. The dietary protein intake (g) in female patients in 3-day menus increased statistically significantly (p = 0.0384), and was in FM, 79.6 ± 19.7 g, and in FU, 89.2 ± 19.5 g (the Estonian Nutrition Recommendations range for men 50–90 g). The percentage of proteins in food energy (%) in female patients was in FM, 15.8%, and in FU, 15.2% (the Estonian Nutrition Recommendations range 10–15%). The mean consumption of dietary proteins (g/kg/day) in female patients was in the case of the first and the second research 1.2 g/kg per day.

Dietary fats. The amount of food fats (g) increased non-significantly in FU (FM, 76.0 ± 23.0 g; FU 88.0 ± 27.1 g), and remained within the recommended norm (the Estonian Nutrition Recommendations range 50–90 g/day). The percentage of fats in food energy did not change from FM, 33.2 ± 5.6% to FU, 33.4 ± 4.7%, and remained within the norm of the Estonian Nutrition Recommendations range of food fats 25–30%. **Cholesterol in food.** The amount of cholesterol (mg/day) in food exceeded statistically significantly (p = 0.013) the upper limit of the Estonian Nutrition Recommendations norm at FM, 271.0 ± 106.2 mg, and to FU, 359.6 ± 146.4 mg.

Dietary carbohydrates. The amount of dietary carbohydrates (g) in female kidney transplant patients statistically significantly increased (p = 0.033) from FM, 252.8 ± 58.3 g to FU, 293.2 ± 61.0 g but remained within the Estonian Nutrition Recommendations of dietary carbohydrates 250–350 g. The percentage of carbohydrates in food energy during both researches remained at range 50.2 ± 5.3% to 50.0 ± 5.3%. The Estonian Nutrition Recommendations range of carbohydrates from food energy was at 55% to 60%.

Fat-soluble vitamins. Retinol content in food (μg-equiv) in female patients exceeded higher (1,420.2–1,369.3 μg-equiv) than in the recommended norm (norm 700 μg-equiv). **Vitamin D** content in food (μg) was statistically significantly lower (p = 0.0037) during the whole period, constituting 50% of the norm (norm 7.5 μg). **Vitamin E** content (mg) non-significant changes between FM 8.2 mg, and FU 8.9 mg, and was within the range of the Estonian Nutrition Recommendation for female populations (mean 8 mg).

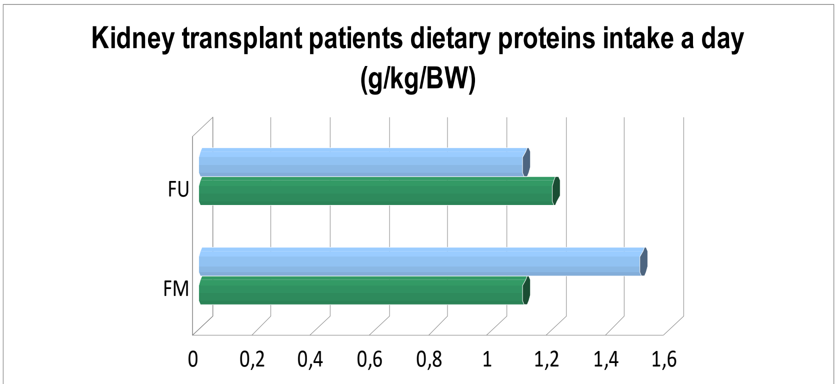
Water-soluble vitamins. Tiamine (p = 0.0343), niacin (p = 0.0178), pyridoxine (p = 0.0057), folic acid (p = 0.0045), pantothenic acid (p = 0.0080), and biotin (p = 0.0142) content in food increased significantly in FU. **Biotin** content in food was lower than the recommended norm 100–200 μg. **Riboflavin** (FM, 1.5 ± 0.5 mg; FU, 1.7 ± 0.5 mg) was in the range of the norm, and **cyanocobalamin** intake (FM, 6.1 ± 6.7 μg; FU, 7.2 ± 5.4 μg) in kidney transplant patients had increased but was non-significantly a higher intake compared within the range of the norm at 2.0 µg. **Vitamin C** content increased but not significantly (FM, 54.6 ± 32.4 mg; FU, 87.2 ± 53.0 mg), and was in the range of the norm 75 mg.

Minerals. Sodium content (mg) in the consumed food did not differ statistically in female patients, and remained within the normal level (2,240.1–2,494.2 mg). Salt content was calculated from the amount of sodium in the food. **Potassium** daily intake somewhat exceeded the normal value (FM, 2,988.6 ± 814.1 mg; FU, 3,578.5 ± 965.8 mg). The mean calcium content in food exceeded statistically significantly the normal value (800 mg), and had a tendency to increase (FM, 731.9 mg; FU, 915.0 mg). **Phosphate** intake from the food (mg) exceeded statistically significantly the normal levels (FM, 1,433.3 ± 408.6 mg; FU 1,616.2 ± 328.3 mg) and had a tendency to increase ($p = 0.0373$). **Magnesium** content was also increased non-significantly but remained within the norm (280 mg). **Iron** content in food (mg) was within the range of FM, 16.8 mg to FU, 17.4 mg, and was at the normal level for female patients (postmenopausal women 9 mg, and 15 mg during menstruation). **Selenium** content in food was significantly higher (84.6–98.3 mg) than the recommended norm (40 mg).

Comparison of energy and main nutrients content in 3-day menus.

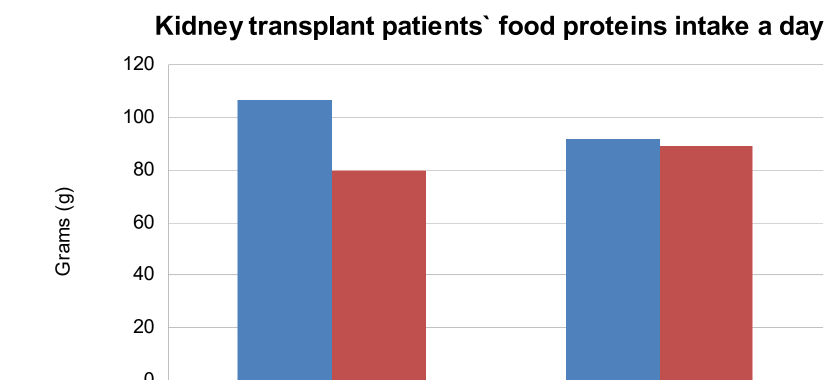
The daily **average food energy** content was decreased non-significantly in the male patients group at 265 ± 176 kcal (min 64 kcal, max 765 kcal) and remained at the normal level in FU, but in females was increased significantly at 325 ± 22 kcal (min 252 kcal, max 292 kcal) and had a tendency to increase in FU compared within the recommended level. The average **food energy content per kg of BW** (kcal/kgBW/day) decreased significantly in males and inreased significantly in female CKD patients groups and remained within the normal level.

The daily average **dietary protein intake (g)** decreased non-significantly in male patients at the 106.7 to 91.6 g, but increased significantly in female patients at 79.6 g to 89.2 g. The daily average **food proteins intake in g/BW** decreased significantly in male CKD patients at 1.5 to 1.1 g/kg, and in female patients it was unchanged in the follow-up (1.2 g/kg). Data are shown in Figure 9 and in Figure 10.



	FM	FU
Male (n = 12)	1,5	1,1
Female (n = 16)	1,1	1,2

Figure 9. The dietary proteins intake in kidney transplant patients based on the 3-day menu analysis. All the data are given per kilogram body weight a day in dynamics (FM, first measurements; FU, follow-up).



	FM	FU
Male (n = 12)	106,7	91,6
Female (n = 16)	79,6	89,2

Figure 10. The dietary proteins intake a day in kidney transplant patients based on the 3-day menu analysis. All the data are given in grams at FM, first measurements and at FU, follow-up.

