Diet composition among paediatric renal transplant recipients

Focusing on cardiovascular disease

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Summary

Background: Cardiovascular disease (CVD) is one of the major causes of death among renal transplant recipients (RTRs). Prevalence of both hypertension, glucoseintoleranse, dyslipidemia, and overweight are shown to be high. These are risk factors that may be influenced by diet. Renal failure is still present after transplantation. According to National Kidney Foundation Kidney Disease Outcomes Quality Initiative (NFK KDOQI) children with CKD stage 2 to 5 after transplantation require dietary management in the same way as children with similar GFRs before transplantation.

Objectives: The aim of this master thesis was to evaluate the need for dietary treatment among Norwegian paediatric RTRs. Dietary composition was evaluated in relation to prevention of CVD. The diet in RTRs was compared to the diet in healthy children and adolescents to evaluate the influence of prior CKD on the current diet. The study also aimed to estimate the prevalence of different stages of CKD, and to evaluate whether the recorded diet was in accordance to NKF KDOQI guidelines regarding restrictions in intake of protein and phosphorous.

Methods: This was a prospective cross-sectional study in 16 9-15 year-old RTRs. Dietary data was collected using pre-coded food diaries for four days. A short questionnaire was used to collect data regarding dietetic counselling. Data from the UNGKOST2000 survey were used as control data. Data collected in the HENT-study at Rikshospitalet were used when evaluating the prevalence of the different stages of CKD.

Results: Diet composition among the paediatric RTRs was not optimal for prevention of CVD; percentage of energy from saturated fat was high, percentage of energy from added sugar was higher than recommended, intake of iron was low among the girls, and intake of dietary fibre, and fruits and vegetables was low. The RTRs had a higher percentage of energy from protein and fat, and a lower percentage form carbohydrates

compared to the healthy control subjects. Sixty-two percent of the participants in the HENT-study had a GFR corresponding to CKD stage 3-4. Intake of protein and phosphorous were higher than recommended in the NKF KDOQI guidelines. Eighty percent of the RTRs participating in the study would like to have dietetic counselling after the transplantation.

Conclusion: The RTRs do not necessarily have a dietary composition very different from the population in general. Still, some improvement in diet can be done in relation to prevention of CVD. Dietary management among RTRs in the same way as children with similar GFRs before transplantation may be beneficial. Considering their elevated risk of CVD, a healthy lifestyle should be strongly emphasised for these patients. By including dietetic counselling as part of the transplantation program, every patient would be provided dietary guidance, and an important signal would be sent to the patients that diet and an overall healthy lifestyle is an important part of the treatment and management after a renal transplantation.

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List of abbreviations

ARF	Acute renal failure
BMI	Body mass index
BMR	Basal metabolic rate
CKD	Chronic kidney disease
CRF	Chronic renal failure
CVD	Cardiovascular disease
DASH	The Dietary Approaches to Stop Hypertension
DRI	Dietary reference intakes
E%	Energy percentage
EPO	Erythropoietin
ESRD	End stage renal disease
GFR	Glomerular filtration rate
Hb	Hemoglobin
HENT	Helse Etter Nyre Transplantasjon
HDL	High density lipoprotein
HOMA	Homeostatic modell assesment of insulin resistance
KBS	Kost beregnings system
KDIGO	Kidney Disease: Improving Global Outcomes
KDOQI	Kidney Disease Outcomes Quality Initiative
kJ	Kilo Joules
LDL	Low density lipoprotein
MJ	Mega Joules
MUFA	Monounsaturated fatty acids

NKF	National Kidney Foundation
NODAT	New onset diabetes mellitus after transplantation
NNR	Nordic Nutrition Recommendations
NPRTSG	Nordic Paediatric Renal Transplant Study Group
PTH	Parathyroid hormone
PUFA	Polyunsaturated fatty acids
RAAS	Renin-angiotensin-aldosterone-system
RTR	Renal transplant recipients
TG	Triglycerides
Tx	Transplantation
WHO	World Health Organization
$25(OH)D_3$	25-hydroxyvitamin D_3 / calcidiol
$1,25(OH)_2D_3$	1,25-dihydroxyvitamin D_3 / calcitriol

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1. Introduction

Renal transplantation is the first choice of treatment of severe chronic kidney disease (CKD) among paediatric patients. Suffering from CKD can be exhausting for children, and transplantation is associated with improved quality of life (1). However, renal transplant recipients (RTRs) are at risk of several complications, both due to prior CKD, the transplantation itself, and immunosuppressive medications. Cardiovascular disease (CVD) is the most common complication, and the major cause of death among RTRs (2-5). The risk of a cardiovascular death is much higher than among the general population (5, 6). Risk factors for CVD may be influenced by diet, and an optimal diet for prevention of CVD should therefore be emphasized in the treatment of RTRs.

Renal transplantation has been an established treatment in Norway since the late 1960's. The first paediatric renal transplantation was performed in 1969. All children suffering from end stage renal disease have since 1983 been offered renal transplantation at Rikshospitalet University Hospital, Oslo, which is the only transplantation centre in Norway. Three children had a renal transplantation at Ullevaal University hospital prior to 1983. These children have later been followed at Rikshospitalet, Oslo.

A high proportion of renal transplantations in children in Norway are performed using living donors; 84% during the years 1970-2006 (7). The Nordic Paediatric Renal Transplant Study Group (NPRTSG) reports a higher proportion of transplantations using living donors, and a lower proportion of pre-transplants dialysis in Norway, compared to other Nordic countries. Other West European countries also have a lower proportion of living donor transplantations compared to Norway, some as low as 20% (8-12). The relatively high proportion of living donor transplantations in Norway and the fact that all renal transplantations are performed at one hospital makes the Norwegian material unique when studying paediatric renal transplantation.

Some long-term follow-up studies concerning paediatric renal transplant recipients have been published (7, 9, 12-16). The Norwegian group of paediatric RTRs is being studied as part of an ongoing study at Rikshospitalet, called Health After Renal Transplantation; the HENT study. One article from this study has been published (7). This present thesis functions as an addition to the HENT-study.

1.1 The Kidney

The kidneys are bean-shaped structures located behind the abdominal cavity, one on each side of the spine. The kidneys functions are maintaining the fluid and electrolyte balance, excretion of waste products and foreign substances, endocrine production, regulation of blood pressure, regulation of osmolarity and homeostatic regulation of pH.

Approximately 180 litres of plasma is filtered through the kidneys every 24 hours. Fluid is filtered through the glomeruli and passes into the lumen of the nephron where it is modified by the addition and removal of solutes and removal of water. Ninety-nine % of the filtrated fluid is reabsorbed back into the blood. Average volume of urine leaving the body is 1.5 L/24h. By modifying the composition of the urine the kidneys maintain normal fluid and electrolyte balance. Surplus quantities of water, sodium, potassium, calcium, phosphate, magnesium and chloride are excreted. The kidneys also excrete nitrogenous metabolites (urea, uric acid and creatinine), hydrogen ions (as part of the acid-base regulation), sulphates (from degradation of sulphur-containing amino acids), and drug metabolites.

Both the hormones erythropoietin and renin are produced in the kidneys. Erythropoietin is essential for the production of red blood cells in the bone marrow. Renin induces the renin-angiotensin-aldosterone-system (RAAS) which play a key role in the regulation of blood pressure. In addition to this the kidneys are the site of activation of vitamin D (i.e. production of 1,25 dihydroxyvitamin D_3). The kidneys are also the site for some hormonal degradation.

Renal function can be measured by glomerular filtration rate (GFR), creatinine, creatinie clearance, and urea (also called carbamide). GFR is an estimate of the volume of fluid filtered through the glomeruli per unit of time, and this is the most precise estimate of renal function. Creatinine is a breakdown product of muscle-creatine. Production of creatinine is fairly constant (depending on muscle mass), and it can only be eliminated from the body through renal filtration. However, GFR may be severely reduced before a rise in serum- or plasma-creatinine is detected. Especially during the early stages of renal failure, GFR is thus a more safe measure of renal function.

1.2 Renal failure

Different diseases and conditions can lead to loss of renal function, and this loss of renal function can be acute or progressive.

Acute renal failure comes sudden (within days or weeks) and causes a rapid fall in glomerular filtration rate. Most cases occur in hospitalized patients, as part of a condition where renal blood flow is decreased, the kidney itself is damaged or the urine flow is obstructed. With proper treatment chronic renal damage can be avoided, and most patients are healed (17).

Chronic kidney disease (CKD) is defined as kidney damage or GFR <60 mL/min for three months or more (18, 19). The term CKD includes kidney disease with both normal and reduced renal function. The term chronic renal failure (CRF) refers to CKD where renal function is reduced. Both terms are used when discussing CKD.

CKD is classified into five stages according to kidney damage and the degree of reduction in GFR (20). As CKD progresses, the number of nephrons decline, and thus the filtration capacity declines. The stages of CKD are presented in table 1.

Table 1: Classification of chronic kidney disease

Stage	Renal function	GFR (ml/min/1.73m^2)	
1	Normal	>90	+ Kidney damage[1]
2	Mildly reduced	60-90	± Kidney damage
3	Moderatly reduced	30-60	
4	Severly reduced	15-30	
5	End stage renal disease	<15	

[1]i.e. proteinuria or renal pathology detected by x-ray.

The most common causes of CRF among all Norwegian patients are vascular and hypertensive damage to the kidneys (27%), glomerulonephritis (20%) and diabetes (18%) (21). Whereas the causes of CRF among adults in most cases are aquired, the cause of CRF among children and adolescents is most often congenital with structural abnormalities and hereditary diseases as the most common.

Initially the symptoms might be moderate. As the kidney disease develops, the symptoms that appear might be tiredness and impaired general condition, nausea, declining diuresis (oliguria < 400ml/24h, anuria < 100ml/24h), oedema, shortness of breath. Some patients do not experience any of these symptoms, and CKD is only diagnosed through blood tests (22).

At GFR <15 uremic symptoms appear. Some uremic symptoms may appear at GFR >15. Most common symptoms of uremia are tiredness, reduced muscle strength, skin itching, poor appetite/metallic taste sensation, nausea and vomiting, diarrhea, weight loss, and shortness of breath.

1.2.1 Consequences of renal failure

Proteinuria, hypertension and dyslipidemia: Normally very little amount of protein is filtered through the kidneys. High blood-pressure in the glomeruli, or improper glomerular filtration caused by disease or damage, may result in proteinuria. Renal

failure causes an increase in release of renin from the kidneys. Renin induces the RAAS-system which results in both vasoconstriction and retention of fluid and sodium, and thus increased blood pressure. Renal failure itself may also reduce the ability to excrete fluid and salts, and this also contributes to hypertension. Hypertension is unfortunate both for the progression of renal failure and as a risk factor for cardiovascular disease (CVD). Renal disease can also adversely alter plasma lipid profiles. The mechanisms for dyslipidemia in CKD are not fully understood, but increased synthesis and decreased clearance of lipoproteins is part of the explanation. Typically, these patients have hypertriglyceridemia and hypercholesterolemia, with very little change in HDL-cholesterol.

Vitamin D, calcium and phosphate: Vitamin D is produced in the skin by ultraviolet radiation from sunshine, or derived from the diet. Either way vitamin D must be metabolized further to become biologically active. This includes two hydroxylations, the first mainly in liver to $25(OH)D_3$ and the other mainly in the kidneys, to its active form $1,25(OH)_2D_3$ (23). This explains why renal failure is associated with low active vitamin D. When the kidney fail to function, renal 1α-hydroxylation of 25(OH)D is decreased, and thus chronic kidney disease is associated with a reduced level of $1,25(OH)_2D_3$ (24-26). One of the consequences of reduced serum-$1,25(OH)_2D_3$ is reduced intestinal absorption of calcium. Low serum-calcium and low serum-$1,25(OH)_2D_3$ stimulates release of parathyroid hormone (PTH), to maintain the level of serum-calcium within a narrow range. Persistent high serum-levels of PTH are unfortunate concerning bone-health; it may cause secondary hyperparathyroidism, and demineralisation and structural changes of the skeleton. Loss of glomeruli causes a reduced ability for the kidney to secrete excess phosphate. PTH can correct this lack of secretion of phosphate by inhibiting reabsorption of phosphate from kidney. This explains why hyperphosphatemia does not appear until GFR <20-30. Elevated plasma phosphate in combination with normal plasma calcium may cause calcification of connective tissue and muscles.

Metabolic acidosis, anaemia and hyperkalemia: At GFR <40-50 ml/min the number of functioning nephrons have become too low for the excretion of acid (H^+) to be adequate, and CKD thus causes metabolic acidosis. This is unfortunate because hydrogen ions are buffered in bone tissue, with resulting release of calcium and phosphate. Metabolic acidosis also induces breakdown of muscles and reduces the production of albumin in liver. Reduced production of erythropoietin in the kidneys causes reduced production of red blood cells and thus renal anaemia. CKD will also result in reduced ability to secrete potassium. Hyperkalemia is however seldom seen among children suffering from CKD, and does not appear until GFR <15-20.

Uremia: When GFR <15 filtration and excretion of urea and other waste products will be severely reduced, and toxic metabolites will build up. This condition is called uraemia. Untreated uraemia will be life-threatening, and thus the patient needs renal replacement therapy.

Different stages of renal failure are associated with different findings. Table 2 gives a brief description of when the various consequences appear.

Table 2: Consequences of CKD at different stages:

GFR (ml/min/1.73m^2)	Renal function	Clinical findings
>90	Normal	Proteinuria
60-90	Mildly reduced	Proteinuria
		Hypertension
		Hyperlipidemia
30-60	Moderatly reduced	↑PTH
		Acidosis
15-30	Severly reduced	↑Phosphate
		Anemia
<20		↑Potassium
<15	End stage renal disease	Uraemia

1.2.2 Treatment

Treatment of CKD involves both medical and dietary treatment. At CKD stage five, the patients need renal replacement therapy.

Medical treatment

The most important treatment for delaying further progression of chronic renal failure is regulation of blood-pressure. This treatment should be initiated, if necessary, when proteinuria is detected. Metabolic acidosis and renal anemia also needs medical treatment. Metabolic acidosis is treated with sodium bicarbonate. Renal anemia is treated with erythropoietin (EPO). Other possible causes of anemia must be ruled out before treatment is started.

Diet

Many patients with CKD have poor appetite, nausea, reduced gastro-intestinal motility and modified taste experience. Together with restrictions concerning intake of different food items and nutrients this often leads to an improper and unbalanced diet (27, 28). The aim of dietary treatment among patients suffering from CKD is to ensure adequate energy intake to promote growth, regulate protein intake, optimize fluid- and electrolyte balance, ensure adequate intake of micronutrients, and regulate calcium and phosphate intake. Dietary recommendations depend upon age, stage of CKD, and type of treatment. Restrictions for intake of nutrients may involve protein, potassium, phosphate and sodium, and thus drinks and food items with a high content of any of these nutrients. Dietary guidelines and recommendations for patients in dialysis will not be discussed in the present thesis.

Protein

Adequate intake of protein is essential for growth, and recommended intake of protein among children aged 2-17 years is 0.9 g/kg bodyweight (29). Renal protection by protein restriction among children is debated. A Cochrane review concluded that protein restriction for children with chronic kidney disease does not have significant impact in delaying the progression of renal failure (27). However, at severe CKD

(GFR<10-20) protein restrictions may be beneficial to reduce the blood urea. According to the National Kidney Foundation, Kidney Disease Outcomes Quality Initiative (NFK KDOQI) protein intake should be 0.95-1.35 g/kg/d for children 4-13 years-old, 0.85-1.20 g/kg/d for children 14-18 years old for ideal body weight in children with CKD stage 3, and 0.95-1.15 g/kg/d for children 4-13 years-old, 0.85-1.05 g/kg/d for children 14-18 years-old for children with CKD stage 4 to 5 (30).