The daily average **food fats (g)** content decreased non-significantly in male CKD patients at the 101 grams to 88 grams, and increased non-significantly in female patients from 76 grams to 88 grams, and remained within the normal level. Consumption of the food **cholesterol** was increased significantly in female CKD patients at 271 mg to 360 mg, but decreased non-significantly in male patients.

Food **carbohydrates** intake significantly increased in female patients and remaind in FU 293 g in a day (50% carbohydrates of food energy) but non-significantly decreased in male patients and was in FU 312 g (51% of carbohydrates of food energy) remaining within the normal level.

The average **sodium** content in food decreased non-significally in all patients: in male patients at 2,752 mg to 2,300 mg (min 1,488 mg in FU), and in female kidney transplant patients at 2,240 mg to 2,494 mg (min 1,642 mg in FU).

The average **potassium** content in food decreased non-significally in male patients at 3,920 mg to 3,843 mg (min 3,096 mg in FU), and increased non-significantly in female kidney transplant patients at 2,988 mg to 3,579 mg (min 1,805 mg in FU).

Consumption of the food **calcium** was increased significantly in female CKD patients at 732 mg to 915 mg, but decreased non-significantly in male patients at 1,221 mg to 1,022 mg.

The average **phosphorus** content in food decreased non-significally in male patients at 2.046 mg to 1,789 mg (min 1,471 mg and max 2,378 mg in FU), and increased significantly in female kidney transplant patients at 1,433 mg to 1,616 mg (min 1,130 mg and max 2,321 mg in FU).

The average **magnesium** content in food decreased significally in male patients at 455 mg to 398 mg (min 332 mg and max 553 mg in FU), and increased significantly in female kidney transplant patients at 1,433 mg to 1,616 mg (min 1,130 mg and max 2,321 mg in FU) but in female patients non-significantly little increased.

The food **iron** average consumption in CKD male patients is higher (at 22 mg to 20 mg) from the recommended level (9 mg) and in female patients 17 mg in FU.

Dietary fiber contents were in the recommended range in male at 31 g to 32 g in FU, and in female kidney transplant patients at 26 g to 27 g in FU.

Dietary water solubile **vitamins** (tiamin, niacin, pyridoxine, folic acid, pantothenic acid, biotin, vitamin C) intake inreased significantly in the female patients groups and remaind at the recommended level in FU, but in the male patients groups non-significant changes in FU were found. Dietary **vitamin D** intake inreased significantly in the female patients groups and remaind under the recommended level in FU (4.0 μg), but in the male patients groups non-significant changes in FU (3.5 μg) were found. Dietary **vitamin E** content was in the recommended range in male and female patients grops (recommended range is 8 mg).

5.12. Correlation analysis between anthropometric and the 3-day menu variables (Paper V)

The correlation analysis of mean anthropometric parameters with mean nutritional variables was carried out separately for males (n = 12) and for females (n = 16). The **Paper V** presents the correlation coefficients of all the 36 anthropometric variables with 10 indices and consumed energy with 10 food nutrients. The results of the correlation analysis between selected anthropometric and nutritional parameters in kidney transplant male and female patients after the first measurements (FM) and the follow-up (FU) are given for male and for female patients.

Male patients (n = 12)
Correlation analysis between selected anthropometric variables and the consumption of energy and the main nutrients in kidney transplant male patients after FM. The consumed energy and the amount of ten basic nutrients and micronutrients are significantly connected with single features (breadths and depths, circumferences, skinfolds, indices). We found at the beginning (FM) of observation positive statistically significant correlations in male kidney transplant patients between seven anthropometric parameters and of **food cholesterol**: chest breadth (r = 0.581), waist breadth (r = 0.592), neck circumference (r = 0.615), calf circumference (r = 0.907), ancle circumference (r = 0.597), wrist circumference (r = 0.818), body surface area (r = 0.647). On the basis of the table it can be concluded that the male patients' features of body build are not significantly connected with the nutritional content and the consumption of food energy.

Correlation analysis between anthropometric variables and the consumption of energy and the main nutrients in kidney transplant male patients after FU. Non-significant correlations between other anthropometric variables and the consumption of energy and the main nutrients in kidney transplant male patients after the follow-up were found.

Female patients (n = 16)
Correlation analysis between anthropometric variables and the consumption of energy and the main nutrients in kidney transplant female patients at FM. We found at the beginning (FM) of observation two statistically significant correlations between **food cholesterol** and body fat indices: body fat (kg) by OMRON (r = 0.501), body fat (%) by OMRON (r = 0.537) but statistically significant correlations were found between the mean **food calcium** and the mean body height (r = -0.508). Only certain features deserve attention: the connections between cholesterol and the skinfold of chest (r = 0.531) and body fat indices by OMRON (r = 0.537, r = 0.501), while the food calcium is statistically in the negative correlation with the body height (r = -0.508).

Correlation analysis between anthropometric variables and the consumption of energy and the main nutrients in kidney transplant female patients after FU.

We found at the end (FU) of observation statistcally significant correlations in female kidney transplant patients between seven mean anthropometrical parameters and the mean food calcium: waist breadth, biceps skinfolds, thigh skinfolds, body fat (%) by OMRON, mean skinfolds, body density. In females at the end (FU) of observation positive statistcally significant correlations were found between six mean anthropometrical parameters and the mean food phosphorus: waist breadth, neck circumference, biceps circumference, thigh circumference, body density.

The results of our work indicated that the amount of consumed food of the studied renal transplant patients was generally little correlated with the anthropometric parameters. Therefore, there is no clinical significance of these correlations.

6. DISCUSSION

6.1. Anthropometrical study

Among other methods, anthropometrics is a central method in the study of anthropometrical parameters and body composition in CKD patients. In scientific research, the standards developed and implemented into practice by anthropometrists and anthropologists are used, including the anthropometric measurement technique and terminology (Hertzberg 1968, Moreau et al. 2006, Tesedo 2011). Anthropometric parameters together with laboratory tests and dietary interviews should be measured routinely because they provide a valid and clinically useful characterization of the protein-energy nutritional status for the maintenance of dialysis patients (KDOQI, 2002). Several authors have underlined that the general state of CKD patients, including transplanted patients, should be assessed in a complex manner together with the anthropometrical, body composition, laboratory and nutritional assessment methods (Patel 1998, El Haggan et al. 2002, Haapala et al. 2002, van den Ham et al. 2002, Coroas et al. 2005, Moreau et al. 2006, Guida et al. 2007, van Düring et al. 2015).

Therefore, as many studies presented in literature have been performed in CKD patients (concerning the parameters of their body build, the indicators of body content, the assessment of nutritional status and their connections using anthropometrical, laboratory and nutritional scientific methods), we also chose a similar approach, using complex methods in our work. Systematic research on assessing body composition and nutrition in chronic kidney disease (CKD) patients has not been carried out earlier in Estonia. In the current longitudinal study we measured and analysed the changes in the body build parameters and the nutritional status of male and female end-stage kidney disease (ESKD) patients. ESKD means that the patients have to receive renal replacement therapy (RRT): either dialysis or transplantation. In the first part of the study we analysed the body build of both the dialysis and the kidney transplant patients, and thereafter focussed on patients who had transplanted kidneys and were in a stable condition after transplantation. We analysed correlative links between the studied features at the Tartu University Hospital for the first time (FM) on average one and a half years after kidney transplantation and for the second time (FU) on average three years after kidney transplantation. Last anthropometric measurements (LM) were performed ten years after kidney transplantation.

The anthropometrical parameters of the dialysis population are not comparable with the ones of the general population because of the accompanying protein-energy wasting syndrome in ESKD patients. But after the transplantation, uremic symptoms disappear, the patients' general state improves and the anthropometric measurements of transplant patients may be comparable with the general population. On the other hand, depending on the timing of the measurements of transplant patients, anthropometrical parameters may be similar to the dialysis patients' data. This was seen in our first study where the dialysis and the male and female transplant patients' anthropometrical parameters were almost similar and that is explained by the fact that the measurements in transplant patients were performed shortly after transplantation. Although time-consuming, the measurements of anthropometric variables are helpful and easy to use in assessing the nutritional status and taking care of kidney transplant patients in the follow-up period (Coroas et al. 2005, Moreau et al. 2006, Briggs 2005, Sezer et al. 2006). On the basis of scientific literature, today, anthropometry is an important measurement, and as mentioned before, should be used regularly in various categories of CKD patients, including kidney transplant patients for the estimation of body composition already before nutritional counselling (K/DOQI 2002, KDIGO 2012).

Our study revealed that the mean **body height** (BH) decreased significantly during the follow-up period in both male and female groups of kidney transplant patients, in male patients by 1.29 cm, and in female patients by 1.38 cm. However, this change may be associated with body posture or body habitus and can also be associated with the underlying disease or bone and mineral disorders. The decrease of the mean BH is an important feature in CKD patients, and may show the development of CKD-mineral and bone disorders (CKD-MBD) (Burger et al. 1994, Grotz et al. 1995, Williams 2009, Mazzaferro et al. 2006, London et al. 2010).

Body weight (BW) is an important anthropometric variable when screening undernutrition or obesity. The main change after kidney transplantation that has been demonstrated by many authors is BW gain that often occurs especially during the first post-transplant year (van den Ham et al. 2000, van den Ham et al. 2003). The increase in BW, which is common after transplantation, is caused by the correction of the anorectic effects of uraemia and by steroid therapy (Moreau et al. 2006). Also, van den Ham et al. have demonstrated that BW gain in CKD patients generally occurs shortly after transplantation, which may be influenced by improved appetite and the reversal of the uremic state (van den Ham et al. 2002). Investigators agree that more attention has to be aimed at the eating habits in the immediate post-transplant period when obesity may develop rapidly (Lopes et al. 1999).

Our study revealed that after kidney transplantation, the mean BW increased significantly more in male kidney transplant patients than in female patients. However, our measurements, contrary to others (Zelle et al. 2013), were carried out later, more than one year after transplantation, when the first post-transplant changes in body build should have already disappeared and corticosteroid use minimalized or withdrawn. Subsequently, we studied transplant patients after intensive counselling for one and a half years. We found that BW gain in females was not significant after the FU and this may be explained partly by the fact that together with an improvement in their health, women probably cared more about their body shape and followed the dietitian's advice which was confirmed by analysing the 3-day menu and FFQ (Kiisk et al. 2010). Other authors have similarly demonstrated that in the post-transplant period there is believably a bigger BW gain difference in male kidney transplant patients compared with female patients. The BW difference may be explained by the more displayed role of undernutrition in male patients in the pre-transplant period, the reversal of the uremic state in the post-transplant period, also by a chronic inflammatory state and the improvement of the general state (Stenvinkel 2001, Coroas et al. 2005, Stenvinkel 2010). Coroas and co-authors indicated in their work that female patients, in comparison with male patients, have significantly lower BW in the post-transplant period which is caused by a smaller loss of weight in female patients in the pre-transplant period (Coroas et al. 2005). Other investigators have demonstrated in their research papers a stable mean BW gain in the post-transplant period with a tendency to increase after the first year. For instance, van den Ham showed a BW gain of 3.9 ± 6.2 kg in the first year, and 6.2 ± 8.6 kg after 5 years in the studied transplant patients (van den Ham et al. 2000, van den Ham et al. 2003). On the other hand, although we observed statistically significant differences in BW gain between the studied and the control group of kidney transplant patients, the mean BW stayed in a range similar to the healthy population of Estonians (Saluste et al. 2002).

The increase in BW is predominantly caused by an increase in body fat (BF) mass as shown by the linear correlation between the increase in the percentage of the BF mass and BMI (Moreau et al. 2006). The assessment of BF content in the male and female kidney transplant patients, studied by us, showed a similar change in the direction to increase (discussion given in section 6.2). However, the increase of fat mass itself shows a risk for cardiovascular complications. Moreau and co-authors in a long-term study of stable thirty-six kidney transplant patients indicated that the body composition in male patients remained stable and close to baseline values while female patients had a significant increase in BW (14%) because of an increase in fat mass: 3.4 kg (19%) in one year and 5.6 kg (30%) in 2 years, and then stabilization was observed over the last 3 years (Moreau et al. 2006). Chang and co-authors indicated in their study that the post-transplant stable mean BW gain of 0–5% was associated with the best outcomes but the BW gain of more than 10–20% was associated with poorer transplant outcomes (Chang et al. 2008). Thus, many authors have studied metabolic parameters and risk factors for kidney transplant patients as well as post-operative complications (Merion et al. 1991, Marcen et al. 2007, Zaudfudim et al. 2010, Zrim et al. 2012) where overweight has been found to be an important prognostic factor. Curran and co-authors observed in their 10-year cohort study that BW reduction in obese patients is important already in the pre-transplantation period (Curran et al. 2013).

Lastly, in the current study, ten years after the KTx we further aimed to clarify a longitudinal effect of intensive nutritional counselling and guidance on WG. We noticed BW gain in all KTx patients, both in males and females as follows: in the standard male care group the mean BW gain was 6.4 kg, female 7.0 kg, and among intensively counselled males 4.6 kg, females 1.1 kg. The BW gain was not significant ten years after KTx in the patients who received additional intensive nutritional counselling compared with the standard care control group of KTx patients (Paper VI). Thus, our study found intensive nutritional counselling and guidance to be effective also in the long term. Similar studies have not been performed earlier.

However, because of the lack of evidence for effective interventions to prevent weight gain after kidney transplantation, Australian researchers have recently designed a randomized controlled study. Ryan with co-authors is studying the effect of intensive nutrition interventions (INTENT trial) on BW gain after kidney transplantation. An INTENT trial is a single-blind, randomised controlled trial to assess the effects of intensive nutrition interventions, including exercise advice, on WG and metabolic parameters in the first year after transplantation (Ryan et al. 2014). Thus, the results may soon provide important data on the effects of intensive nutrition interventions on WG after transplantation and the associated metabolic consequences. However, long-term WG data already in our study clearly showed that in KTx patient population, the patients who received intensive individual dietary counselling had much more educated behaviour in the long term, thereby preventing WG.

Body Mass Index (BMI) is the most popular index in clinical practice for a complex assessment of patients' nutrition together with other anthropometric features. Several authors have underlined in their papers that a very high BMI or a very low BMI before kidney transplantation constitutes a significant independent risk factor for kidney graft failure and the patient's death (Meier-Kriesche et al. 1999, Meier-Kriesche et al. 2002, Coroas et al. 2005, Weissenbacher et al. 2012). Marks with co-authors indicated that obese transplant patients had a significantly higher complication rate in the post-transplantation period, compared with non-obese patients (Marks et al. 2004). Jezior and co-authors studied 418 kidney transplant patients and noticed that BMI significantly increased in male patients (7%) and in female patients (9.6%) during 56 months after kidney transplantation (Jezior et al. 2007).