Vitamin D, calcium and phosphate

Low levels of $1,25(OH)_2D_3$ must be treated with supplementations, usually alphacalcidiol or calcitriol (Etalpha or Rocaltrol). The dose is based on serum calcium and PTH levels. Deficiency of $25(OH)D_3$ can be treated with regular vitamin D supplements. Hyperphosphatemia must be corrected prior to treatment with active vitamin D. The reason for this is that phosphate stimulates release of PTH. Treatment with active vitamin D without treatment of hyperphosphatemia will improve vitamin D status, but the level of PTH will still be too high. Dietary phosphate restriction should start at CKD stage 2. Different guidelines for phosphate intake exist. Guidelines based on body weight are <800 mg /day for children 20-40 kg and <1000mg for children >40 kg (31). According to the NKF KDOQI guidelines phosphorous intake should be 1.250 mg/d for children aged 9-18 years-old, with high PTH and normal serum-phosphorous. If serum phosphorous levels increase, intake should be restricted to 1.000 mg/d (32). The aim is to keep serum phosphate within normal reference values for age. Because restrictions in phosphate intake results in reduced intake of protein-rich foods, an adequate energy intake must be ensured to promote anabolism. If plasma phosphate levels remain above the reference values for age, phosphate binders can be prescribed.

Sodium and potassium

If hypertension is caused by retention of fluid and sodium, sodium restrictions will be necessary. Elevated potassium is seldom seen among paediatric CKD patients. If detected, dietary potassium restrictions will be necessary.

Renal replacement therapy

Both clinical observation and biochemical analyses of plasma and urine are used to provide a reliable assessment of renal function. Findings indicating renal replacement therapy include elevated urea, creatinine, and PTH, uremic symptoms, hypertension, severe metabolic acidosis, pulmonary lung oedema, and severely reduced GFR. When GFR is <10-15, the patient needs renal replacement therapy. Renal replacement therapy includes dialysis and transplantation.

Dialysis has a huge impact on quality of life and it is tiring for children. Studies have also shown that children grow poorly when treated with dialysis (13, 33). Renal transplantation is the first choice of treatment for ESRD among Norwegian children.

1.3 Transplantation

Renal transplantation is a major procedure, and the patients are hospitalized for approximately ten weeks. During these weeks the patients must be thoroughly monitored, especially with respect to postoperative complications, graft function/rejection, and infections.

Due to a relatively large reserve renal capacity, living with one kidney is not a challenge. The transplanted kidney is usually placed in the groin, and in most cases existing kidneys are not removed. Figure 1 shows placement of the transplanted kidney.

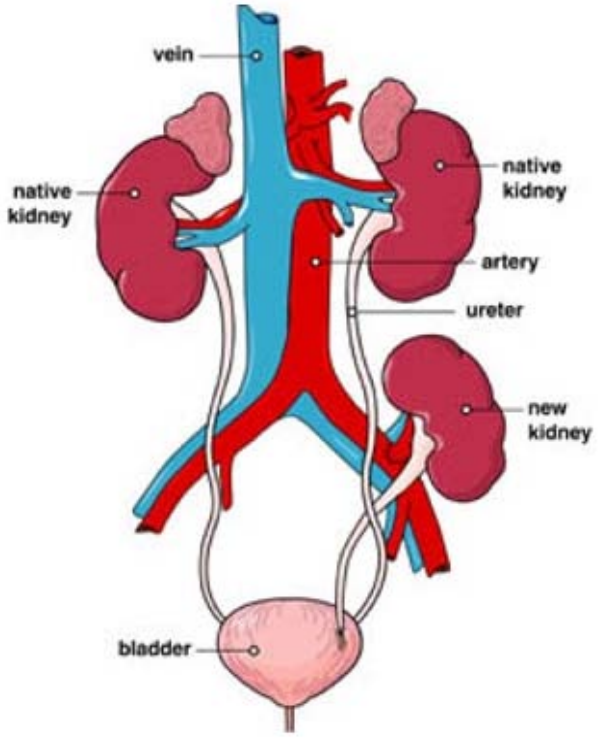

Figure 1: Placement of transplanted kidney.

Renal transplantation can be performed using living donor or deceased donor. Most transplantations among children in Norway are performed using living donor, usually

a relative. This gives physicians a chance to plan the time for transplantation, and dialysis can be avoided. Living donor transplantation performed without previous dialysis (pre-emptive) seems to improve graft survival when compared to transplantation performed after the initiation of dialysis (34). Using living donor grafts is convenient also because renal function seems to be normalized much faster when compared to cadaveric grafts (35).

In Norway the formal guidelines for monitoring, management, and treatment of RTRs is The Protocol for Renal and Pancreatic Transplantation (Tx-protocol) (36). This protocol has been revised, and this work was finished April 2010. In 2009 Kidney disease: Improving Global Outcomes (KDIGO) published evidence-based clinical practice guidelines on the monitoring, managements, and treatment of RTRs (37). The Norwegian Society of Nephrology recommend on their web-site these KDIGO guidelines as an useful addition to the Norwegian Protocol for Renal and Pancreatic Transplantation (38).

The procedures for follow-up is once per month the first year after transplantation (post-tx), once per two month two years post-tx, and once per 3-4 months >3 years post-tx. These follow-up consultations are performed by a nephrologist at the local hospital. Once a year the RTRs get follow-up consultation at Rikshospitalet, where they are examined for infections, malignancy, osteoporosis, and CVD (36).

1.3.1 Prevalence

The number of patients entering renal replacement therapy has been constantly increasing since 1980 (when registration started). By the end of 2008 a total of 3888 patients were receiving renal replacement therapy in Norway, and 70% of these patients are renal transplant recipients (RTR). One % of the patients (i.e. 39 patients) are <15 years old, and 35 of these patients are RTRs. 2.3% (i.e. 88 patients) are 15-24 years old, and 76 of these patients are RTRs (21). Tangeraas et al reports that during the years 1970-2006, 251 renal transplantations were performed in 178 children in Norway. Fifty-eight patients received a second kidney, twelve patients received a

third, and three patients received a forth kidney. The proportion of living donors was 84% (7). The primary diseases leading to ESRD and transplantation among Norwegian paediatric patients are listed in table 3.

Table 3: Primary renal disease in transplanted children 1970-2006. Adapted from Tangeraas et al. (7).

	Tx[1]
Total	178
Structural abnormalities	37.1
Hereditary diseases	32.5
Glomerulopathies and aquired diseases	28.7
Unknown	1.7

[1]Percentage distribution in cause for transplantation

1.3.2 Cardiovascular disease post transplantation

Life pre- and post renal transplantation can be very different. The discomfort from the time of renal failure disappears, and restrictions concerning food are absent. The patients and the parents report an increase in quality of life. Renal transplantation is however associated with several complications, both post-operative, short-time and long-time complications can appear. Post-operative complications are mainly different types of infections. Some of the short-term complications are acute rejection of the transplanted graft, viral infections, metabolic disorders (glucose intolerance and dyslipidemia), and hypertension. Among the long-time complications are CVD, bone-disease and malignant diseases, with CVD as the most prevalent (1, 5, 7, 39).

Cardiovascular disease is the major cause of death both among CKD patients and renal transplant recipients, with an incidence much higher than among the general population (11, 40). CVD is also the number one cause of death globally, and an estimated 17.1 million people die of CVD each year (41). A lot of research has been

done to help us understand the risk factors for CVD and to improve our knowledge on prevention of CVD. According to the Framingham and the INTERHEART study risk factors for cardiovascular disease are dyslipidemia, smoking, overweight and obesity, hypertension, diabetes, unhealthy diet with low intake of fruits and vegetables, and physical inactivity (42, 43). According to the World Health Organization (WHO) the most important behavioural risk factors of CVD are unhealthy diet, physical inactivity and tobacco use, which results in raised blood pressure, raised blood glucose, raised blood lipids, and overweight and obesity (41). Prevalence of both hypertension, glucoseintoleranse, dyslipidemia, and overweight are shown to be high among paediatric RTRs, and cardiovascular risk factors in childhood are shown to be predictive of cardiovascular risk in adulthood (44).

Metabolic syndrome is defined as a cluster of risk factors for cardiovascular disease and type 2 diabetes mellitus. The awareness on the presence of metabolic syndrome in RTRs has been increasing, and high prevalence of metabolic syndrome has been reported both among adult (45, 46), and paediatric RTRs (47-49). Nafar et al. found among 160 adult RTRs that the Mediterranean diet (dietary pattern characterized by high consumption of fruit, vegetables, poultry, olives, fish, low-fat dairy, legumes, and nuts) is associated with reduced risk of metabolic syndrome (50). Dietary intakes were assessed with food-frequency questionnaires. High intake of dietary fibre has also been associated with reduced risk of metabolic syndrome among 160 adult RTRs in a cohort study (51). Similar studies among children have not been found.

The increased risk of CVD among paediatric RTRs can in large part be explained by pre-existing CKD, the use of immunosuppressive medications, and perhaps still presence of CKD after successful renal transplantation.

Any organ transplantation means taking immunosuppressive medications to avoid rejection of the transplanted organ. Most transplant recipients are treated with corticosteroids as a usual component of clinical immunosuppressive regimens. Although steroids have contributed greatly to the success that has been achieved in organ transplantation, chronic steroid usage comes with a very high price. Steroids

have several well-known side effects, including increased appetite, weight gain, endothelial dysfunction, hypertension, glucose intolerance, hyperlipidemia, secondary osteoporosis, loss of muscle mass, and growth retardation among children (52, 53). Calcineurin inhibitors (cyclosporine, tacrolimus) have improved the outcome concerning graft rejection, but induce many of the same adverse effects as corticosteroids. Cyclosporine induces the same adverse effects as corticosteroids concerning CVD risk factors, in addition of being nephrotoxic. Tacrolimus and another immunosuppressiva, mycophenolate mofetil has a more favourable cardiovascular risk profile. Tacrolimus has however a strong diabetogenic effect (53). Sirolimus has hyperlipidemic effects, accelerating both hypercholesterolemia, and hypertriglyceridemia (54). Nutritional side effects of immunosuppressive medications are listed in table 4.

Table 4: Nutritional side effects of immunosuppressive medications. Adapted from McPortland et al. (55).

Immunosuppressive drug	Nutrition side effects
Azathioprine	Nausea, vomiting, sore throut, altered taste acuity
Corticosteroids	Hyperglycemia, hypertension, sodium retention, electrolyte disturbance, impaired wound healing, calciuria
Calcineurin inhibitors (cyclosporine and tacrolimus)	Hyperlipidemia, hyperglycemia, hypomagnesemia, hyperkalemia, hypertension
Sirolimus	Hyperlipidemia, gastrointestinal symptoms

Hypertension

Hypertension (defined as systolic blood pressure greater than 95th percentile for age and height or on any anti-hypertensive medications) is common in children after renal transplantation (14, 56). Post-transplant hypertension arises from multiple factors including pre-transplant hypertension, side-effects of immunosuppressive medications, renal artery stenosis, overweight, and excessive dietary salt intake (57, 58). In addition of being a CVD risk factor, high blood pressure in the kidney will

destroy nephrons and result in proteinuria and reduced renal function. Kidney Disease: Improving Global Outcomes (KDIGO) clinical practice guidelines suggest maintaining blood pressure at <90th percentile for sex, age, and height if <18 years old (37). The aim at Rikshospitalet is to keep blood pressure as close to the 50th percentile as possible among all paediatric RTRs. According to the Norwegian Renal Associations Annual Report 2008 a majority of RTR patients use antihypertensive medication; only 18 % of patients with functioning graft do not (21).

Lifestyle changes can significantly lower blood pressure in the general population (59), and such an approach may benefit transplant recipients. The Dietary Approaches to Stop Hypertension (DASH) trial demonstrated that a diet that emphasizes fruits, vegetables, and low-fat dairy products, that contains decreased amounts of total and saturated fat and cholesterol, includes whole grains, poultry, fish, and nuts, and contains only small amounts of red meat, sweets, and sugar-containing beverages, lowers blood pressure substantially, both among hypertensive and non-hypertensive subjects (60). Reducing the intake of sodium has also been shown to reduce blood pressure, and is even more beneficial in combination with the DASH diet (61).

Dyslipidemia

Dyslipidemia is another common complication among RTRs (37). Most of the research regarding dyslipidemia among RTRs has so far focused on adults. However, dyslipidemia has also been reported among peadiatric RTR (62-67). Sgambat et al. reported that among 38 paediatric RTRs aged 12±5 years old, elevated serum-cholesterol (defined as >5.18mmol/L) was found in 26.3%, and elevated serum-TG (defined as >2.27mmol/L) was found in 10.5%, 23.6% had high LDL levels (defined as >3.36 mmol/L), and 28.9% had low levels of HDL (defined as <1.03 mmol/L) (64). Feber et al. examined complications of CKD among 23 paediatric RTRs aged 11.9±5.2 years-old, and detected hypercholesterolemia (defined as fasting serum-cholesterol >4.4mmol/L or the use of cholesterol lowering medications) in 44% (68).

Post-transplant dyslipidemia can be caused by pre-transplant dyslipidemia, renal dysfunction, immunosuppressive medications, obesity, familiar dyslipidemia, physical inactivity, unhealthy diet and more (69, 70). The risk of dyslipidemia may differ based on the type and dose of immunosuppression used, and lower prevalence are reported with more recent protocols (30).

KDIGO recommend keeping serum-TG ≤5.65 mmol/L and LDL-cholesterol ≤3.36 mmol/L among paediatric RTRs, and therapeutic lifestyle changes as the first choice of treatment. Abnormal plasma lipids may also be improved by treating proteinuria and poorly controlled diabetes (if present), and by modifications of immunosuppressive medications (37). These recommendations are based upon the NKF KDOQI Dyslipidemias in Chronic Kidney Disease (71).

Lifestyle changes (weight reduction, physical activity, replacing saturated fat with polyunsaturated fat (PUFA), dietary cholesterol restrictions, intake of dietary and n-3 PUFA) have the potential to improve lipid profile among the general population (72), and should be the first choice of treatment for paediatric dyplipidemia.

Impaired glucose tolerance and post transplant diabetes

Impaired glucose intolerance and new onset diabetes mellitus after renal transplantation (NODAT) is common among adult RTRs (45, 73, 74), and also found to be common in paediatric RTRs (75, 76). Burroughs et al estimated incidence of NODAT among 2168 paediatric RTRs aged 0-21 years old, without diabetes mellitus before transplantation. They found that at three years post-transplantation, 7.1 % of the participants had been diagnosed with NODAT (75). This is lower compared to what is reported among adult RTRs, but still higher than in the general population (77).

Studies have shown that lifestyle changes have the ability to prevent or postpone diabetes mellitus among subjects with impaired glucose tolerance, and that this effect persists years after intervention (78-80). Physical activity (≥30min per day), weight reduction if necessary, and dietary guidelines as for the general population is

recommended both for treatment and prevention of diabetes mellitus (77). Especially wholegrain products and dietary fibre seem to have the potential to reduce the risk of diabetes (81). Although impaired glucose intolerance and diabetes among RTRs is mainly caused by side-effects of immunosuppressive medications(82), lifestyle modification has been shown to improve postprandial glucose in both glucose intolerant- and glucose tolerant RTRs (83). Lifestyle modifications in this study included a diet containing less fat and more fibre, exercise programs and weight reduction if necessary.