We found that the mean BMI increased significantly in both groups of studied kidney transplant patients during the follow-up period. The changes in the BMI indicators of the transplant patients we studied were compared with the kidney transplant patients in the control group. Our study indicated that the mean calculated BMI of male kidney transplant patients increased statistically significantly during the observation period, from 24.7 to 27.7 kg/m^2 during the FU similarly to the control group's increase in BMI from 24.4 to 26.0 kg/m^2. The mean BMI in female kidney transplant patients increased during the observation period significantly, from 27.3 to 28.5 kg/m^2 but in the control group the increase was from 25.0 to 26.0 kg/m^2 (Paper IV). When comparing the results with the healthy population, we found interestingly that the male patients' mean BMI at the first measurement differed significantly from the healthy population's BMI but in the follow-up measurement no significant differences were found. In female patients, the mean BMI at the first measurement, and also in the follow-up did not differ significantly when compared with the mean BMI of the female group of the healthy population (Paper I).

Skinfolds. In the post-transplant period, we noticed a different tendency in the studied patients' body composition parameters which was probably caused by increased appetite, improved health and uremic status. Out of 11 measured folds in male patients, only 5 folds changed statistically significantly in the follow-up period: chin skinfolds, chest skinfolds, subscapular skinfolds, biceps skinfolds, and triceps skinfolds. In female patients we did not find significant changes in skinfold thickness in the follow-up measurements.

Other authors have also shown statistically significant differences between nutritional and anthropometric parameters when comparing male kidney transplant patients with female patients. Coroas and co-authors showed that the results in the measurements of triceps, biceps, subscapular and suprailiac skinfolds in CKD patients are significantly different between male and female patients during the first years after kidney transplantation. Uremic men before transplant displayed undernutrition indices, and differently, women started close to normal and had significantly increased BW and fat content in the post-transplant period (Coroas et al. 2005). Srivastava with co-authors studied clinical, nutritional, anthropometric parameters and skinfolds thicknesses in kidney transplant patients during a 12-month period, and found no correlation between body fat percentage and dietary intake among patients with CKD, the fact that all the studied patients were allowed regular dietary counselling (Srivastava et al. 2014). Although skinfold thickness may give useful information about the patient's nutritional status, the measurements are not in clinical routine in every centre but, pursuant to a few clinical guidelines, these measurements should be performed regularly in ESKD patients (KDOQI 2002).

Body composition. Out of 8 calculated body composition characteristics we found 7 statistically significant changes in male patients in the FU period, but 2 statistically significant changes in female patients. In the male group, there were statistically significant body content indicators or parameters in the follow-up period: the body surface area, the body density, the relative mass of fat by Siri in percent, the mean skinfolds, the mass of subcutaneous adipose tissue in kilograms, the relative mass of subcutaneous adipose tissue in percentage, the BMI, and the WHR. In the female group there was only one statistically significant indicator with growth tendency for the body content indicator or BMI, and one statistically significant indicator with the falling tendency of the WHR in the follow-up period. In addition to the BH and BW we also compared several anthropometric features and the changes in their measurements for characterizing body build, consequently a total of 36 anthropometric variables were measured: body height, body weight, 2 depth and 8 breadth measurements, 13 circumferences and 11 skinfold thickness measurements (Paper IV).

In literature, we have not found such profound measurements of anthropometric features in kidney transplant patients, and no long-term studies exist. Several researchers have studied the anthropometric and nutritional parameters of kidney transplant patients at baseline and after one year and, contrary to female patients, have found no significant change in body composition of men (Chang et al. 2008, Srivastava et al. 2014).

Circumferences. In connection with the increase of BW, significant increase was also found in the characterized circumferences in both groups of studied patients (Paper IV). Significant changes in circumferences were found in different directions both in males and females. Out of thirteen measured circumferences of males, four significant changes in growth were noted, but in females, concerning the same feature, there was an insignificant lowering tendency. In male kidney transplant patients, mid-arm relaxed circumference and mid-arm flexed-tensed circumference at upper limb as well as calf circumference at lower limb had statistically significantly increased. In male kidney transplant patients a significant increase in hip circumference after the FU (FM at 99.19 cm to 103.04 cm at FU, difference 3.85 cm) was found. In the male group we found in total five significant lowering tendencies in circumferences: head circumference, neck circumference, waist circumference, proximal thigh circumference and forearm circumference which did not appear in the female group. In the female group we still found some significant lowering tendencies in waist circumference from FM 88.55 cm to FU 86.57 cm which did not appear in the male group.

Breadths and depths. The mean biacrominal breadth decreased significantly in male transplant patients (0.49 cm), but decreased insignificantly in female patients (0.39 cm). The mean **waist breadth** indicated insignificant lowering tendencies both in males and females. We found one significant one direction change in the widths of hips in both males and females. The **pelvis breadth** increased significantly in male and female patients. The changes of pelvis breadth were evidently caused by the changes in the thickness of the subcutaneous fat tissue (Paper IV).

Thickness of bone at the upper limb. We noticed non-significant changes in the mean humerus breadth and in the mean wrist breadth measurements in both male and female patients. **Thickness of bone at the lower limb.** The data of the mean femur breadth showed insignificant changes in both groups. We found that the mean ankle breadth decreased significantly in male patients (from 7.35 cm to 6.93 cm), and decreased non-significantly in female patients (from 6.33 cm to 6.11 cm).

On the basis of literature, the data of the anthropometrics of CKD patients are often limited to the measurements of mid-arm, waist and hip circumferences (Moreau et al. 2006, Ryan et al. 2014). But other investigators have used comprehensive measures using biceps, triceps, subscapular and suprailiacal skinfolds thicknesses, and many indicators of the BF content the BMI, the WHR, mean skinfolds, body density, relative mass of fat by Siri, the mass of subcutaneus adipose tissue have been taken into consideration (Patel 1998, El Haggan et al. 2002, Haapala et al. 2002, van den Ham et al. 2002, van den Ham et al. 2003, Coroas et al. 2005, Moreau et al. 2006, Guida et al. 2007, van Düring et al. 2015, Uysal et al. 2015, Vega et al. 2015, Sasaki et al. 2015, Heng et al. 2015, Andreoli et al. 2016). Systematised anthropometrics is not stipulated in clinical guidelines but should become an obligatory procedure in the routine management of kidney transplant patients.

6.2. Instrumental assessment methods of body composition

Bioimpedance. In our study, the assessment of the BF content in the kidney transplant male patients showed the significant one-direction change to increase, BF % by OMRON at baseline from 18.2% to follow-up 23.5%, and the mean BF in kg by OMRON at baseline from 14.9 kg to follow-up 20.4 kg. The assessment of BW content in the kidney transplant female patients studied by us showed the one-direction trend to increase: the mean BF% by OMRON from 33.1% to follow-up 34.8%, and the mean BF in kg by OMRON increased from the first measurement 25.74 kg to follow-up 28.36 kg. The minimal BF% of kidney transplant patients by OMRON is very low compared with the normal range of healthy population, and it was for male patients at the first measurement 7.8% and in the follow-up 8.4%, and for female patients at the first measurement 9.9% and in the follow-up 10.5% (Kiisk et al. 2012). Thus, these measurements show similarity with the anthropometrical data of the BW and BMI.

Several authors have similarly shown that undernutrition exists in male patients before kidney transplantation, and, during the follow-up, they increased their BW and BF content, but it remained in the normal range (Marcén et al. 2007, Mitch 2007). High doses of steroids in the early period after renal transplantation are possibly mediated by their inhibiting effect on lipid peroxidation, it also appears to be related to physical inactivity. Hyperlipidaemia, overweight or obesity and improved appetite were normalized by dietary intervention and exercise training in stable kidney transplant patients (Coroas et al. 2005, Marcén et al. 2007, Mitch 2007). Coroas and co-authors studied 11 men and 7 women anthropometrically, and indicated the difference in male and female patients' body fat content as follows: in uremic men, indices of undernutrition were found before transplant, and female patients had a significantly increased body weight and body fat content after kidney transplantation (Coroas et al. 2005, Moreau et al. 2006, Stenvinkel 2010, Tesedo 2011). Our anthropometric and bioimpedance measures showed similar changes of body composition (Paper IV).

Densitometry. Dual-energy x-ray absorptiometry (DXA) is used for routine clinical care and can be used to validate other methods of measuring the body fat. However, pursuant to the clinical guidelines (KDIGO, 2009), measuring bone mass density (BMD) after kidney transplantation is needed in the cases where patients receive corticosteroids or have risk factors for osteoporosis as in the general population and there are insufficient data to guide treatment after the first 12 months. After analysing our data and literature data, we feel that the DXA usage deserves more attention in the complex management of transplant patients. Comparing our investigation with the works of other authors, we have found similar results in BMD and bone research results. The total body mean BMD after the follow-up both in the male and female kidney transplant patient groups was within the lower normal range (Reference Population Database. Lunar DPX-IQ Reference Manual). Individual measures of the total body BMD revealed osteopenia in 50% of males and 18% of females but anterior-posterior (AP) lumbar spine (L2–L4) measured T-scores showed osteopenia in 33% of males and in 25% of females. Osteoporosis was not found using the total body BMD measurements but in the region AP lumbar spine (L2–L4) osteoporosis was found in 8% of male and 25% of female patients (Paper IV).

Brandenburg and co-authors showed in their study that the bone loss in transplant patients is a long process. A rapid bone loss is seen in the first 3–6 months after transplantation. Kidney transplant patients had stable BMD in the lumbar region during one year, and after 4–6 years it was significantly lower (Brandenburg et al. 2004, Mitterbauer et al. 2006). The Canadian researchers in the long-term study (1996–2011) investigated the BMD of 326 male and female patients (mean age 45 years) three times: the first scan was 0.5 years after kidney transplantation, and the second scan was 2.7 years after the first scan, and the third measurement was made 8.2 years after the first scan. This study investigated long-term changes in CKD patients with the monitoring and treatment of osteoporosis. Naylor and co-authors indicated that the bone density remained stable or improved for age and sex, and the data of Z scores in lumbar spine increased from -0.4 ± 1.6 to + 0.7 ± 1.6 (Naylor et al. 2014).

Thus, the results of densitometry indicated the need for the complex preventive and individual therapeutic treatment according to the increase of bone mineral density levels. But, the recommendation by KDIGO 2012 suggests that no bone mineral density testing is performed routinely in those with eGFR < 45 mL/min/1.73 m^2 (GFR categories G3b–G5) as information may be misleading or unhelpful (KDIGO 2012).

6.3. Correlation analysis between the variables of anthropometry, biochemical data and food nutrients

The associations between anthropometrical and biochemical variables were different in the male and female patients of kidney transplant. Our study revealed that the male patients gained BW in the post-transplant period because of the increase of bone, muscle and fat mass. These changes appeared to correlate with the inflammatory status. Similar association was not noticed in the female patients where BW had not increased significantly. Inflammatory status (Ozdemir 2007) and hyperlipidaemia (Dumler 2007, Ramezani 2007) are well-known cardiovascular risk factors. In our study, most patients normalized their inflammatory status similarly to the studies of the other authors (Moreau et al. 2006). As a confirmation of the inflammatory status association with the body composition, we found a significant number of correlations in males between CRP and different body circumferences and body fat. Previously, it had been shown that the graft survival rate in the recipients with hypercholesterolemia was lower than that in the recipients without hypercholesterolemia (Akioka et al. 2005). Therefore, lipid profile monitoring is clinically important in the management of patients with kidney transplants. Hyperlipidaemia, overweight or obesity, physical inactivity and improved appetite were normalized by dietary intervention and exercise training in stable renal transplant patients (van den Ham 2002). On the contrary, in our study we found a tendency of increase in S-CHL in both males and females after transplantation. Interestingly, many significant correlations were found in females between the mean weight, BMI and triglycerides both at FM and after FU. At the same time, the skinfolds thicknesses in female patients correlated significantly with the serum triglycerides level at the beginning of measurements, but less in FU which means that intensive counselling was effective. In males, there were no statistically significant correlations between skinfolds thicknesses and studied lipids (Paper IV).

The results of our study revealed that the amount of consumed food was generally not much associated with the anthropometrical variables both at FM and after FU.

6.4. Nutrition assessment of nutritional status and nutritional counselling of kidney transplant patients

The assessment of nutritional status is time-consuming but forms a central part in the CKD patients' nutrition management. The nutrition assessment of dialysis patients performed by a dietitian includes the compilation of a plan of care that incorporates all aspects of nutrition evaluation (assessment of nutritional status, nutrition history, patient preferences, and the nutritional prescription). The data are incorporated into an active plan that is then implemented by the medical team (KDOQI 2002). After transplantation uremic symptoms disappear and the patients' general state improves. Therefore, patients feel well and often forget to pay attention to healthy eating. As shown earlier, the studied transplant patients were generally in a satisfying nutritional status at the first measurement after kidney transplantation which can be explained by regular monitoring, cooperation with treatment, and good collaboration between specialists, but nevertheless, later the BW gain appeared. In the long term, optimal and intensive counselling by a dietitian can prevent significant body weight gain after kidney transplantation.

Multiple body composition and nutritional characteristics may be used together to estimate the projected long-term risk of BW gain among kidney transplant patients. Two main methods have been appreciated in the assessment of a nutritional status: the nutrition frequency questionnaire (FFQ) and the 3-day nutrition diary. However, the 24-hour recall is not appropriate for scientific studies but it is often in use in clinical routine practice (KDIGO 2012). The nutrition of CKD patients after kidney transplantation has not been studied in Estonia but the nutrition issues of the patients with chronic cardiovascular disease (CVD) have been studied by Born et al. using 3-day dietary records (Born et al. 2002).

We implemented a special food-frequency questionnaire (FFQ) compiled by the Centre of Physical Anthropology at the University of Tartu. The FFQ consists of the questions concerning socio-economic aspects, physical activity and nutrition (Kiisk 2010). The analysis of the FFQ questionnaire shows a diverse selection of nutrients with different frequencies but mainly protein-, fat- and carbohydrate-rich food products are consumed. Using the above-mentioned questionnaire, we analysed prospectively long-term nutritional issues in the CKD patients with kidney transplants who were in a stable status after kidney transplantation. The differences in the parameters of body build, laboratory data and the nutritional status were studied for the first time on average one and a half years after kidney transplantation and for the second time on average three years after kidney transplantation.

Similar research has been performed by others where the assessment of the nutritional status of the patients with the transplanted kidney is also used beside anthropometric measurements, biochemical indicators and FFQs (Levey et al. 2006, Finkelstein et al. 2006, Yong et al. 2010, Nauta et al. 2011, Hoogeveen et al. 2011). However, these studies are usually retrospective and examine patients during the first year after kidney transplantation (Zelle et al. 2013). Therefore, the risk of BW gain in the first post-transplant year is widely known and, before leaving the hospital, patients usually receive routine dietary counselling according to clinical guidelines. Medical researchers at the Auckland City Hospital found, based on their research, that the Intensive Nutrition Intervention (INTENT study) helps avoid metabolic changes, also important changes of BW in the direction of growth if nutritional counselling has already started during the first month and later with three-month periods in the first year after kidney transplantation (Ryan et al. 2014). Additionally, the influence on the CKD patients' lifestyle factors guarantees a stable status after transplantation (Disler et al. 1981, van den Ham et al. 2002, Zelle et al. 2013).

Since the first year BW gain is widely known (Zelle et al. 2013) and our patients had routine dietary counselling performed before leaving the hospital after transplantation, we aimed to study the stable kidney transplant patients after the first post-transplant year with the inclusion of additional intense dietary counselling, and found that the intervention had been appropriate in our patients' groups to avoid further BW gain. As BW gain after transplantation occurs mostly during the first and also during the second year after the transplantation, the second year appears even more critical because patients forget the advice given by a dietitian or doctor who monitors them, and further weight gain may occur.