Weight gain

Weight gain after renal transplantation is observed frequently (48, 84-86). The first three months following RTx seems to be a critical period concerning weight gain (84, 86). One explanation for this is that the steroid dosage is usually higher during these months compared with later periods (86, 87). Another plausible explanation for weight gain is increased quality of life, and absence of nutritional restrictions and symptoms from the time of CKD. Steinberger et al reported a significant correlation between BMI at age 13 and BMI at age 22 in 31 healthy children (88). The association between childhood obesity and obesity in adulthood was also shown in the Bogalusa Heart Study (89). Overweight is a risk factor for both graft dysfunction (85, 90), hypertension, type 2 diabetes and cardiovascular disease (91).

1.3.3 Additional CVD risk factors in RTRs

Chronic kidney disease

The inclusion of RTRs in the K/DOQI classification of CKD has been confirmed in a position statement from KDIGO (19). One of the benefits of including RTRs in this classification is increased attention towards CKD management in this patient population. Feber et al. (68), White et al. (92), and Sinha et al. (14) have all studied the prevalence of CKD, and its complications among paediatric RTRs. Feber et al. reports CKD stage 3 in 43% of 23 paediatric RTRs aged 11±5.2 years old, White et al. reports 62% CKD stage 3-5 in 45 children aged 1-20 years old, and Sinha et al.

reports 66 % CKD stage 3 or 4 in 129 children aged 2.7-20 years old. This is consistent with findings among adult RTRs (93-95). Ansell et al. reports high prevalence of CKD among 9542 British adult RTRs; nearly 76% of patients had GFR <60 (mL/min/1.73m^2), of which 57.5% were classified as CKD stage 3 (93). In these studies, the prevalence of hypertension, anemia, hyperlipidemia, and metabolic bone disease remains high despite successful transplantation. The studies suggest that complications of CKD are being underdiagnosed and undertreated in transplant patients. Advanced CKD is associated with hypertension, anaemia, and dyslipidemia, which are all cardiovascular risk factors (96-98).

Renal anemia develops among CKD patients due to a reduction in the renal production of erythropoietin, and anemia is reported to be prevalent among RTRs (14, 68, 97, 99-101). Kausman et al reported that among 50 paediatric RTRs aged 13.5±5.2 years old, 60 % were anemic (defined as hemoglobin (Hb) <11 g/dL for subjects age 2–6 years, Hb <11.5 g/dL for subjects age >6–12 years, Hb <12 g/dL for subjects aged >12 years, or treatment with erythropoiesis-stimulating agents) (100). This is consistent to other reports (14, 68). Reduced renal function and iron deficiency are reported to be the most frequent cause of anemia after renal transplantation (97, 99, 101). Post-transplant anemia most likely has a negative impact on the quality of life and cardiovascular risk, and possibly on mortality of kidney transplanted patients (97, 102).

1.3.4 Dietary advice for preventing CVD

National guidelines for individual prevention of CVD was published by The Norwegian Directory of Health in 2009 (103). According to these guidelines dietary counselling for prevention or treatment of CVD should be based upon dietary guidelines for the general population. These dietary guidelines are based upon the Norwegian Recommendations for Nutrition and Physical Activity (104). The dietary guidelines tell us to eat at least three portions of vegetables and two portions of fruit per day, to choose boiled and baked potatoes instead of chips and fries, to choose

wholegrain products and eat more fish and fish products, to choose lean meat- and dairy-products, replace hard margarine and butter with soft vegetable margarine and oil, and to limit the intake of added sugar (especially from candies and soft drinks with sugar) and salt. The Norwegian recommendations for energy and nutrient intake are based upon the Nordic Nutrition Recommendation 2004, and are consistent with recommendations given by the WHO 2003. The recommendations are listed in table 7, section 4.1 Energy and nutrient intake.

National Council of Nutrition has evaluated the national dietary guidelines. The report is being circulated for comments these days, and a final report is expected to be published during autumn 2010 (105). One of the aims of this work was to make the dietary guidelines more concrete, with recommended amounts of different foods. These guidelines include recommendations to eat more vegetables, fruit and berries (five portions per day; 500g), wholegrain products (four portions of wholegrain products/day; 75g/10MJ), and fish (2-3 portions/week; 300-450 g/week, including >200 g oily fish), and to restrict the amount of red meat (choose lean meat and restrict intake of red meat to <500 g/week), sodium (NaCl <6 g/day), added sugar (< 10E%), and energy dense foods. Low fat dairy product, soft vegetable margarine and oil, and drinking water should be emphasised. Energy expenditure and energy intake should be balanced, and at least 30 minutes of moderate physical activity/day is recommended. As part of this work there has been a systematic evaluation of risk factors for CVD; including foods, dietary composition, supplements and physical activity. Some of the convincing associations include increased intake of fruit, berries, vegetables, wholegrain products (≥25g/day) and fish (twice per week), reduced intake of sodium (<6g/day) and trans fatty acids (<1 E%), replacing saturated fat with polyunsaturated fat, and regular physical activity (≥ 30 min moderate intensity/day) to reduce the risk of CVD. This evaluation was based upon reports from World Health Organization, Food and Agriculture Organization of the United States, American Dietetic Association, American Heart Association and more.

1.3.5 Dietary advice for renal transplant recipients

The Norwegian tx-protocol contains only a short chapter regarding post-operative nutrition. No further recommendations concerning diet for RTRs is given here (36). Dietetic counselling after renal transplantation is not a regular part of the treatment after transplantation. Whether patients meets with a dietician depend on whether the patients ask for it, whether their physician is considering the patients as having special need for dietetic counselling, and whether the dieticians has the capacity to meet with the patient. All Norwegian renal transplant patients receive written information regarding medications, physical activity, diet and more (106). The information is originally written for adult patients; no written information specific for children exists. The information regarding diet contains several practical advices for how to secure a healthy diet. Immunosuppressive medications may increase appetite, and some advice to reduce the appetite is given (water, wholegrain products, regular meals). The other advices given are to choose unsaturated fat instead of saturated fat, eat sufficient amount of fruit and vegetables, choose wholegrain products, limit the intake of added sugar, replace sodium with other spices and herbs, and secure sufficient intake of calcium and vitamin D (106).

The KDIGO clinical practice guideline for the care of kidney transplant recipients recommend that patients are strongly encouraged to follow a healthy lifestyle, with exercise, proper diet, and weight reduction if needed. In the rationale for these recommendations KDIGO claim that there is no reason not to believe that a proper diet can help prevent CVD and other complications in RTRs as in the general population (37).

The 2008 update of NFK KDOQI Clinical Practice Guideline for Nutrition in Children with CKD (30) is intended for infants, children and adolescents with CKD stage 2-5, on long-term dialysis or with a kidney transplant. The rationale for recommending CKD-based dietary guidelines to paediatric RTRs is the prevalence of CKD among RTRs. According to these guidelines management of children with a kidney transplant includes taking care of the complications of CKD, in addition to

care of the graft, and thus children continue to require dietary modifications after transplantation; "*Long-term interventions are needed to prevent or aid management of excessive weight gain/obesity, dyslipidemia and steroid-induced osteoporosis. Children with CKD stage 2 to 5 after transplantation require dietary management of protein and phosphorous in the same way as children with similar GFRs before transplantation"*. Among the recommendations in these guidelines are balancing the percentage of energy from protein, fat, and carbohydrates, and dietary modification for transplanted children with CKD and hypertension, or abnormal serum mineral or electrolyte concentrations (dietary sodium restriction as hypertension management. Hyperkalemia, hypophosphatemia and hypomagnesemia often occurs in the early stages of transplantation and must be managed with dietary modifications and supplements). Other recommendations are ensuring calcium and vitamin D intakes of at least 100% of the DRI, promote water and drinks low in sugar, and attention to food hygiene and safety. Assessment of diet and physical activity are suggested to ensure best outcomes for paediatric RTRs (32).

2. Objectives

This master thesis functions as an addition to the HENT-study (Helse Etter Nyre Transplantasjon). The results from this master thesis, and from the HENT-study, will make a contribution to the evaluation of the treatment of paediatric RTR's. Hopefully these studies will also make a contribution to the improvement of the treatment and follow-up.

The aim of this master thesis is to evaluate the need for dietary treatment among Norwegian paediatric RTRs. A dietary assessment among paediatric RTRs aged 9-15 years old will be performed, to evaluate whether the registered diet is in accordance with the Nordic Nutrition Recommendations 2004 and national dietary guidelines, in relation to prevention of cardiovascular disease. Chronic renal failure with dietary restrictions prior to transplantation may influence the dietary composition in RTRs, and the registered diet will therefore be compared to the diet of non-transplanted healthy children and adolescents. Evidence based guidelines regarding nutritional management of RTRs have been made by the National Kidney Foundation, Kidney Disease Outcomes Quality Initiative (NFK KDOQI guidelines). This master thesis will evaluate whether the registered diet is in accordance to these guidelines. The rationale for recommending CKD-based dietary guidelines to paediatric RTRs is the reported prevalence of CKD among RTRs. An estimate of the prevalence of different stages of CKD among the participants in the HENT-study will therefore be made. Information regarding consultations with dieticians before and after the transplantation will be collected.

2.1 Research questions

Diet composition:

1. Do paediatric RTRs have an optimal dietary composition for prevention of cardiovascular disease?
2. Is the intake of nutrients among paediatric RTRs consistent with Nordic Nutrient Recommendations 2004?
3. Is intake of nutrients and dietary composition different among paediatric RTRs compared to healthy children and adolescents?
4. Is the intake of protein and phosphorous among paediatric RTRs in accordance with the NKF KDOQI guidelines?

CKD

5. How is the renal function measured as GFR among paediatric RTRs participating in the HENT study?

Dietetic counselling

6. To which extent is the dietician involved in dietary counselling pre-transplant and post-transplant? Is there a need for dietetic counselling among patients and caregivers post-transplant?

3. Subjects and methods

3.1 Subjects

The paediatric RTR's were recruited from the participants in an ongoing study at Rikshospitalet, concerning health after renal transplantation (HENT-studien), and from the Department of Paediatrics, Rikshospitalet. Children and adolescents age 9-15 years old, at minimum six months post-transplantation, were included. Twenty-one patients were invited, and a total of 20 agreed to participate. Fourteen of these patients were recruited from the HENT-study.

The RTRs were compared with healthy control subjects from the Ungkost-2000-study (107). Data collection among control subjects were carried out from September until the beginning of December 2000. Students from 8th grade (12-13 years old) were invited to participate in this study. This included 105 schools in 53 municipalities. The selection of schools was made by Statistics Norway. A total of 1005 subjects completed the study.

Characteristics of all the 38 paediatric participants aged 2-19 years-old in the HENT-study are collected to give a description of common complications among Norwegian paediatric RTRs. These data were collected as part of the HENT-study during the period May 2008 to May 2009.

3.2 Study design

Data collection concerning dietary intake and dietary counselling among the renal transplant recipients was carried out during January and February 2010. They all received a call from their physician in November-December 2009, with brief information about the project, and an oral invitation to participate. All patients were also informed that they could withdraw from the project at any time, and that this

would not in any way affect their follow-up at Rikshospitalet, Oslo. Early January 2010 they received an information letter by post, together with an informed consent form, a short questionnaire and the materials needed to record their diet (appendix I, II, IV-XIII). The information letter, informed consent form, and the short questionnaire were made by the master student (appendix I, II, IV). When the participants had finished the registration they were asked to send the signed informed consent form together with all the completed forms in a prepaid envelope to the Department of Paediatrics, Rikshospitalet.

Diet composition

The participants recorded their entire intake of food and beverages for four consecutive days, one food diary per day. They also received an instruction folder with detailed information on how to fill in the food diary, showing an example (appendix V). Distributed by a draw, half of the participants recorded their diet from Wednesday to Saturday, the other half from Sunday to Wednesday.

The master student phoned the participants and agreed on when they should start to register their diet. A text message was sent the evening before to remind the participants to start the registration period. The participants also received a call from the master student the second day of the registration period to hear if they had any questions and to encourage them to finish the registration. The participants also had the opportunity to call the master student if they had questions concerning the registration.

Based on their food diaries and their latest blood samples, the paediatric RTR’s were given individual feedback concerning their diet. This feedback was given by the master student and a clinical dietician at Rikshospitalet.

Data collection among the control subjects was carried out from September to December 2000. The control subjects received an invitation letter with a consent form and a questionnaire at school. A nutritionist visited each class and instructed the students on how to record their diet. The control subjects recorded their entire food

intake for four consecutive days (three weekdays and one weekend day) using the same type of pre-coded food diary as the paediatric RTR's were using. On the second day a nutritionist called the parents/students to correct any misunderstandings and encouraged them to complete the registration. The participants mainly recorded their diet themselves (107). Approximately half of the control subjects recorded their diet from Wednesday to Saturday, the other half from Sunday to Wednesday (Elin Bjørge Løken, personal communication).

CKD

Values regarding GFR for evaluating the prevalence of different stages of CKD in the Norwegian paediatric RTRs were collected as part of the HENT-study during the period May 2008 to May 2009.

Dietetic counselling

The parents were asked to answer a short questionnaire (appendix IV) regarding dietetic counselling. This should preferably be done in cooperation with the child/adolescent.

Ethics

The study protocols were approved by the National Committee for Research Ethics in Norway (appendix III). Informed consent was obtained from the parents (appendix II).

3.3 Methods

3.3.1 Food diary

The food diary comprised 277 drinks, food items and dishes grouped into sections according to a typical Norwegian diet: drinks, bread, spread on bread, yoghurt, breakfast cereals, milk for breakfast cereals, meat dishes, fish dishes, other dishes, mixed salads, potatoes/rice/pasta, vegetables, sauces, dessert, cakes, fruit and berries,

snacks, sweets and chocolate, supplements (appendix VI). The most common drinks, food items and dishes were listed in the food diary. Each food group was also supplemented with open-end alternatives. Food amounts in the food diary were presented in predefined household units (i.e. glasses, spoons) or as portions. All participants received a booklet (appendix VIII) containing photographs of different sizes of drinking glasses and different thickness of slices of bread in addition to 12 photograph series, each showing four different portions for food items/dishes. This booklet was used by the participants to estimate portions. The participants recorded an eating event by filling in the number of units or portion size of drinks, food items or dishes in predefined time intervals in the food diary. The day was divided into five time spans, from 06.00 to 10.00, from 10.00 to 14.00 etc. The participants were instructed to record their food intake immediately after an eating event preferably in the food diary, or on a notepaper and then fill in the diary in the evening. The participants were also urged not to change their food intake these four days, but to eat as they usually did. The participants did not record their intake of supplements in the pre-coded food diary, but were asked to record this in a separate form (appendix VII). This was done because we suspected that several participants were using many different supplements.

3.3.2 Calculations of dietary intake

The food diaries were collected and scanned using the Teleform program version 6,0 (Cardiff TLEFORM, Cambridge, UK). Intake of drinks, food items and dishes, energy and nutrients was calculated using the food database AE-10 in the KBS software version 6 – developed at the Department of Nutrition, University of Oslo (108). Drinks, food items and dishes registered in the open-end alternatives were “coded and included” in the food database before the dietary calculation was performed. Supplements registered in the separate form were also included in the food database before the calculations were done. Intake of drinks, food items and dishes, energy and nutrients concerning the control subjects were calculated using the food database IE-96, KBS version 6. Energy-intake and percentage contribution of

macronutrients were recalculated after including energy derived from dietary fibre (8kJ/g). The KBS food databases are mainly based on the Norwegian food composition table (109, 110), supplemented with values borrowed from other databases and calculated recipes.

Estimation of underreporting of energy intake can be done based on basal metabolic rate (BMR), reported energy intake and pre-defined cut-off values. BMR is defined as *the energy expenditure of an individual lying at physical and mental rest in a thermoneutral environment, about 12 hours after the previous meal* (29). Individual measurements of BMR are challenging, and thus estimated BMR is usually used. Estimated BMR was calculated in KBS, using equations based on weight, age, and sex. BMR factor (energy intake/estimated BMR) were calculated, and Goldberg's cut-off values were used to evaluate whether reported energy intake was plausible. A BMR factor < 1.06 indicate underreporting of energy intake in a four-day diary (111).

3.3.3 Short questionnaire

The short questionnaire (appendix IV) included questions about whether or not the participants had consultations with a clinical dietician before or around the time of or after the transplantation; and if so how often. Four response options were given; once a year or less often, 1-2 consultations, 3-4 consultations per year, more often. The questionnaire also included a question for those who had consultation with a clinical dietician whether this had been useful or not. The participants who had not had any consultations with a clinical dietician, were asked whether they *"do/did need or have/had the wish"* to meet with a dietician, and if so how often. Four response options were given (described earlier). All participants were also asked how often they would like to have consultations with a clinical dietician before and after transplantation. Response options were given; these were the same response options as described earlier in addition to a fifth option "never, did/do not need".

3.3.4 Weight, height and BMI

Data regarding weight, height and BMI was collected from the last yearly follow-up at Rikshospitalet, Oslo, i.e. March 2009 to January 2010.

3.3.5 Biokjemiske parametere

Values regarding serum- GFR, PTH, phosphate, calcium, total cholesterol, LDL-cholesterol, HDL-cholesterol and triglycerides are collected from the latest yearly follow-up at Rikshospitalet, Oslo, i.e. March 2009 to January 2010.

3.3.6 Statistics

The analyses were performed using The Statistical Package of Social Sciences (SPSS, Inc., Chicago, IL, USA) version 16.0 and Microsoft Excel version 2003. The level of statistical significance was set at 5%.

Each variable was tested for normality, and several of the variables were markedly skewed. Independent sample t-test for means was used to examine differences in intake of energy, fat and carbohydrates between the RTRs and control group. Mann-Whitney *U* test was used when examining intake of protein, fibre, vitamin A, vitamin D, vitamin E, vitamin C, thiamine, riboflavin, calcium, iron and magnesium between RTRs and control group. Mann-Whitney *U* test was also used when examining consumption of selected food items.

One of the findings in the Ungkost2000 survey (control group) was a high intake of added sugar. Due to this, most analysis was done using a selected control group. In the selected control group subjects in upper quartile of intake of added sugar (g) was excluded.

4. Results

Sixteen participants completed the study. Twelve of these were also participating in the HENT-study. One participant withdrew because of disease, one participant withdrew because of difficulties recording Pakistani food, and two participants withdrew without giving a particular reason. Eight participants registered their diet from Wednesday to Saturday, and eight participants registered diet from Sunday to Wednesday. One participant registered two Mondays, and missed one Wednesday. Characteristics are given in table 6.

Among the control subjects two participants had a very high energy intake. Most likely this can be explained by inappropriate recording. Both cases had recorded huge amounts of energy-dense food, and were therefore excluded. Another participant was excluded due to a high intake of supplements. Most likely this high amount of supplements is caused by a mistake during recording of food intake or during processing of data. Characteristics of the control subjects are listed in table 5. Characteristics for selected control subjects where subject in upper quartile in intake of added sugar are excluded are also shown.

Table 5: Characteristics of the control subjects

	All control subjects		Selected control subjects	
	Boys	Girls	Boys	Girls
	n=473	n=513	n=334	n=405
Age (years)	12.9 (0.8)	12.9 (0.9)	12.9 (0.9)	12.9 (0.7)
Height (cm)	160.6 (9.3)	160.9 (6.6)	159.7 (9.0)	161.0 (6.7)
Weight (kg)	49.3 (10.5)	49.4 (8.5)	48.7 (10.0)	49.6 (8.8)
BMI (kg/m^2)	19.0 (2.9)	19.1 (2.7)	19.0 (2.7)	19.2 (2.9)

Table 6: Characteristics of the renal transplant subjects.

	Present thesis	HENT-study	Range of reference[1]
	n=16	n=38	
Boys	10	24	
Girls	6	14	
Age	12.6 (1.9)	13 ± 4	
Boys	12.1 (1.9)		
Girls	13.3 (1.6)		
Height (cm)			
Boys	144.1 (13.6)		
Girls	144.8 (10.3)		
Weight (kg)			
Boys	45.0 (6.7)		
Girls	40.8 (8.8)		
BMI (kg/m^2)	20.6 (5.7)	20.9 ± 5.3	
Boys	21.3 (6.7)		19.2-26.6[2]
Girls	19.4 (3.3)		19.5-25.6[2]
Years from tx1		6 ± 4	
GFR (ml/min/1.73m^2)	63 ± 22	56 ± 18	
CKD stage 3[3], %	37.5	57.9	
25(OH)D (nmol/l)		62 ± 27	37-131
Vit D medication, %		23.7	
PTH (pmol/L)	8.6±3.1	7.4 ± 4.3	1.0-8.5
Calsium (ionized), mmol/L		1.30 ± 0.14	1.15-1.35
Phosphate (mmol/L)	1.4±0.2	1.44 ± 0.23	0.80-1.90
Total cholesterol (mmol/L)	4.5 ± 0.8	4.5 ± 1.1	3.0-6.0
LDL-cholesterol (mmol/L)	2.4 ± 0.6	2.4 ± 0.7	1.2-4.3
HDL-cholesterol (mmol/L)	1.5 ± 0.7	1.5 ± 0.6	1.0-2.7♀ , 0.8-2.1♂
Triglycerides (mmol/L)	1.3 ± 0.5	1.1 ± 0.5	0.45-2.60
Hypertension[4], %		57.9	
Insulin resistance[5], %		48.4	
Anemia[6], %		40.5	

[1]Reference values (112) (♂-male, ♀-female).

[2]10th - 90th percentile, from the Growth Study in Bergen (113, 114).

[3]GFR 30-60 ml/min/1.73m^2

[4]Defined as systolic blood pressure >95th percentile or use of hypertensive medications.

[5]Estimated by HOMA>95th percentile for gender and age. Data missing for 7 subjects.

[6]Defined as hemoglobin less than age reference. Data missing for one subject.

4.1 Energy and nutrient intake

Daily intake of energy and nutrients among RTRs compared to Nordic Nutrition Recommendations (NNR), are presented in table 7. Data was separated by age and sex (included in the table when a statistically significant difference was detected). Eleven subjects used supplements (67%), and these supplements are included in the calculations. The median percentage of energy from protein and fat was in accordance with NNR for both age-groups. Some of the subjects had an intake of protein >20E%, and 50% had an intake of fat >35E%. None of the paediatric RTRs had an intake of saturated fat <10E%. Median value when including all 16 subjects was 14.5E%. Percentage of energy from monounsaturated fatty acids (MUFA) was in accordance with NNR for both age-groups. Intake of PUFA was low among the subjects aged 14-15 years-old; four subjects had an intake <5 E%. Intake of carbohydrates was low for both age-groups. Only five subjects had an intake of carbohydrates in accordance with NNR. The intake of dietary fibre was also low, and the intake of added sugar was high among the subjects aged 14-15 years-old. Both intake of α-tocopherol, thiamine, riboflavin, vitamin C and potassium was in accordance with the NNR for both age-groups. Intake of vitamin A was high for all subjects, except for girls aged 14-15 years-old who had an intake below the recommendations. Eight subjects had an intake of vitamin D above 7.5 µg/d, and five subjects had an intake >10 µg/d. Median intake of calcium was 890 mg/day (25^{th}, 75^{th} percentile 690,1149). Intake was higher among the subjects aged 9-13 years old, compared to the subjects aged 14-15 years old. The intake of iron was low, except among boys aged 14-15 years-old. When excluding two subjects with intake of iron >100mg/d, median value (including both age-groups) was 8.2 mg/d (25^{th}, 75^{th} percentile 7.0,9.2). Intake of phosphorous was high in both age-groups, only two subjects had in intake of phosphorus <1.0 g/d.

BMR factor (Energy intake/BMR estimated) was calculated to assess the frequency of underestimation of dietary intake among the participants in the present study. Thirteen % of the RTRs, and 27 % of the selected control subjects had a BMR factor < 1.06.

Table 7: Intake of energy and nutrients in RTRs in comparison with NNR

	9-13-year-olds		14-15-year-olds	
	RTR subjects 3 girls, 7 boys	NNR[1]	RTR subjects 3 girls, 3 boys	NNR[1]
Macronutrients				
Energy (MJ)	7.1 (6.5-8.3)[2]	-	8.8 (7.6-10.8)	-
Protein (E%)	18.2 (14.7-20.1)	10-20	14.5 (14.2-16.4)	10-20
Fat (E%)	33.9 (27.5-40.1)	25-35	33.9 (31.9-39.8)	25-35
Saturated fat (E%)	13.6 (12.5-18.1)	<10	14.8 (13.2-16.5)	<10
MUFA (E%)	11.3 (8.9-13.0)	10-15	11.5 (11.0-12.9)	10-15
PUFA (E%)	5.4 (3.6-5.8)	5-10	4.0 (3.9-5.4)	5-10
Carbohydrate (E%)	46.7 (36.6-54.1)	50-60	49.0 (43.4-52.5)	50-60
Added sugar (E%)	9.7 (4.1-15.7)	<10	15.2 (10.7-22.6)	<10
Fibre (g)	12.8 (12.0-18.8)	23-35	11.7 (10.7-17.7)	25-35
Micronutrients				
Vitamin A (µg)	1.047 (558-1.402)	600		
Girls			393 (310-1,126)	700
Boys			1,049 (567-1,511)	900
Vitamin D (µg)	7.8 (1.9-13.2)	7.5	7.2 (4.1-8.2)	7.5
α-tocopherol (µg)				
Girls	6.2 (5.6-12.9)	7	9.2 (3.6-10.1)	8
Boys	12.5 (6.5-25)	8	19.3 (5.9-22.2)	10
Thiamin				
Girls	1.3 (0.9-1.5)	1.0	1.0 (0.9-1.1)	1.1
Boys	1.1 (0.8-1.3)	1.2	2.9 (0.8-2.9)	1.4
Riboflavine				
Girls	1.4 (1.1-1.7)	1.2	1.3 (1.3-1.6)	1.3
Boys	1.7 (1.5-2)	1.4	3.1 (1.2-4.0)	1.7
Vitamin C (mg)	107 (40-143)	50	91 (35-114)	75
Calcium (mg)	942 (702-1225)	900	791 (684-951)	900
Iron (mg)	8.7 (7.8-24.8)	11/9	7.6 (6.2-23.7)	
Girls			7.0 (6.2-8.2)	15
Boys			23.7 (5.8-122.9)	11
Potassium				
Girls	2.1 (1.2-3.1)	2.9	2.3 (1.9-2.6)	3.1
Boys	2.7 (1.9-3.3)	3.3	3.3 (1.8-4.1)	3.5
Phosphorus	1.366 (1.947-3.136)	700	1.177 (1.093-1.527)	600
Magnesium (mg)	281 (205-336)	280		
Girls			225 (184-244)	280
Boys			525 (390-853)	350

[1]Nordic Nutrition Recommendations 2004 (29). The micronutrient recommendations vary for age and sex

[2]Median values, 25th and 75th percentile in parantheses (all such values)

Intake of energy among RTRs and control subjects are presented in table 8. There were no significant differences between RTRs and control subjects regarding intake of energy. RTRs had a significantly higher percentage of energy (E%) from protein, fat and fibre, and a lower percentage of energy from carbohydrate and added sugar compared to control subjects. When comparing RTRs and selected control subjects (subjects in upper quartile of intake of added sugar excluded), RTRs had a significantly higher percentage of energy from protein and fat, and a lower percentage of energy from carbohydrates. Further analysis is performed using the selected control subjects.

Table 8: Daily intake of energy in RTRs compared to all control subjects and selected control subjects.

	RTR subjects n=16			Control subjects n=1002				Selected controls[1] n=751			
	Mean	SD	Median	Mean	SD	Median	*P*[2]	Mean	SD	Median	*P*[2]
Energy (MJ)	7.8	2.1	7.7	8.8	3.0	8.3	0,17	7.9	2.4	7.6	0,80
Protein (E%)	17.0	3.1	15.8	14.3	3.1	14.1	<0,001	14.8	3,0	14.6	0,004
Fat (E%)	34.6	6.0	33.9	30.3	5.3	30.3	0,001	30.6	5.3	30.6	0,003
Carbohydrate (E%)	46.8	7.8	48.6	54.1	6.5	53.9	<0,001	53.1	6.3	52.9	<0,001
Fibre (E%)	1.6	0.6	1.4	1.4	0.5	1.3	0,048	1.4	0.5	1.4	0,18
Added sugar (E%)	13.6	8.1	12.0	18.3	7.2	17.9	0,009	16.1	6.0	16.1	0,10

[1]Subjects in upper quartile concerning intake of added sugar are excluded
[2]Students *t*-test between RTR subjects and both control groups (Mann-Whitney *U*-test for difference in protein (E%)).

Comparison of intake of energy and nutrient density between RTRs and selected control subjects are presented in table 9. When comparing the RTRs and control subjects, the analysis was performed using values where intake was measured as g/MJ. Recommended nutrient density to be used for planning diets for groups of individuals 6-60 years of age are presented in the table.

The RTRs had a significantly higher percentage of energy from protein compared to control subjects, and this difference was larger among male subjects compared to female subjects. The RTRs had a significantly higher intake of vitamin D, α-tocopherol, calcium and magnesium compared to control subjects. The difference between RTRs and control subjects concerning α-tocopherol and calcium was larger among female subjects compared to male subjects. The same analysis to compare intake of energy and nutrients was performed among subjects aged 9-13 years old. The analysis revealed the same pattern as when including all RTRs, except for percentage of energy from added sugar and intake of calcium (g/MJ). A Mann Whitney *U*-test revealed a significant difference in intake of added sugar (E%) of RTRs (median = 9.7, n = 10) and selected control subjects (median = 16.2, n = 740), $p = 0.030$, $r = 0.08$. No significant difference concerning intake of calcium (g/MJ) was found when including only RTRs aged 9-13 years.

Table 9: Comparison of energy intake and nutrient density between RTRs and selected control subjects (supplements included).