We used the Finnish Micro-Nutrica Nutritional Analysis program which had been modified and translated into the Estonian language at the Tallinn University of Technology, Department of Food Processing (Estonian Version 2, 1997) in analysing the patients' dietary records. The 3-day dietary records data of CKD patients were compared with the Estonian Nutrition Recommendations (the Estonian Nutrition Recommendations 2006), based on the Finnish Nutrition Recommendations (1998) and the Nordic Nutrition Recommendations (2004).

There were large variations in the studied kidney transplant patients' nutrition parameters based on individual 3-day dietary records analysis. We found several examples both in male and female patients which credibly explained all their anthropometric changes that had occurred during the study.

Our **3-day dietary record** revealed that the average amount of **consumed food energy** in the male and female groups, diurnally in males, decreased insignificantly in the follow-up period (from 2,689.7 kcal to FU, 2,424.9 kcal), and in females it increased significantly in the follow-up period (from 2,028.0 kcal to FU, 2,352.9 kcal), but remained in the limits of the recommended daily consumption of food energy by the Estonian Nutrition Recommendations, the reference energy content 2,000 ± 150 kcal (the Estonian Nutrition Recommendations 2006). In our study, the CKD patients were advised to consume 25–35 kcal of food energy per kg of BW a day, which is in accordance with the nutritional recommendations. Our results showed that the daily consumption of food energy per kilogram of BW decreased significantly in males (from 37.2 to 30.2 kcal/kg) but increased in females from 29.2 to 32.9 kcal/kg which at the same time did not exceed the average recommended reference. Similar findings have also been described by others authors (Aparicio et al. 2000, Bernardi et al. 2000, Srivastava et al. 2014).

According to the 3-day menu analysis, our study found that male patients did not follow the dietitian's advice very carefully, when compared with females. BW gain in females, contrary to males, was not significant and that may be partly explained by the fact that together with the improvement in their health, females probably cared more about their body shape and followed the dietitian's advice.

After intense additional dietary counselling after FU, the mean intake of **dietary protein** in male patients in the 3-day menus decreased non-significantly (106.7 ± 22.4 g, to 91.6 ± 10.7 g in FU), and in female patients the dietary protein intake increased significantly in the follow-up (79.6 ± 19.7 g, to 89.2 ± 19.5 g in FU). According to the Estonian Nutrition Recommendations, the range of dietary protein is 50–90 g per day. Thus, after counselling, protein consumption was almost in the normal range. But we have to consider the fact that kidney transplant patients belong to the CKD patient population. According to clinical recommendations, CKD patients are advised to consume 0.8 to 1 g/kg/day of protein (K/DOQI guidelines). Our results showed that, both in male and female patients, the recommended normative value was exceeded in the first measurement when the mean consumption of recommended dietary protein was 0.8 to 1 g/kg/day of protein per day for one kilogram of BW (g/kg/day). But after FU, protein consumption decreased both in male (from 1.5 to 1.1 g/kg, $p = 0.009$) and in female patients (from 1.2 to 1.2 g/kg, $p = 0.289$). Also, the percentage of proteins in food energy decreased non-significantly both in males (from 15.9% to 15.2%) and in females (from 15.8% to 15.2%) but remained in the normal range, being in accordance with the Estonian Nutrition Recommendations (2006).

The average amount of **carbohydrates** consumed diurnally by the studied patients remained in the recommended limits (the Estonian Nutrition Recommendations 2006). However, other investigators have paid attention to high carbohydrate consumption because it has been found that overweight patients consume carbohydrate-rich drinks and they are physically inactive (Hines et al. 2000, Zelle et al. 2013).

Hyperlipidaemia is a well-known clinical feature after kidney transplantation and a risk factor for cardiovascular complications. Already a moderate decrease in the total amount of fats from 30% to 27% and a decrease in saturated fats from 12% to 8% in the amount of diurnally consumed food energy helps avoid the appearance of hyperlipidaemia in the post-transplant period and improves the indicators of kidney function (Tonstad et al. 1995). The clinical practice guidelines are presented for CKD patients, and are used for planning renal diets. The major goal in nutrition is to prevent excessive weight gain and dyslipidaemia as well as the changes in calcium-phosphate balance (NKDEP. National Kidney Disease Education Program 2014). In our study, the total amount of **fats** consumed in food did not show the tendency of growth either in male or female patients but the content of cholesterol in menus slightly exceeded the recommended norm, remaining on average in the limits of 356 mg to 359 mg per day. In the male group studied by us, statistically insignificant lowering tendencies of fats in the 3-day menus, on average from 101.3 g to 88.3 g but in the female group from 76.0 g to 88.0 g, remained in the recommended limits (the Estonian Nutrition Recommendations 2006). In the pathogenesis, BW gain and dyslipidaemia indicated the optimal effect of dietary intervention, the normal renal diet, nutritional counselling and physical activity (Disler et al. 1981, Tonstad et al. 1995, KDIGO 2012, Zelle et al. 2013, Marckemann et al. 2015).

The lifestyle factor is certainly important in post-transplant BW gain. According to clinical guidelines (KDIGO 2009), it is recommended that transplanted patients follow a healthy lifestyle, with exercise, proper diet, and weight reduction as needed. We recommended physical quality walking for all CKD patients at least 30 minutes a day, 5 times per week. Although physical activity was not additionally investigated in the current study, we obtained general background data about the lifestyle of the studied CKD patients with the help of the FFQ. The data revealed that **the socio-economic situation** was poor in 16.7% of men and 12.5% of women, satisfactory in 75% of men and 68.8% of women, and only 8.3% of men and 18.8% of women considered their economic status good. Patients' working load may indirectly reflect the intensity of their physical activity (PA). Data analysis indicated that 2/3 of male and 2/3 of female patients did not work as they were categorized as the disabled, and 1/3 of subjects worked either constantly or sometimes, either full- or part-time. Many authors have indicated that, after transplantation, the socio-economic situation, education, psychosocial factors and physical activity play an important role in all patients. At the same time, a decreased quality of life, lack of education, depression and the decreased nutrient intake in the patients' renal diet was found (Stenvinkel et al. 2001, Wells 2003, Lynch et al. 2007, Mitch

2007, Guida et al. 2007, Levey et al. 2011). Briggs with co-authors emphasizes that there are four important components of lifestyle changes where positive changes are especially important for renal patients: body weight, diet, exercise and smoking (Briggs 2005). On the other hand, Zaydfudim and co-authors (2010) tested the health-related quality of life, and indicated that pre-transplant overweight and obesity do not affect the physical activity of CKD patients after transplantation in a 10-year period. Our long-term BW gain data clearly showed that, in KTx patient population, the patients who received intensive individual dietary counselling had much more educated behaviour in the long term, thereby preventing BW gain which is a really well-known risk factor for long-term graft failure as well as for cardiovascular complications and mortality.

7. CONCLUSIONS

1. The anthropometrical profile in the studied dialysis and transplant patients was almost similar. No significant differences were found in the studied anthropometrical parameters of the dialysis and kidney transplant patients either in male or female patients' groups which evidently can be explained by the fact that transplant patients were studied shortly after the transplantation.

2. The body composition characteristics indicated systematic differences between the male and female patients of renal transplantation. After the intensive nutritional counselling, anthropometric measurement changes were in accordance with the increase of body weight after the follow-up which was statistically significant in the studied males but not in females.

3. The effect of intensive nutritional counselling on the changes of biochemical indices revealed the normalization of inflammatory status in most patients, and the studied lipids levels remained within normal reference values.