	RTR subjects n=16 (10 boys, 6 girls)			Selected controls[1] n=751 (334 boys, 405 girls)				
	Mean[2]	Median	Percentile[3]	Mean[2]	Median	Percentile[3]	*P*[4]	NNR[5]
Macronutrients								
Energy (MJ)	7.8 (2.1)	7.7	6.8-9.0	7.9 (2.4)	7.6	6.8-10.4	0.80	
Protein (E%)	17.0 (3.1)	15.8	14.2-19.4	14.8 (3.0)	14.6	12.1-16.2	0.012	15
Boys	17.5 (3.0)	17.9	14.7-20.6	15.3 (3.1)	15.4	13.1-17.0	0.036	
Girls	16.2 (3.5)	14.7	14.2-16.4	14.5 (2.9)	14.2	12.4-16-2	0.24	
Fat (E%)	34.6 (6.0)	33.9	31.5-40.0	30.6 (5.3)	30.6	26.8-33.7	0.003	30
Carbohydrate (E%)	46.1 (7.8)	48.6	41.9-52.9	53.1 (6.3)	52.9	49.9-58.4	<0.001	55
Added sugar (E%)	13.6 (8.1)	12.0	9.0-19.8	16.1 (6.0)	16.1	13.4-22.6	0.10	<10
Fibre (g/MJ)	2.2 (1.4)	1.7	1.3-2.5	1.8 (0.6)	1.7	1.4-2.0	0.48	3
Micronutrients								
Vitamin A, µg/MJ	146.3 (112.9)	115.5	78.0-163.2	117.0 (247.4)	84.1	56.6-128.0	0.08	80
Vitamin D, µg/MJ	1.0 (0.6)	0.9	0.5-1.2	0.5 (0.6)	0.3	0.2-0.6	<0.001	1.0
α-Tocopherol, µg/MJ	1.7 (0.9)	1.5	0.9-2.3	1.1 (0.7)	0.9	0.7-1.2	0.004	0.9
Boys	1.6 (1.0)	1.3	0.8-2.4	1.1 (0.8)	0.9	0.7-1.3	0.09	
Girls	1.8 (0.8)	1.9	1.2-2.1	1.1 (0.7)	0.8	0.7-1.2	0.015	
Thiamin, mg/MJ	0.19 (0.11)	0.13	0.12-0.23	0.16 (0.07)	0.14	0.12-0.17	0.60	0.12
Riboflavin, mg/MJ	0.25 (0.13)	0.20	0.16-0.29	0.20 (0.09)	0.17	0.14-0.22	0.06	0.14
Vitamin C, mg/MJ	15.0 (13.0)	11.3	4.16-18.7	12.6 (8.6)	10.6	6.9-16.1	0.83	8
Calcium, mg/MJ	133.4 (58.3)	126.8	82.8-162.9	99.8 (34.2)	97.5	75.8-120.1	0.017	100
Boys	116.8 (53.6)	88.9	80.3-157.8	101.8 (36.5)	97.6	75.4-123.6	0.57	
Girls	161.2 (59.6)	136.2	122.3-184.6	98.2 (32.2)	96.7	76.4-116.5	0.001	
Iron, mg/MJ	3.6 (5.1)	1.2	0.9-2.6	1.3 (0.7)	1.1	1.0-1.3	0.42	1.6
Magnesium, mg/MJ	44.6 (28.9)	33.1	27.8-49.0	29.6 (5.3)	29.0	26.3-32.5	0.032	35

[1]Subjects in upper quartile concerning intake of added sugar are excluded.

[2]SD in parentheses.

[3]25th and 75th percentile.

[4]Students *t*-test or Mann Whitney *U*-test.

[5]Nordic Nutrition Recommendations 2004 (29). Recommended nutrient density for groups of individuals 6-60 years of age.

Intakes of protein and phosphorus in comparison to dietary guidelines, are presented in table 10. One subject had a protein-intake below the Nordic Nutrition Recommendation, and the rest of the subjects had an intake of 1.20 g/kg/day or higher. Among the subjects with GRF corresponding to CKD stage 3-5, none of the subjects had an intake consistent with the KDOQI guidelines (one subject had an intake below the recommendation, and the others had intake above the recommendations). Table 10 presents the intake in comparison to guidelines based on body weight (31). Only one subject had a phosphorus intake below 1.000 mg/day, which is the recommended upper level of intake among subjects >40 kg. Nine subjects have a body weight >40 kg. Upper level of intake according to NKF KDOQI guidelines is higher. According to NKF KDOQI guidelines dietary intake of phosphorus should be <1.250 mg/day if PTH is high, and <1.000 mg/day if serum-PTH and serum-phosphate is elevated. None of the subjects had serum-phosphate above reference-values (1.20-2.20 mmol/L). Values for PTH were collected for ten subjects; eight subjects had serum-PTH above reference-value (1.0-8.5 pmol/L). Eight subjects had a dietary phosphorus intake above 1.250 mg/day. Recommended intake according to NNR2004 is 700 mg/d (29).

Table 10: Intakes of protein and phosphorous in comparison to dietary guidelines

	9-13 years old (n=10)			14-15 years old (n=6)		
	Median	Min-Max	Guideline	Median	Min-Max	Guideline
Protein, g/kg	2.1	0.6-3.5	0.9[1]	1.7	1.2-2.2	0.9[1]
CKD stage 3-5 (n=7)	2.0	0.6-3.5	0.95-1.35[2]	1.8	1.5-2.0	0.85-1.05[2]
	20-40 kg (n=7)			>40 kg (n=9)		
	Median	Min-Max	Guideline	Median	Min-Max	Guideline
Phophate, mg/d	1.286	759-1.627	<800[3]	1.138	724-2.211	<1.000[3]
CKD stage 2-5 (n=13)	1.314	759-1.627	1.250[4]	1.405	724-2.211	1.250[4]

[1]NNR 2004 (29).

[2]NKF KDOQI guidelines (30).

[3]Clinical Paediatric Dietetics (31).

[4]NKF KDOQI guidelines; recommended upper level of intake if PTH is elevated (30).

4.2 Intake of selected food groups

Table 11 shows the intake among RTRs, total control subjects, and selected controls where the subjects in the upper quartile of intake of added sugar are excluded. Intake of fruit and vegetable is low among both RTRs and control subjects. However, RTRs had a significantly higher intake of vegetables compared to both total control subjects and selected control subjects. RTRs also had a significantly higher intake of cheese and diet soft drinks, and a significant lower intake of soft drinks with sugar, and sugar and sweets compared to control subjects. The same pattern was found when performing the analyses using selected control subjects, except there were no significant difference between RTRs and selected control subjects regarding intake of sugar-containing soft drinks, and chocolate and candies. Intake of sugar-containing soft drinks was however still higher among selected controls.

Among girls (RTRs n=6, selected controls n=405) the RTRs had a significant lower intake of sugar and sweets when compared to selected control subjects ($p=0.033$). However, there were no differences concerning intake of chocolate and candies. No other significant differences were among girls. Among the boys (RTR n=10, selected controls n=334) the RTRs had a significant higher intake of vegetables ($p=0.042$), cheese ($p=0.013$), and diet soft drinks ($p=0.026$), and a significant lower intake of soft drinks with sugar ($p<0.001$) when compared to selected control subjects. No other differences were found.

RTRs were separated by age into two groups (9-13 years-old and 14-15 years old) and total intake of food between the age-groups (measured in gram) was compared. A significant difference was found ($p<0.001$). Comparing intake of selected food groups between paediatric RTRs and control subjects aged 9-13 years-old gave some different results; RTRs now had a significant higher intake of eggs ($p=0.020$), and a significant lower intake of soft drinks with sugar ($p=0.004$). There were no longer significant differences concerning intake of sugar and sweets.

Table 11: Intake of selected food groups among RTRs and control subjects.

	RTR subjects (n=16)		Control subjects (n=1002)		p-value[1]	Selected controls[2] (n=751)		p-value[1]
	Mean	Median	Mean	Median		Mean	Median	
Vegetables, g	113 (111)[3]	78 (47-121)[4]	69 (74)	50 (16-97)	0.042	69 (75)	50 (17-96)	0.041
Fresh fruit and berries, g	59 (66)	35 (13-93))	56 (77)	28 (0-79)	0.37	59 (81)	28 (0-82)	0.47
Milk[5], g	305 (244)	271 (110-446)	321 (274)	275 (130-445)	0.87	312 (246)	272 (128-445)	0.91
Cheese, g	38 (28)	33 (23-44)	24 (26)	16 (5-35)	0.010	23 (26)	15 (4-34)	0.005
Other dairy products[6], g	49 (46)	31 (21-64)	62 (79)	37 (0-88)	0.90	53 (66)	32 (0-82)	0.60
White bread, g	25 (32)	18 (0-41)	41 (44)	30 (5-62)	0.11	35 (39)	25 (0-53)	0.26
Wholemeal bread, g	24 (39)	0 (0-41)	36 (54)	12 (0-52)	0.35	38 (55)	19 (0-56)	0.26
Meat, g	113 (48)	114 (81-146)	109 (86)	88 (54-137)	0.24	104 (79)	85 (53-133)	0.17
Fish, g	45 (60)	18 (0-77)	24 (36)	6 (0-37)	0.32	25 (37)	8 (0-38)	0.36
Egg, g	19 (39)	5 (0-16)	9 (18)	0 (0-12)	0.16	9 (18)	0 (0-14)	0.17
Soft drinks with sugar, g	187 (395)	106 (0-490)	428 (336)	365 (190-585)	0.015	308 (209)	275 (150-448)	0.10
Diet soft drinks, g	206 (268)	29 (0-343)	54 (135)	0 (0-38)	0.007	57 (143)	0 (0-38)	0.009
Sugar and sweets, g	24 (26)	19 (9-34)	50 (45)	38 (18-68)	0.005	36 (30)	30 (14-51)	0.049
Chocolate and candies, g	18 (19)	14 (2-27)	40 (43)	28 (8-55)	0.027	27 (28)	20 (5-41)	0.19

[1]Mann-Whitney *U*-test between RTR subjects and both control groups

[2]Subjects in upper quartile of intake of added sugar (g) excluded

[3]SD in parentheses (all such values)

[4]25th and 75th percentile in parentheses (all such values)

[5]Including milk used in cooking

[6]Including yoghurt, cream, sour cream.

Percentage contribution of different food to intake of saturated fat and protein are presented in table 12- 13. Percentage contribution of different food to intake of added sugar, calcium, vitamin D and iron are presented in (appendix X). Concerning saturated fat and protein, cheese is a more important source to intake among the RTRs compared to control subjects. Supplements contribute with 10% of the intake of calcium among RTRs. Supplement also contribute with 72% of the intake of iron, and 53% of the intake of vitamin D among RTRs.

Table 12: Percentage contribution of selected foods to intake of saturated fat

	RTR subjects (n=16)	Control subjects (n=1005)
	Mean intake 31 g/day	Mean intake 32 g/day
Cheese	19	11
Dairy products	16	18
Full fat milk	1	4
Low fat milk	5	5
Cream, sour cream	3	2
Icecream	4	3
Meat	18	17
Butter, margarine	10	11
Cakes	10	9
Cereals	9	10
Chocolate	4	9
Potatochips	5	5
Other food items	9	10

Table 13: Percentage contribution of selected foods to intake of protein

	RTR subjects (n=16)	Control subjects (n=1005)
	Mean intake 76 g/d	Mean intake 74 g/d
Meat	25	26
Dairy products	15	18
Low fat milk	7	8
Bread	13	15
Cheese	12	8
Other cereals	9	12
Seafood	9	5
Cakes	4	4
Egg	3	2
Vegetables	2	1
Other food items	8	9

Intake of selected food groups among RTRs and control subjects, including only those who have consumed the different foods, are presented in appendix XI.

4.3 Prevalence of different stages of CKD

Prevalence of different stages of CKD among all the participants in the HENT-study are presented in table 16. A large proportion of the participants (87%) have GFR-values corresponding to CKD stage 2 and 3.

Table 14: Prevalence of different stages of CKD in the HENT-study.

	CKD stage			
	1	2	3	4
GFR (ml/min/1.73m^2)	>90	60-90	30-60	15-30
Number of subjects	3	11	22	2

4.4 Dietetic counselling

Sixteen subjects completed the short questionnaire. Four subjects have not had dietetic counselling at all, and four subjects had only had dietetic counselling prior to the transplantation. 80% of the responders (one subject did not answer all questions) report that they would like to have dietetic counselling after the transplantation.

Table 15: Selected results from the short questionnaire All the results are presented in appendix IX.

	Yes n=	No n=
Did you have consultation with a clinical dietician before the transplantaton ?	11	5
Did you have consultation with a clinical dietician around the time of the transplantaton ?	6	10
Have you had consultations with a clinical dietician after the transplantation?	8	8

5. Discussion

Methodological aspects of the present thesis, and a discussion of the results in context of other studies will be presented in the following sections.

5.1 Methodological considerations

The present study was an observational cross-sectional study aiming to describe the diet among paediatric RTRs, and evaluate their need for dietary counselling, especially in relation to prevention of cardiovascular disease.

5.1.1 Study design

This cross-sectional study can only tell us something about the need for dietetic counselling among Norwegian paediatric RTRs today. It is important to notice however that recorded dietary intake in the present study does not give information on the actual risk of CVD. Both individual and general dietary habits, and the range of foods available may change during the course of time, and a cross-sectional study design will only give information on diet composition as it is today. It must also be emphasized that diet alone does not predict CVD risk.

A part of the present thesis was a comparison of dietary intake in RTRs and non-transplanted control subjects to evaluate the effect of prior CKD on current dietary composition. The control data was collected in year 2000 using the same pre-coded food diary as in the present study. More recently collected data were not available. Using control data ten years old may influence the interpretation of the results. Differences found when comparing the groups do not necessarily reflect a possible disease-related impact in the dietary composition among RTRs. The differences detected may also reflect possible changes in dietary composition in the Norwegian population in general.

5.1.2 Selection bias

Selection bias means errors caused by systematic differences in characteristics among those participating compared to those not participating in a study. In the period November 2009-February 2010 there were a total of 25 RTRs aged 9-15 years-old treated at Rikshospitalet. This is the only transplantation centre in Norway, which means that these 25 RTRs were the only potential participants for this study in the country. Some paediatric RTRs aged 9-15 years-old were not invited to participate in the present study due to additional diseases with implications on diet and ability to record dietary intake. A total of twenty-one RTRs were invited to participate, and 20 subjects accepted the invitation. The one RTR who did not accept the invitation reported lack of motivation. One participant withdrew because of disease, one due to difficulties recording Pakistani food (as the pre-coded food diary is based on a typical Norwegian diet), and two participants withdrew from the study without giving any reason. However, lack of motivation is suspected. Characteristics of those not participating have not been collected, and we do not know if results would be different if all possible candidates participated. Seventy-six percent of the invited RTRs completed the study.

The main difference in results after the exclusion of control subjects in upper quartile of intake of added sugar was that the intake of sugar-containing soft-drinks was no longer significantly lower among the RTRs. Some other differences were detected, but overall the exclusion process did not seem to drastically change mean intake of other foods or nutrients among control subjects.

5.1.3 Collection of dietary data

A pre-coded food diary for four days was used to measure the dietary intake This prospective method has been found to be a good tool for assessing dietary intake among children and adolescents (115-117). The main advantage of prospective dietary assessment methods is that they provide a direct measure of the current diet, and a varying length of time can be chosen according to the aim of the assessment.

The method has some advantages compared to other traditional methods for measuring food intake. The method seemed to be convenient for the participants in the present study. The participants and their parents reported that they found it easy to fill in the food diary. Two subjects had question regarding how to record specific food items. These feed-backs and the two questions were communicated when the master student called the participants during day two of the registration period. None of the participants called the master student. Adolescents participating in a study which validated this method, also found it easy to fill in the food diary (115). In addition to being a relatively convenient method, it is less time-consuming for the participants compared to other methods, i.e. weighed food records and dietary history. The method also gives more in-depth information on both the food intake and the variability in food intake compared to other methods like dietary history and food frequency questionnaires. However, the diary has a limited number of foods, and not every type of food fit in to the pre-defined lists of food items. This may cause some imprecise recording. The food diary has open-end alternatives for each food group. These fields were used by almost all the participants. However, in most cases this was a description of foods already recorded in the predefined lists. The amount of food is presented in predefined households, which may make the recording less time-consuming, but at the same time cause imprecise recording on the amounts of food.

Dietary assessment among children may be a challenge, because children may have limited ability to self-report food intake and may thus need help from their parents. Among adolescents self-reported food intake can be challenging due to lack of motivation and issues with regard to body image, and also because more food is eaten away from home, and they can forget to record these foods. Validation of methods for self-reporting energy intake has shown a tendency for the methods to underestimate the food intake (118, 119). These tendencies of underreporting are found also among children and adolescents (115, 120-122). Energy intake estimated from the pre-coded food diary has been validated against energy expenditure measured with the activity monitor ActiReg® in groups of both 9- and 13-year-old Norwegian children and adolescents (115, 116). Average energy intake was underestimated by 18% and 34%

compared with energy expenditure among 9-year-olds and 13-year-olds, respectively. Percentage of underreporters was 39% and 83% respectively. Using BMR-factor <1.06 as cut-off, underreporting was found in two (13%) of the RTRs and 27 % of the selected control subjects (111).

The photograph-booklet has also been validated, and found to be a useful tool for portion size estimates (123).

5.1.4 Short questionnaire

The answers from the short questionnaire revealed some weaknesses; some of the questions contained too many alternative answers, and some questions have not been precise enough. The combination of few responders and too many alternative answers made it difficult to interpret the results from the short questionnaire. The question for those who had consultation with a clinical dietician concerning whether this had been useful or not, and the question for the participants who had not had any consultations with a clinical dietician concerning whether they do/did need/wish to meet with a dietician, were misunderstood by some. This was meant as a question related to dietetic counselling after the transplantation, but the responders seem to have answered this based on dietetic counselling in general. The questionnaire would perhaps have been more useful if it only included questions regarding dietetic counselling after the transplantation. Perhaps the questionnaire should have contained some information regarding what a clinical dietician can do, to ensure that every responder was familiar with the profession.

Such a questionnaire may be a useful tool in detecting the need for dietetic counselling, and for finding out how many patients who actually meets with a clinical dietician. The questionnaire used in the present thesis should be improved to be used again.

5.1.5 Statistics

Each variable was tested for normality, and most of the statistical analysis was performed using non-parametric tests (Mann-Whitney *U* test). Non-parametric tests tend to be less sensitive than parametric tests, and may therefore fail to detect differences between groups that actually exist.

5.1.6 Generalizability

Generalizability is one of the most important aims of any research, and can be defined as the extension of research findings and conclusions from a study conducted on a sample population to the population at large. Small sample size and selection bias will reduce the generalizability.

A large part of the Norwegian paediatric RTRs aged 9-15 years old participated in present study, and applying the results from the present study to other paediatric RTRs in this age-group seems rational. We have no information on dietary composition or dietetic counselling among the younger and older RTRs. Still, they are all treated at the same hospital, by the same physicians, and the treatment is based on the same transplantation protocol. The results from the present study may therefore be applied to all paediatric RTRs.

5.2 Diet and prevention of CVD

The present thesis shows that diet composition among paediatric RTRs is not optimal for prevention of CVD; percentage of energy from saturated fat was high, percentage of energy from added sugar was higher than recommended, intake of iron was low among the girls, and intake of dietary fibre, and fruits and vegetables was low.

Dietary guidelines and recommendations for preventing cardiovascular disease are equal to the dietary guidelines and recommendations given to the population in general. Renal failure and immunosuppressive medications put RTRs in a special position concerning CVD risk. There is some debate concerning what risk factors are most predictive for CVD, and also on the dietary influence on different risk factors among RTRs.

5.2.1 Recorded diet vs recommendations and dietary guidelines

Some inconsistencies between recorded diet, and NNR and Norwegian dietary guidelines were detected. These will be discussed in the following section. The new evidence-based Norwegian dietary guidelines are made to promote public health and to prevent chronic diseases, including CVD. However, these are unpublished guidelines. Diet composition among RTRs will therefore be discussed both in context of studies and reports concerning diet and prevention of CVD, NNR (29), today's national dietary guidelines (104), and the new guidelines expected to be published autumn 2010 (105).

Macronutrients

The energy intake levels among the paediatric RTRs could not be evaluated, because of lack of information regarding level of physical activity. However, based on weight and an assumption of a moderate physical activity level, estimated daily energy requirements were approximately 10 MJ for boys and 8 MJ for girls. This is higher

than the recorded median intake (7.7 MJ/day for both girls and boys). Estimated daily energy requirements made with the assumption of a light physical activity level were approximately 8.9 /day for the boys and 7.1 MJ/day for the girls.

The paediatric RTRs had a relatively high percentage of energy from fat, and a low percentage of energy from carbohydrates. The median percentage of energy from fat was in accordance with NNR, but in the upper part of reference range. Half of the subjects had an intake of fat >35E%. All of the paediatric RTRs had an intake of saturated fat above 10E%, and the intake of PUFA was low. Percentage of energy from added sugar was high, and intake of dietary fibre was low compared to the recommendations. Percentage of energy from protein was relatively high for some of the participants. A dietary assessment among 29 Spanish renal transplanted children (mean age 14, range 6-18) revealed pretty much the same pattern; 16E% protein, 45E% carbohydrate, and 39E% fat (124). Dietary intake was recorded for three days. All subjects were recommended low intake of saturated fat and a high consumption of olive oil, lean meat, fish, fruit and vegetables, prior to the recording.

Fat

This dietary composition is not optimal concerning prevention of CVD. Saturated fatty acids raise total-cholesterol and LDL-cholesterol (125, 126). Replacement of saturated fat with carbohydrates reduces both HDL- and LDL-cholesterol (meaning no change in LDL-HDL ratio) and increases triglycerides. This dietary change has therefore minimal benefit concerning CVD risk. Replacement of saturated fat with monounsaturated or polyunsaturated fat results in decreased LDL-cholesterol and only slight changes in HDL-cholesterol, and is thus beneficial concerning CVD risk (125, 127). Trans fatty acids have the same effects as saturated fat concerning total-cholesterol and LDL-cholesterol, in addition to reducing HDL-cholesterol, and intake of trans fatty acids are associated with increased risk of CVD (128). Intake of trans-fatty acids should therefore be limited as much as possible, and not exceed 1 E% (104). Calculated mean intake of trans fatty acids among Norwegians is however found to be consistent with the recommendations (129).

The most important ω-3 PUFAs are eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA) and α-linolenic acid. The main sources of EPA and DHA are fish and fish products, while the main sources of α-linolenic acid are green leaves and flaxseed oil. ω-3 PUFAs reduce the risk of CVD (130), and consumption of two servings fish per week is recommended by many (125, 130, 131). Mean fish intake among the subjects in the present thesis is only 45 g/day; 25^{th}-75^{th} percentile 0-77 g/day (fish intake is 0 g/day for seven subjects). Eight subjects use cod liver oil on a regular basis, and 2.6% of the total intake of PUFA was provided from supplements. The subjects only recorded their diet for four days, and no fish consumption among some subjects can thus be a coincidence. However, mean intake indicate that the fish intake is low among these subjects, and far from the two servings recommended.

Due to ω-6 PUFAs possible pro-inflammatory effects, there are different opinions on whether these fatty acids have the potential to reduce the risk of CVD. Harris et al reviewed the evidence on the relationship between ω -6 PUFAs and the risk of CVD, and concluded that the consumption of at least 5-10 % of energy from ω -6 PUFAs reduces the risk of CVD relative to lower intakes. Higher intake seems to be even more beneficial if it is part of a low saturated-fat diet (A Science Advisory from the American Heart Association) (132). The primary dietary ω-6 PUFA is linoleic acid, which is found mainly in vegetable oils (corn, sunflower, safflower, soy).

The food database used in the present thesis does not have values for specific fatty acids, and thus only the sum of saturated fat, MUFA, and PUFA can be evaluated. Some data concerning saturated fat, MUFA and PUFA is missing in the food database, and results concerning quality of fat must be therefore be used with caution.

Major sources of saturated fat for these subjects were cheese (19%), other dairy products (milk, cream, sour cream, ice-cream) (16%), meat (18%), and butter and margarine (10%). Approximately 70% of the consumed cheese is full fat white cheese. A reduction in intake of saturated fat can thus be done by choosing low fat cheese, and by choosing other types of bread spread. By substituting some of the cheese with bread spread based on fish, saturated fat intake would be reduced and

intake of PUFA would be increased. Substituting butter and hard margarine with soft margarine and vegetable oils would also make an important contribution to a reduction in saturated fat, and at the same time increasing the intake of PUFA. This is also one of the recommendations in the Norwegian Recommendations for Nutrition and Physical Activity (104). A huge part of the meat consumed is processed meat. Substituting processed meat to lean meat fillets and fish, should be recommended to decrease intake of saturated fat. Increasing the intake of fish and choosing lean meat products is one of the recommendations in the Norwegian Recommendations for Nutrition and Physical Activity. As part of the recently proposed Norwegian dietary guidelines, the recommendations with regard to meat is more specific; choose lean meat and restrict intake of red meat to <500 g/week (105). Meat is an important source of protein, iron, vitamin B_{12}, and a moderate intake of meat (preferably lean meat) should therefore be part of a healthy diet.

Dairy products make an important contribution to the intake of protein and calcium, and are therefore recommended as part of a healthy diet. However, dairy products contribute to the intake of saturated fat (in addition to trans fatty acids and cholesterol), also detected among paediatric RTRs in present thesis. By choosing low fat dairy protein and calcium are still present, and the intake of saturated fat is decreased, and such a substitute is therefore beneficial. Low fat dairy products (two servings per day) are also part of a dietary pattern (the DASH diet) shown to reduce blood pressure (60). The positive effects of dairy products with regard to blood pressure are not fully understood. One proposed explanation is a blood pressure lowering effect of bioactive peptides, found especially in fermented products (133).

Carbohydrate

Percentage of energy from carbohydrate was relatively low among the RTRs; with median value 48.6 E%. Five subjects had a carbohydrate intake within the recommended 50-60 E%, eight subjects had 40-50 E%, and three subjects had 30-40 E% from carbohydrate.

Optimal percentage of energy from carbohydrates for weight loss and glycemic control has been extensively debated. Short-time studies have been able to show benefits from low-carbohydrate diets for weight reduction and glycemic control, but longer studies are needed to examine the long-term effects from a low-carbohydrate diet (134, 135). Yet, weight reduction is a matter of reduction in energy intake, and clinically meaningful weight loss has been reported independent of which macronutrient is being emphasized (136).

The recommended combination of 50-60E% carbohydrate, 25-35E% fat, and 10-20E% protein is however found to be the combination most beneficial for promoting good health (29).

Added sugar

Intake of added sugar should not exceed 10 E%. For children this is an important limitation both to ensure an adequate nutrient density to prevent obesity, and to prevent dental caries (29). Øverby et al found among 8th graders that individuals with a high consumption of added sugar had a 42 % lower intake of vitamin D compared with those having a low intake of added sugar. This study also showed that high consumption of added sugar is associated with a calcium-intake below the recommendations (137). Only 16 subjects participated in the present study, and discussing such associations among these subjects is inappropriate.

Chocolate and candies, dairy products (especially flavoured milk), and cakes are among the major sources of added sugar intake in the RTRs. Limitations in intake of these foods would be beneficial. Substituting some of these foods with fruit and berries would be even more beneficial.

Concerning the paediatric RTRs intake of added sugar was higher among the subject aged 14-15 years-old compared to the subject aged 9-13 years-old. One explanation for this difference between the age-groups might be that at this time of adolescence there is an ongoing detachment from the parents; the adolescents spend more time apart from their parents, and also buy more food themselves. The parents probably

have more influence on the diet among subjects aged 9-13 compared to the subjects aged 14-15. This difference in intake of sugar according to age has also been reported by others (107, 137, 138).

Dietary fibre

The intake of dietary fibre among paediatric RTRs is low compared to recommended intake of 25-35 g/d. According to NNR the dietary fibre intake should be at least 10 g/d by school age, and then gradually increase to reach recommended intake for adults (25-35 g/d) during adolescence. The recommendation of 25-35 g/d is thus probably high for the paediatric RTRs aged 9-15 years-old. However, intake of dietary fibre could easily be higher by increasing the consumption of fruit, vegetables and wholegrain bread. National dietary guidelines includes recommendations on five portions of fruit and vegetables (three portions vegetables, and two portions fruit, i.e.750 g/day) and choosing wholegrain products (104). These recommendations may be changed when new dietary guidelines are published; intake of fruit and vegetables adjusted to 500g/day (potatoes not included), and more specific recommendations with regard to wholegrain products (four portions of wholegrain products/day; 75g/10MJ) (105). Recorded intake of fruit and vegetables is far below the recommended five portions per day. The median intake of fruits and vegetables in sum among RTRs is 149 g/day (25^{th}-75^{th} percentile, 70-215). When including potatoes, juices and dried fruit the mean intake is 207 g/day. This is however still lower than the recommended intake.

In a position paper from year 2008 the American Dietetic Association concludes that there is strong evidence that high intake of dietary fibre may lower blood pressure, improve dyslipidemia, reduce inflammation, and hence have the potential to reduce risk of CVD, in addition to produce lower serum-glucose levels compared to a low-fibre diet, and thus be beneficial with regard to glucose intolerance and diabetes (139). Convincing associations for intake of dietary fibre and reduced risk of CVD was also found in the Norwegian systematic evidence-based evaluation of dietary prevention of CVD (105). For RTRs who have an increased risk of cardiovascular

disease, an increased intake of dietary fibre seems even more important. High-fiber diets are also more satiating, an effect that is beneficial for RTRs considering their increased appetite as a side-effect from the immunosuppressive medications. An inverse association of fibre intake with the risk of metabolic syndrome have been found among adult RTRs; subjects with the highest intake of dietary fibre had a lower odds ratio for incident of metabolic syndrome (51).

The participants in the present thesis do not have a dietary composition which is extreme in any direction. Yet, some improvement can be done to accomplish a diet more optimal in relation to preventing CVD.

5.2.2 Risk factors for CVD among RTRs

Hypertension, anemia, and glucose-intolerance seem to be the most common complications among Norwegian paediatric RTRs. CKD stage 2-3 was detected in 87% of the patients, while dyslipidemia was less prevalent, and overweight do not seem to be very prevalent among the Norwegian paediatric RTRs (unpublished data).

The risk factors for CVD among the general population are not necessarily equally important in RTRs, and some research has been performed to examine the risk factors for CVD in RTRs.

Aakhus et al performed a cross-sectional study with a five year follow up, to assess cardiovascular morbidity and mortality in 406 Norwegian stable RTRs (age 47.0±15.6), and to identify predictors for cardiovascular events during long-term follow-up. Every third patient died of or developed symptoms of CVD during the follow-up. The patients who died were older, less physically fit, had reduced graft function, and had a higher prevalence of hypertension, dyslipidemia, diabetes, and cardiovascular disease (5).

Based on data from the Framingham Heart Study and an adult renal transplant population, hypertension, hyperlipidemia, diabetes mellitus, cigarette smoking, and two or more acute rejection episodes during the first year after transplantation were

found to be predictive risk factors for cardiovascular disease among adult RTRs (140). Dyslipidemia do however seem to be a more common complication among the adult RTRs compared to the paediatric RTRs (140). Twenty-six percent of the patients had the combination of elevated triglycerides (>1.69 mmol/L) and low HDL-cholesterol (<1.04 mmol/L). Hypercholesterolemia (≥5.18 mmol/L) was detected in 21% of the patients (unpublished data). These results are comparable to what was reported by Sgambat et.at. (64). Higher prevalence of hypercholesterolemia has however been reported by Feber et.al. (68).