4. The associations between anthropometrical and biochemical parameters were found to be different in male and female patients. In male patients, several anthropometrical parameters were associated with CRP but in females with lipids. These associations deserve attention because inflammation and hyperlipidaemia are well-known cardiovascular risk factors.

5. The amount of consumed food (3-day menu indices of macro- and micronutrients) was not associated with the anthropometrical variables of the studied transplant patients which shows that there is no clinical significance of these correlations.

6. Intensive nutritional counselling was effective in a long-term: ten years after kidney transplantation, statistically significant BW gain was not seen either in males or in females, but on the contrary, BW gain was present in kidney transplant patients with the standard care.

7. The increased consumption of proteins and carbohydrates after kidney transplantation was found in females but not in males. The consumption of fats was within the normal range. After intensive nutritional counselling, all the values of macronutrients were within normal range in accordance with the Estonian nutritional recommendations.

8. MAIN PRACTICAL IMPLICATIONS

Practical usage of accepted treatment diets

The author of the thesis has drawn up a systematized list of diets and compiled a collection of articles which take the contemporary principles of feeding treatment into consideration.

By today, the activities of the Tartu University Hospital in the field of nutrition have been reorganised in connection with the introduction of the electronic case history in the years 2008–2009. This enables the catering service of the Tartu University Hospital to provide for the special needs of 17 clinics with ca 1,000 patients every day. The share of the diet food is about 25–28%. The electronic database contains the titles of diets for each meal. Personal menus are entered in the case history by a dietitian according to the special needs of the patient and the indications of the diet treatment. For all the foods, there are recipes and the technology for preparing them which should guarantee food safety. The food energy and the content of nutrients of ready-made foods and menus are calculated on the basis of the nutrition program of the National Institute for Health Development (NutriData Food Composition Database 2014). All the above mentioned changes in dietology have been checked by the treating doctors together with a dietitians when monitoring the patients.

The above-described common system of diets for treatment implemented at the Tartu University Hospital was finally accepted by the Ministry of Social Affairs, and the special Regulation of the Ministry of Social Affairs dealing with feeding treatment (Regulation No 131) was worked out for the nutritional care of patients. The common system of diets for treatment has been implemented by now in all the hospitals and care centres in the whole country. The normative values of basic nutrients are in accordance with the Estonian Nutritional Recommendations, the nutrition guidelines of the WHO Regional Office for Europe, and Regulation number 131 Health Protection Requirements for Nutrition in Health Care and Social Welfare Institutions, issued on 14 November 2002 by the Estonian Minister of Social Affairs.

9. SUMMARY IN ESTONIAN

Pika-ajaline toitumise uuring: antropomeetriliste ja kliinilis-laboratoorsete näitajate hindamine neeruasendusravi patsientidel intensiivse toitumisalase nõustamise järgselt

Sissejuhatus

Krooniline neeruhaigus (KNH) on vaikselt ja algstaadiumis oluliste kaebusteta kulgev haigus, mis progresseerub lõpp-staadiumi neerupuudulikkuseni aastate ja sageli aastakümnete jooksul. KNH peamisteks tekkepõhjusteks Eestis on glomerulonefriit, suhkur- ja kõrgvererõhktõbi ning harvem muud kroonilised neeruhaigused. KNH lõpp-staadiumi haigete arvu suurenemine Eestis ja globaalselt on seotud eelkõige KNH progresseerumist põhjustavate riskitegurite laialdase esinemisega elanikkonna hulgas (hüpertensioon, suitsetamine, ülekaal, rasvtõbi, jm.), diagnostika- ja ravivõimaluste paranemisega ning dialüüsiaparatuuri täiustumisega. KNH-ga kaasnevalt areneb südame- ja veresoonkonna kahjustus ning KNH-ga patsientide kardiovaskulaarne suremus on üldrahvastikuga võrreldes oluliselt suurem.

Lõpp-staadiumi neerupuudulikkuse kõige efektiivsemaks ravimeetodiks on neerusiirdamine hemo- ja peritoneaaldialüüsi kõrval. Neeru siirdamise järgselt patsiendi üldseisund ja söögiisu paraneb ning sageli kehakaal suureneb. Teaduskirjaduses ilmub üha uusi andmeid siirdatud neeruga patsientide antropomeetriliste, densitomeetriliste ja biokeemiliste näitajate, toitumisharjumuste ja toiduvaliku kohta, kuid kehakaalu suurenemise ärahoidmise efektiivsete meetodite kohta on läbi viidud väga vähe uuringuid.

Käesoleva uurimustöö üldine eesmärk oli analüüsida lõpp-staadiumi kroonilise neeruhaige kehakoostist ja toitumisharjumusi. Me püstitasime hüpoteesi, et intensiivne toitumisalane nõustamine võimaldab muuta patsientide toitumisharjumusi nii, et peale neerusiirdamist ei teki olulist kehakaalu suurenemist.

Uuringu eesmärgid

1. Analüüsida antropomeetriliste mõõtmiste tulemusi lõpp-staadiumi neerupuudulikkuse haigetel ning võrrelda dialüüsi ja transplanteeritud haigete kehakoostise andmeid.
2. Testida, kas intensiivsel toitumisalasel nõustamisel on efekti neerutransplantatsiooni mees- ja naishaigete kehakoostisele.
3. Hinnata intensiivse toitumis-alase nõustamise mõju antropomeetriliste, biokeemiliste ja toitumuse parameetrite muutustele peale jälgimisperioodi ning analüüsida nimetatud parameetrite omavahelisi seoseid eraldi siirdatud mees- ja naishaigetel.
4. Hinnata intensiivse toitumisalase nõustamise pika-aegset efekti kehakaalu suurenemisele neerutransplantatsiooni haigetel.

5. Hinnata makro- ja mikrotoitainete kasutust neerutransplantatsiooni haigetel 3-päeva menüü alusel dünaamikas.

Uuritavad ja uurimismeetodid

Uuring viidi läbi Tartu Ülikooli Kliinikumi Sisekliiniku nefroloogia osakonnas aastatel 2003–2005 ja 2015. Uuringul on Tartu Ülikooli inimuuringute eetikakomitee luba.

Esimesse uuringugruppi kaasati kliiniliselt stabiilses seisundis järjestikulised neeruasendusravi patsiendid (dialüüsravil ja siirdatud neeruga), kes andsid nõusoleku uuringus osalemiseks: 37 mees- ja 38 naispatsienti.

Teise uuringugrupi moodustasid stabiilses seisundis järjestikulised neerusiirikuga patsiendid, kes andsid nõusoleku uuringus osalemiseks: 12 meespatsienti (keskmine vanus 42,8 ± 16,1 aastat) ja 16 naispatsienti (keskmine vanus 47,0 ± 14,9 aastat). Uuringud viidi läbi kahe visiidi käigus: esimene visiit poolteist aastat ja teine visiit kolm aastat peale neerusiirdamist.

Uurimismeetodid olid järgmised: antropomeetrilised mõõtmised, kehakoostise hindamine bioimpedansi ja densitomeetria abil, laboratoorsete näitajate kogumine ning toitumise uurimine 3-päeva menüüde alusel. Lisaks koostati spetsiaalne ankeet-sagedusküsimustik toitumise uurimise kohta (Food Frequency Questionnare, FFQ).