Some studies has also been performed among the paediatric RTRs. White et.al. performed a study looking at comorbid conditions associated with chronic kidney disease (CKD) in paediatric RTRs (after successful renal transplantation). Forty-five RTRs aged 1-20 years old were compared to 102 CKD patients, matched by age and CKD stage. They found that children with CKD after transplantation appear to have greater odds of having anaemia and hypertension than those with CKD in native kidneys, and suggest that increased attention to these two modifiable risk factors for CKD and cardiovascular disease may improve outcomes after transplantation (92). High prevalence of hypertension and anaemia has also been reported by Feber et.al. (hypertension in 69% and anemia in 61% of 23 paediatric RTRs aged 11.9±5.2 years old) and Sinha et.al. (hypertension in 53% and anemia in 50% of 129 paediatric RTRs aged 2.7-20 years old) (14, 68). Ramirez-Cortes et.al. examined the prevalence of metabolic syndrome among 32 Mexican children and adolescents aged 9-19 years old. The most common complication was hypertension, which was found in 53 % of the children (48). These findings are consistent with the results from the HENT-study (unpublished data).

CKD stage 2-3 was found in 87% of the patients in the HENT-study, which is consistent with the results from other studies (14, 92). There is strong evidence that CVD is related to renal function measured as GFR, and decreased GFR and proteinuria have also been reported to predict CVD among the general population (141). It seems reasonable that this would be of importance also among RTRs. Meier-

Kriesche et al report serum creatinine (measure of renal function) among 58.900 adult RTRs at one year after transplantation to be strongly associated with the incidence of cardiovascular death, independent of risk factors. (142). Good graft function among RTRs may therefore have the potential to lower cardiovascular risk. Similar studies in children have not been found. Yet, renal failure causes several complications, and some of them have been reported with high prevalence in the paediatric population. Loss of renal function could be at least part of the explanation for the high prevalence of some of the complications among RTRs.

Overweight, which have been reported to be prevalent in paediatric RTRs in other studies (48, 86), was not found to be equally prevalent among the Norwegian patients.

Due to the side-effects, steroids may contribute to cardiovascular disease and infections, and may thus be an important cause of morbidity and probably mortality among RTRs. There is an ongoing debate concerning use of steroids (143-145). A Cochrane review concluded that "*steroid avoidance and steroid withdrawal strategies in kidney transplantation are not associated with increased mortality or graft loss despite an increase in acute rejection*" (146). Studies are needed to see if this applies also to children.

The presence and severity of different complications after a renal transplantation is dependent on many factors, including prior renal failure, immunosuppressive medications, BMI, diet and physical activity, and current renal function (30, 55, 57, 69, 78). Any attempt to evaluate the risk of CVD among the RTRs will not be made in the present thesis.

The debate regarding risk factors for CVD, and the impact of these among RTRs will continue. However, risk factors for CVD in the general population are reported with high prevalence among both adult and paediatric RTRs. Any differences in impact of risk factors for CVD among RTRs and the general population seem to be more a question of immunosuppressive medications and reduced renal function as additional risk factors for CVD among RTRs.

5.2.3 Dietary impact on CVD risk factors among RTRs

There is some debate concerning the role of dietary treatment for prevention of CVD among RTRs; is the risk of CVD mainly increased due to loss of renal function and the use of immunosuppressive medications, or will dietary treatment have the potential to improve the severity of CVD risk factors as in the general population.

Some studies have been performed to examine dietary impact on dyslipidemia among RTRs, and the results are conflicting. Delucchi et al. reports a significant reduction in total-cholesterol and LDL-cholesterol after twelve weeks of diet modification (total fat ≤30 E%, saturated fat <7 E%, PUFA 10 E%) among 22 paediatric RTRs aged 6-20 years old (147). Siirtola et al. reports higher serum total-cholesterol and TG among 45 paediatric RTRs aged 4-17 years old compared to 178 healthy controls aged 3-18 years old, despite no differences in intake of saturated and polyunsaturated fats, and cholesterol (148). This difference is most likely explained by the use of immunosuppressive medications. Both the RTRs and the control subjects had a low intake of PUFA (4.8 E% and 4.6 E% respectively) and a high intake of saturated fat (14.4 E% and 14.1 E% respectively). The authors of this study concluded that diet do not explain the higher prevalence of dyslipidemia among the RTRs, but still recommend dietary counselling for a healthier lifestyle (148). Results among adult RTRs have also been conflicting (149, 150).

Studies have also been performed to examine the impact of dietary sodium on blood pressure among renal transplant recipients (151-153). Prasad et al measured 24-h urine excretion rates of sodium as a measure of dietary sodium intake in 244 stable adult RTRs, and found no correlations between excretion of sodium and blood pressure (systolic or diastolic). The authors conclude that recommendations to reduce sodium intake should not be part of post-transplant hypertension management (153). Two similar studies have been performed, with equal results and conclusions (151, 152). These studies have some important limitations; i.e. they make the assumption that urine excretion of sodium is equivalent to dietary intake. However, renal excretion of sodium is highly dependent on renal function. Ninety-two % of the

participants in the ongoing HENT-study at Rikshospitalet have a GFR corresponding to CKD stage 2-4 (of which 58 % has a GFR corresponding to CKD stage 3). Similar results are reported from other studies (14, 68, 92). Thus dietary intake and renal excretion of sodium can not be equivalent among RTRs. All three studies exclude participants with serum-creatinine > 400 μmol/L. The facts that the reference range for serum-creatinine is 53-97 μmol/L, and that elevated measures of serum-creatinine appears late compared to measured reductions in GFR, gives this exclusion process limited value.

Nonetheless, loss of renal function and the use of immunosuppressive medications may be controlling much of the risk for CVD among these patients, but these are factors that can not be changed. Lifestyle, including dietary composition, on the other hand can be improved. The size of the effect is uncertain, but this is an area where the patients can do an effort themselves.

5.3 Stages of CKD, diet, and KDOQI guidelines

Diet is an important part of the treatment for CKD-patients, and may involve dietary restrictions in protein, phosphorous, and sodium for paediatric patients. The rationale for dietary treatment among CKD patients is to reduce the severity of the complications and reduce the uremic symptoms (31). It seems reasonable that this should be of equal importance in treatment of renal failure among transplant recipients. By including RTRs into the KDOQI Clinical Practice for Nutrition in Children with CKD, more attention is pointed towards the relevance of renal failure among the RTRs. According to these guidelines protein intake should be restricted in children with CKD stage 3-5 after transplantation, intake of phosphorous should be restricted in children with CKD stage 2-5 after transplantation, and dietary sodium should be restricted as part of hypertension management (30). Sixty-two percent of the participants in the HENT-study had a GFR corresponding to CKD stage 3-4, which is consistent with other reports (14, 68, 92). Among the participant in the present thesis, CKD stage 2 was present in six subjects, and CKD stage 3 was present in six subjects. Yet, the intake of these nutrients among the participants in the present thesis is not consistent with KDOQI guidelines. None of the participants with GFR corresponding to CKD 3-5 in the present study had an intake of protein in accordance to these guidelines. The KDOQI guidelines with regard to intake of phosphorous are high compared to other guidelines, and they are based on measured levels of serum-PTH and serum-phosphate. Measured levels of serum-PTH were not collected for all subjects in the present study. The reason for this was that measurement from last yearly control was missing. Therefore the intake of phosphorous were evaluated also with respect to guidelines based on body weight (31). Intake of phosphorous among the participants is high compared to both guidelines. However, for comparison the dietary intake of phosphorus among Danish people aged 4-75 years-old are 1.490 mg/10MJ, and intake among Swedish people aged 18-74 years-old are 1.610 mg/10MJ (data collected using 7-day food record). Data regarding intake among Norwegians have not been calculated earlier (29). Dietary sodium intake has not been

evaluated in the present thesis; the calculation would bee inappropriate due to uncertain data concerning sodium-content in different foods in the food database, and due to lack of information regarding the amounts of sodium the subjects have added to the food themselves.

Hypertension is one of the complications reported to appear most common in paediatric RTRs (14, 48). If dietary sodium restriction is relevant in hypertension management in CKD-patients, it seems reasonable that this should be so also after the transplantation. Elevated serum-PTH is common after renal transplantation (154). This was also detected in the HENT-study (unpublished data). Measurements for serum-PTH among the participants in the present thesis, detected elevated PTH in eight out of ten subjects. Dietary phosphorous restriction is recommended at elevated PTH in CKD. PTH decreases the renal reabsorption of phosphate, and thus high serum-phosphate is masked by PTH. High serum-phosphate is usually not measured before CKD reaches stage 4. If dietary phosphorous restriction is relevant in the treatment of renal failure, it seems reasonable that it would be of importance also for renal failure among RTRs. Dietary protein restrictions may not have nephroprotective effects (27), but, restricting the intake in CKD stage 3-5 is still recommended by the KDOQI . The rationale for this recommendation is that protein restriction will reduce the accumulation of nitrogenous waste products, and thus delay the symptoms of uremia. In addition to this it may lower the phosphorous intake (30).

There has been, and still is, an important and necessary focus on finding optimal immunosuppresive treatment, and hence minimizing the adverse side-effects. Now, there is an increasing attention towards optimizing long-term health among RTRs, and this attention includes both the reported presence of CKD and the prevention of CKD. The dietary treatment in CKD may be beneficial also in renal failure after the transplantation, and may perhaps reduce the severity of some CVD risk factors in RTRs.

5.4 Diet composition compared to healthy subjects

Some differences between recorded diet among RTRs and control subjects were detected. These will be discussed in the following section. The differences will be discussed in context of other studies and reports.

When comparing the RTRs and control subjects, the analysis was performed using percentage of energy from protein, fat, carbohydrates and added sugar, and values where intake was measured as g/MJ for the other nutrients.

When comparing diet among paediatric RTRs and healthy children and adolescents, some interesting differences were found. The percentage of energy from protein, and fat were significantly higher, and the percentage of energy from carbohydrates was significantly lower among the RTRs compared to the control subjects. The most important sources of protein among the RTRs were meat, dairy products (especially low fat milk), cheese and bread. The RTRs had a significantly higher intake of cheese, and a non-significantly higher intake of meat, fish, and egg, compared to control subjects. In addition to this RTRs had a significantly lower intake of sugar and sweets, and a non-significantly lower intake of bread and soft drinks with sugar compared to control subjects. These are differences that will contribute to a higher percentage of energy from protein, and a lower percentage of energy from carbohydrates. Significantly lower percentage of energy from carbohydrates was another finding when comparing RTRs and control subjects. The percentage of energy from carbohydrate among the RTRs was also lower than what has been reported by others (107, 155). The intake was more consistent with the reported intake among 177 diabetic children (9-10 years-old) and adolescents (12-13 years-old) (156). These studies have all been using the same method for dietary assessment as in the present study

The sources of protein are foods that also contribute to an increase in percentage of energy from fat, which was also found to be higher among the RTRs.

Another difference detected when comparing RTRs and control subjects was a statistically significant higher intake of vegetables among the RTRs (p=0.041), which is positive. However, the total intake of fruits and vegetables is low, both among RTRs and control subjects. The total mean intake of fruit and vegetables, including potatoes, and juice is 207 g/day among the RTRs (236 g/day among selected control subjects). This is lower than reported mean intake among Norwegian two year-olds (i.e. 302 g/day) (157), and asthmatic and healthy 13-years-olds participating in the "Asthma and lifestyle" project (155). Yet, it is consistent with reported intake among diabetic children and adolescents aged 9-10 and 12-13 years-old (156).

Prior CKD and possible influence on dietary composition

Living with severe CKD can be exhausting, with symptoms like tiredness, nausea, poor appetite, metallic taste sensation, and vomiting. To the best of my knowledge, no data regarding dietary composition among the Norwegian paediatric CKD patients have been collected. As a result there is no precise information on the extent of dietary restrictions available. However, we know that most of today's paediatric RTRs have had dietary restrictions in some form during the time of CKD, and we can assume that this has had an impact on their dietary composition. Most patients probably have had restrictions with regard to protein, phosphorus, and sodium. During this period the aim is to ensure adequate energy intake to promote growth, and at the same time regulate protein intake to prevent increase in serum-urea and further loss of renal function. Additional aims are to optimize fluid- and electrolyte balance, ensure adequate intake of micronutrients, and regulate calcium and phosphorus intake. To ensure adequate energy intake for a child with uremic symptoms and dietary restrictions can be challenging. A part of raising children is to teach them healthy dietary habits, including limitations in consumption of unhealthy food. Raising a child born with CKD might influence this. It is easy to imagine that sick children, who need energy, usually get to eat as they wish. Some of the patients/parents in the present thesis have received dietetic counselling during the time of CKD, and perhaps some of them have managed to maintain a healthy diet.

Perhaps some have managed to maintain a healthy diet without dietetic counselling as well. Still we can assume that this is not the case for all. Very few paediatric RTRs have been in dialysis prior to the transplantation, and diet for patients in dialysis is therefore not discussed.

Protein

We expected the percentage of energy from protein to be moderate due to prior protein restrictions among the RTRs, but found it to be significantly higher compared to healthy children. Intake is also higher than reported among Norwegian children and adolescents in other studies (117, 155, 156). Yet, intake was consistent with NNR2004 for both groups (29). One explanation for this difference can be the awareness among the RTRs and their parents that renal failure has a huge impact on bone-mineralization, and thus awareness on ensuring sufficient intake of calcium. Focus on sufficient intake of calcium, might result in a relatively high intake of protein, since dairy products are an important source of both calcium and protein. Significant difference in intake of calcium, with higher intake among the RTRs was another difference detected when comparing the two groups. Six subjects used calcium supplements. Another explanation for the difference in protein intake can be that prior restrictions may cause an urge to consume food with a high content of protein after the transplantation. The assumption that the intake of protein would be low might have been wrong, and the extent of protein restriction might have been lower than assumed. However, a wrong assumption does not explain an even higher protein intake among the RTRs. There is also of course a chance that these 16 participants coincidentally have a higher intake of protein compared to other paediatric RTRs. When separating the RTRs according to age, 9-13 year-olds and 14-15 year-olds, the percentage of energy from protein is a bit higher among the youngest. Control subjects are 12-13 year-olds (a few 11- and 14-year-olds), and one might speculate that the difference is influenced by differences in age. However, the same results were found when only including RTRs aged 11-14 years old.