Antropomeetrilisi mõõtmisi teostati vastavalt klassikalise Martini (1928) ja Knussmann (1988) metoodika järgi. Mõõdeti 36 antropomeetrilist näitajat: kehakaal, pikkus, 2 keha sügavusmõõtu, 8 keha laiusmõõtu, 13 ümbermõõtu ja 11 nahavolti. Kõik mõõtmised teostati litsentseeritud antropometristi poolt. Nende mõõtmiste alusel arvutati indeksid ja kehakoostise näitajad: keharasvamass (kg; %), kehamassiindeks (BMI, kg/m^2), kehapindala (m^2), kehatihedus (g/cm^3), Siri indeks (%), keskmine nahavoldi paksus (mm), nahaaluse rasvkoe mass (kg), suhteline rasvkoe mass kehakaalu suhtes. Kehakoostise tähtsamad komponendid on kehatihedus (Db) ja keharasvamass (FM), mida arvutati kahe regressioni võrrandi (Jack H. Wilmore ja Albert R. Behnke, Durnin ja Rahaman) alusel.

Densitomeetriline uuring teostati uuringu teisel visiidil. Osteopeenia ja osteoporoosi hindamiseks teostati regionaalne luutiheduse mõõtmine lülisamba lumbaalpiirkonnas. Mõõtmised teostati aparaadil GE LUNAR DPX-IQ densitomeeter (Madison, WI, US, software version 4.7e) sertifitseeritud tehniku poolt.

Laboratoorsed andmed koguti peale neeru siirdamist uuringu esimesel ja teisel visiidil. Vereseerumis määrati 18 olulist laboratoorset parameetrit, sealhulgas verelipiidide, parathormooni, homotsüsteiini ja tsüstatiin C tase.

Toitumise uurimine viidi läbi kasutades kahte meetodit: esimene meetod käsitles ühekordset ankeet-sagedusküsimustikku (FFQ), mida uuritav täitis ainult uuringu esimesel visiidil. Teine meetod käsitles 3-päeva menüüde kogumist mõlemal visiidil. Individuaalset toitumisalast nõustamist alustati kohe peale ankeet-küsitluslehe täitmist ja 3-päeva menüüde analüüsimist. Kroonilise neeruhaige toitumisalase nõustamise aluseks on antropomeetrilised ja kehakoostise näitajad ning laboratoorsed testid. Lisaks eelnevale arvestati ka haige toitumisharjumusi, kuid soovituslikul toiduvalikul lähtuti Eestis kehtivast ja autori poolt välja töötatud haiguspuhusest dieetide nomenklatuurist.

Statistiline analüüs
Meie uuritavatel viidi läbi klassikalised antropomeetrilised mõõtmised ja mõõtmisandmete statistiline analüüs (statistikaprogramm SAS), mille alusel on toodud kirjeldava statistika näitajad antropomeetriliste tunnuste kohta (keskväärtused, standardhälbed) eraldi mees- ja naispatsientidel. Korrelatsioonianalüüsil uuriti seoseid antropomeetriliste ja kliinilis-laboratoorsete tunnuste ning toitainete kasutuse vahel, kasutades Pearsoni korrelatsiooni- analüüsi. Regressioonianalüüsiga arvutati parimad prognostilised mudelid siirdatud neeruga patsientide toitumise hindamiseks. Erinevate uuritavate gruppide tunnuste keskväärtuste hindamisel ja varasemate andmetega võrdlemiseks on kasutatud t-testi. Lubatud statistilise vea piiriks valiti 5% ($p < 0.05$).

Tulemused

1. Esimese uuringugrupi neeruasendusravil olnud haigete antropomeetriliste mõõtmiste tulemused näitasid, et uuritud dialüüsi ja neerusiirikuga haigete gruppide keskväärtusete näitajad olid sarnased. Neerutransplantatsiooni järgselt tavaliselt haigete ureemiline seisund taandub, üldseisund paraneb ja isu suureneb, mis omakorda avaldub kehakaalu suurenemises, kuid meie esimesse uuringugruppi kaasatud neerusiirikuga haigetel ei esinenud veel olulist kehakaalu suurenemist.
2. Teise uuringugrupi moodustasid neerusiirikuga haiged, kellel viidi läbi antropomeetrilised mõõtmised ja dietoloogi poolt toitumisalane intensiivne nõustamine 1,5 aastat peale neerusiirdamist (1. visiit) ja 3 aastat peale neerusiirdamist (2. visiit). Transplanteeritud haigete kehakoostist hinnati eraldi meestel ja naistel. Peale intensiivset toitumisalast nõustamist olid uuritavatel paljude antropomeetriliste näitajate muutused kooskõlas kehakaalu suurenemisega. Samas, meeste kehakaalu suurenemine oli peale jälgimisaega statistiliselt oluline, kuid naistel mitte. See võib olla seletatav sellega, et naised järgisid dietoloogi-poolseid soovitusi ja kehakaalu hoolsamalt võrreldes meestega.
3. Intensiivse toitumisalase nõustamise järgselt kliinilisest aspektist lähtudes, esinesid olulised biokeemiliste näitajate muutused, põletikulise staatuse (CRV) normaliseerumine ja lipiidide taseme normi piirides püsimine nii meestel kui naistel.
4. Antropomeetriliste ja biokeemiliste näitajate vahelised seosed olid meestel ja naistel erinevad. Meestel esinesid antropomeetriliste mõõtmiste seosed põletikunäitajatega ja naistel lipiididega. Vaatamata intensiivsele toitumisalasele nõustamisele jäid need seosed püsima ka korduval mõõtmisel (3 aastat peale

neerusiirdamist). Need seosed väärivad tähelepanu, sest põletikuline staatus ja hüperlipideemia on üldtuntud kardiovaskulaarsed riskitegurid. On teada, et lõpp-staadiumi neerupuudulikkuse haigetel, sealhulgas neerutransplantatsiooni järgselt, on peamised surmapõhjused neeruhaigetel just kardiovaskulaarsed tüsistused.

5. Antropomeetriliste näitajate usaldusväärseid seoseid mikro- ja makrotoitainete kasutusega 3-päeva menüüde andmete alusel ei esinenud. Järelikult nimetatud seosed ei oma kliinilist tähtsust.
6. Intensiivse toitumisalase nõustamise efektiivsus avaldus ka kaugtulemusi uurides: 10 aastat peale neerusiirdamist ei esinenud statistiliselt usaldusväärset kehakaalu suurenemist nõustamist saanud transplanteeritud meeste ega naiste seas erinevalt neerusiirikuga kontrollhaigetest.
7. Peamiste toitainete kasutamisel leidsime valkude ja süsivesikute tarbimise suurenemist jälgimisperioodi ajal naistel, kuid mitte meestel ning rasvade kasutus jäi normi piiresse nii naistel kui meestel. Nii naiste kui ka meeste osas on nende makro- ja mikrotoitainete kasutamine kooskõlas Eesti toitumis- ja toidusoovitustega. Järelikult, intensiivne toitumisalane nõustamine oli efektiivne, patsientide toitumisharjumused paranesid niivõrd, et kehakaal ei suurenenud, kuigi mõnede toitainete osas esines suurenenud tarbimise tendents, ei ületanud nende tarbimine kaasaegsete Eesti vabariigi toitumissoovituste referentsväärtusi.

Kehakaalu suurenemine leiab aset neerusiirdamise järgsetel esimestel aastatel ning seetõttu on oluline õigeaegne ja asjakohane patsientide teavitamine ning antropomeetriliste mõõtmiste regulaarne läbiviimine. Kliinilises tavapraktikas teeb seda patsiendi raviarst ja dietoloog annab oma soovitused vajadusel neerusiirdamise järgselt haiglast lahkudes. Edaspidine dietoloogi-poolne monitoorimine ei tarvitse alati olla enam järjepidev kuna haigete üldseisund paraneb ja nad külastavad neerukeskust harvem. Transplanteeritud patsientide toitumisalane nõustamine peab olema individuaalne ja regulaarne, mis eeldab kõikide kliiniliselt oluliste andmete järjepidevat kogumist ja analüüsimist dünaamikas.

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PUBLICATIONS

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