Added sugar

Dietary assessment among the control subjects was performed in year 2000, so these data are relatively old (107). One of the conclusions from Ungkost2000 was that the intake of added sugar was alarmingly high. There has been a governmental effort to lower the intake of added sugar among the population the last decade, and according to a report from the Norwegian Directorate of Health, consumption of sugar among the Norwegian population has decreased during the previous ten years (158). Intake of added sugar has also been found to be greatly reduced among Norwegian two-year-olds during the period 1999-2007. Mean intake of added sugar among two-year-olds were 11.7 E% in 1999, and 7 E% in 2007 (157, 159). We can thus assume that the intake of added sugar among children and adolescents are lower today compared to ten years ago. This was also the reason why subjects in the upper quartile of added sugar intake among control subjects was excluded in analysis in the present thesis. Percentage of energy from added sugar was significantly lower among RTRs compared to all control subjects. When excluding the 25% of the control subjects with the highest consumption of added sugar, RTRs still had a lower percentage of energy from added sugar, but the difference was no longer statistically significant. However, percentage of energy from added sugar was still above the recommended upper limit of 10 E%, also among the RTRs. Recorded intake of added sugar above the recommendations has also been reported in 144 12-14-year-old Norwegian children with current asthma or a history of asthma (155) and 100 nine-year-old Norwegian children participating in a study validating methods for dietary assessment (117). The governmental effort to reduce sugar consumption can be the explanation for the lower intake of soft drinks with sugar, and the significantly higher intake of diet soft drinks among RTRs compared to control subjects. Another possible explanation might be that RTRs are aware of their risk of excessive weight gain due to the use of immunosuppressive medications, and therefore limit their intake of sugar-containing soft drinks. It should be noted that six RTRs did not consume sugar-containing soft-drinks at all, and two subjects had a very high consumption (830 g/day and 1370 g/day respectively). Intake of sugar and sweets were also lower among the RTRs.

However this difference is not due to huge differences concerning intake of chocolate and candies. Thus the differences must be explained by differences in intake of sugar-containing bread-spread, honey, syrup and sugar. It seems like there is some effort to limit the intake of sugar among the RTRs, but they don't seem to be willing to give up soft drinks, chocolate and candies. They seem to choose diet soft drinks instead of sugar-containing soft drinks. When adding the mean value of sugar-containing soft drinks and diet soft drinks, the difference in consumption between RTRs and control subjects is small. The RTRs should be recommended to substitute sugar-containing soft-drinks with water, and not so much with diet soft drinks. Diet soft drinks contribute to the intake of artificial sweeteners. Artificial sweeteners are associated with possible adverse side-effects, and limits for consumption are given; for children these are based on body-weight. The use of artificial sweeteners is relatively new, and some possible side-effects might be undetected. However, calculations concerning intake of artificial sweeteners among the RTRs have not been performed, and will not be discussed further.

Possible changes in dietary composition in the Norwegian population

During the last years there has been a focus in media on low-carbohydrate-diets. Especially bread, pasta, potatoes, and added sugar have gained much attention. In addition to reporting a lower intake of bread and a lower percentage of energy from added sugar, the RTRs also had a lower intake of potatoes (35.4 g/day compared to 51.9 g/day among control subjects), while there were only slight differences in intake of pasta (9g/day compared to 10.1 g/day among the control subjects). The differences in intake of cheese, meat, sugar, fruits and vegetables, between RTRs and control subjects are in accordance with changes during the period 1999-2008 in quantity consumption of foods, reported by the Norwegian Directorate of Health (158). One might speculate that the differences observed at least partly can be explained by the focus on low-carbohydrate diets (Any possible health benefits from low-carbohydrate-diets among the general population will not be discussed in the present thesis). Other reasonable explanations for the differences observed are increased

focus on health benefits from eating fruit, berries, and vegetables, and increased availability and range of such foods, cheaper meat, increased range of cheese etc.

The RTRs also had a higher percentage of energy from fat compared to control subjects. It seems reasonable that also this difference can be at least partly explained by changes in quantity of consumption among the general Norwegian population. Reducing the intake of carbohydrate naturally means increasing intake of protein, fat, or both. The RTRs consume less sugar-containing soft drinks, and sugar and sweets compared to control subjects, which is beneficial. Substituting these foods with vegetables, fruit, berries and wholegrain products would be beneficial and in accordance with national dietary guidelines. Unfortunately, higher intake among RTRs compared to control subjects is rather seen in intake of meat and cheese. These foods contribute to both the intake of protein, fat, and saturated fat. The RTRs also have a higher intake of fish and vegetables compared to control subjects. As mentioned, this could be reflecting a dietary trend.

5.5 Dietetic counselling

Dietetic counselling is not part of the general transplantation program at Rikshospitalet, and thus only some of the patients are guided by a trained dietician. The patients must request a consultation, or the physician must be considering the patients as having special need for dietetic counselling, for a referral to be written. Follow-up consultations after transplantation are performed at the local hospitals every third month, and dietetic counselling may thus be part of the treatment either at Rikshospitalet, or at the local hospitals, or both. However, not every local hospital in Norway can offer dietetic counselling. As a result not all patients are offered thorough dietetic counselling.

The paediatric RTRs in the present thesis seem to have understood the importance of ensuring sufficient intake of calcium and vitamin D as they are at increased risk of bone disease (both due to prior CKD and immunosuppressive medications) (160, 161). Thus, some dietary guidelines have been communicated. Sufficient intake of calcium and vitamin D might be easier to accomplish compared to following dietary guidelines for prevention of CVD, although these are the same guidelines as for the population in general.

Dietetic counselling among paediatric RTRs seems to be more common before the time of transplantation; i.e. 11 subjects have had consultation before the transplantation, and eight subjects have had consultation after the transplantation. Yet, 80% of the responders (one subject did not answer all questions) report that they would like to have dietetic counselling after the transplantation. The adult RTRs at Rikshospitalet receive teaching on healthy diet after the transplantation. A similar arrangement would be beneficial also for the paediatric RTRs. However, dietary counselling for paediatric patients must include the whole family. The teaching could be arranged in many ways. Some patients and their families could be gathered in connection with yearly follow-up, and at the same time get teaching on healthy diet.

This would also be an opportunity for the patient to meet others in the same situation. Since the regular follow-up is performed at the local hospitals, guidelines for dietary counselling of RTRs would be beneficial. Not every hospital can offer counselling by a dietician, and guidelines would make it easier for the local hospitals to offer proper dietary follow-up. A contact person at Rikshospitalet available for questions and consultation would be even more beneficial.

The need for dietetic counselling among paediatric RTRs and their parents will of course vary. Prior chronic kidney disease with dietary restrictions has most likely been quite challenging both for the patient and his/hers parents, and some patients and parents may have increased their knowledge regarding dietary recommendations and guidelines during this period. Prior dietary restrictions may however also have some drawbacks; after a period with dietary restrictions it is a relief not to be forced to focus on proper diet, they can finally eat whatever they want to. The patients in most cases feel much better compared to the time of CKD, and focusing on prevention of a disease that might appear in the future can be difficult.

Some studies have been performed to evaluate the effect of dietary treatment among RTRs (50, 51, 83, 162, 163), whereas some has already been mentioned in the introduction. Giuda et al. reports weight loss, lower cholesterol and triglycerides, and improved fasting glucose levels in 46 adult RTRs after a 12-month lifestyle interventional study (162). The participants were recommended a diet with 55E% carbohydrates, total fat not exceeding 30E%, protein intake restricted to 0.8 g/kg of ideal body weight/day, low-sodium diet, and increased physical activity ≥30 min/day. Patel et al. found in a study among adult RTRs, that early dietary counselling and follow-up is effective in controlling weight gains during the first year after the transplantation. The authors concluded that dietary guidelines should be emphasised in the treatment of RTRs (163).

According to the NKF KDOQI guidelines; nutritional management of transplanted patients *dietary assessment, diet modification, and counselling are suggested for children with CKD stages one to five post transplantation to meet nutritional*

requirements while minimizing the side effects of immunosuppressive medications(…) In the long-term stage of transplantation, nutritional goals are targeted to preventing chronic complications of immunosuppressive therapy, such as excessive weight gain/obesity, hyperlipidemia, hypertension, and corticosteroid-induced hyperglycemia and/or osteoporosis (…)The frequency of nutritional assessment may be highest in the early posttransplantation period and decrease as the dosage and side effects of immunosuppressive medications are reduced. At a minimum, the frequency of nutritional assessment should be compatible with age- and stage-of-CKD-matched recommendations for children with CKD stages two to five (32).

The results from the present thesis tell us that nutritional guidance could be emphasised more in the treatment of paediatric RTRs. Improvement can be done with regard both to dietary prevention of CVD (in relation to fat quality, intake of fibre, fruits and vegetables, sugar and iron), prevention of symptoms of uremia, and prevention of bone disease through dietary phosphorus restrictions. Advices on healthy food may also be beneficial to reduce the appetite which is being stimulated by the immunosuppressive medications. The reason for the inconsistency between recorded diet, and recommendations and guidelines is hard to say. For some it might be lack of knowledge, and for some it might be lack of will or awareness. No-one can be forced to follow dietary recommendations and guidelines, but as long as dietetic counselling is not a part of the transplantation program, it seems difficult to communicate the importance of a healthy diet to all patients. Dietetic counselling as part of the transplantation program may be an important signal in itself, saying that diet is an important part of the treatment.

RTRs do not necessarily eat different compared to others, and they do not generally need dietary guidelines that differ from dietary guidelines for the general population. It is their severely increased risk of CVD that put them in a vulnerable position, and hence a diet optimal for prevention of CVD should be strongly emphasised.

5.6 Limitations of the present study

There are several limitations of the present study. First, dietary assessments give information on the current diet, and do not necessarily represent the usual diet. Imprecise recording of dietary intake may be caused by several reasons, including conscious, or unconsciously underreporting unhealthy foods, over-reporting of healthy foods, and forgetting to record some of the food consumed. Social expectations, and perhaps guilt due to the awareness on the importance of healthy diet may be the cause for both over- and underreporting (164). The method used in the present study has both pros and cons, but are found to bee a good tool for dietary assessments among children and adolescents (115, 117).

Food producers may change the content in their products, and new foods are constantly being developed. This constitutes a challenge concerning dietary assessments. The food database used in KBS must be updated continuously. Still, keeping the food database up to date at all times is a huge challenge. Some foods can not be found in the food database, and must be coded as something similar. This will cause some inaccuracy in the results.

Although the same method was used in collection of data among RTRs and control subjects, there are some important limitations; data was collected ten years apart, and in different seasons. As already discussed, changes in the dietary intake among the general population can be suspected. Dietary intake is most likely influences by season because the range of food available is different in summer-time compared to winter-time. However, when excluding Christmas-time, the differences in intake during September to February might not be of great importance. It can be questioned whether January is a suitable month for diet assessment or whether a “hang-over” from Christmas-time is present. This could either mean continuing eating excessive amount of meat, cookies, and chocolate, or an urge to eat more healthy than usual.

However, this might be a question of greater importance when performing survey among adults.

Data regarding weight, height and BMI was collected from the last yearly follow-up, i.e. March 2009 to January 2010. Thus for some of the participants these data are old. Considering the age of the participants, this is a central limitation in the present study. Early adolescence is a period of growth, and weight and height may have changed a lot from the time of measurement to the time of dietary registration.

The study included 16 participants. The study population is relatively small, and thus 16 participants are quite acceptable. However, it is a relatively small sample size, and this weakens the strength of the results. Small sample sizes give less room for excluding subjects with extreme values for any variables, and for adjusting for differences between the groups, including age, sex and BMI. However, by comparing nutrient density some adjustment is being done.

An important limitation in the present study is the lack of information on level of physical activity. Without this information a proper evaluation of the energy-intake can not be done. Information on the level of physical activity is also essential when evaluating lifestyle and prevention of CVD (41). Only an evaluation of diet and whether or not this is optimal for prevention of CVD can be made in the present study. Any attempt to evaluate the actual risk of CVD would be unsuitable.

The use of immunosuppressive medications results in increased appetite, and especially the first period after the transplantation, when the dose of immunosuppressive medications is highest, this can be a challenge. This period will vary in length, depending on graft-function. Thus the heterogeneous immunosuppressive protocols, and the variation in years from transplantation is a limitation of the study. The dose and type of immunosuppressive medications will also influence the severity of other side-effects (55).

Blood samples and dietary registration were not performed at the same time. This is a limitation especially when discussing the need for protein and phosphorous

restrictions, since these restrictions depend on measured GFR, PTH, and serum-phosphate (30).

6. Conclusions

This study of dietary composition among paediatric RTRs showed both positive and negative results. Most of the participants had an intake of vitamin D and calcium consistent with the Nordic Nutrition Recommendation, which is positive considering their increased risk of bone disease. Intake of these nutrients was also higher than among healthy control subjects.

The dietary composition among the paediatric RTRs is however not optimal for prevention of CVD; percentage of energy from saturated fat was high, percentage of energy from added sugar was higher than recommended, intake of iron was low among the girls, and intake of dietary fibre, and fruits and vegetables was low.

The RTRs in the present study had a different macronutrient composition compared to the healthy control subjects; with a higher percentage of energy from protein and fat, and a lower percentage form carbohydrates. Due to the large time-span in collection of dietary data in these two groups, it is uncertain whether the differences detected reflect possible changes in dietary composition among the population in general, or different dietary composition among the RTRs due to prior renal disease.

There seem to be a high prevalence of CKD stage 2-3 among the Norwegian paediatric RTRs. According to NKF KDOQI guidelines the paediatric RTRs should have protein- and phosphorous restrictions in the same way as for CKD-patients with similar GFR before transplantation. The participants in the present study have a protein intake above these recommendations. Also the intake of phosphorous is high when compared to the recommendations from NKF KDOQI.

The RTRs do not necessarily have a dietary composition very different from the population in general. Still, considering their elevated risk of CVD, a healthy lifestyle should be strongly emphasised for these patients. Fifty percent of the participants have had dietetic counselling after the transplantation, and a higher proportion (80%) would like to have dietetic counselling after the transplantation. By including dietetic

counselling as part of the transplantation program, every patient would be provided dietary guidance, and an important signal would be sent to the patients that diet and an overall healthy lifestyle is an important part of the treatment and management after a renal transplantation.

7. Future aspects

Kidney transplantation provides improved quality of life compared to dialysis, and is the first choice of renal replacement therapy. Still, CVD is one of the main causes of death among the Norwegian patients (7). More studies are needed to achieve the optimal immunosuppressive protocols with minimal side-effects, as these medications seem to contribute greatly to the CVD risk factors among RTRs today.

Dietetic counselling as a central part of the management of these patients should be introduced, and the patients should receive teaching on healthy lifestyle. Guidelines for lifestyle counselling in RTRs should be made and distributed to the local hospitals. Thus, all patients could be offered dietary guidance regularly. These guidelines should also include recommendations in relation to dietary management of CKD. A healthy lifestyle may reduce the risk of cardiovascular disease, and perhaps also slow the progression of renal failure. The importance of a healthy lifestyle should be emphasized strongly to these patients. Studies to evaluate the efficiency of these proposed measures in the effort to prevent CVD will be needed.

"Transplanted children are, given their longer life expectancy than adults, exposed for cardiovascular risk factors both as children and as adults. It is therefore even more important to identify and prevent risk factors for cardiovascular death at an early stage" (7).

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RIKSHOSPITALET
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HENT studien

Forespørsel om å delta i forskningsprosjekt ved Rikshospitalet:

Kostholdsundersøkelse blant nyretransplanterte barn og ungdom ved Rikshospitalet

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Du er en av de som er nyretransplantert her ved Rikshospitalet. Nå spør vi deg om du vil delta i denne undersøkelsen vedrørende kostvaner etter nyretransplantasjon.

Vi ønsker å vite mer om hvordan de som er nyretransplantert har det, og vi har derfor på Barneklinikken på Rikshospitalet en undersøkelse som heter Helse Etter Nyre Transplantasjon ”HENT” studien som du tidligere har vært med i.

Det vi ønsker at du skal gjøre er å skrive ned så nøyaktig som mulig alt du spiser i fire dager i en matdagbok. Dette kan sikkert foreldrene dine hjelpe til med. Du får en matdagbok for hver dag. Sammen med dagbøkene får du en skriftlig veiledning over hvordan du skal gjøre dette, og en bildebok som hjelper deg til å bestemme størrelsen på porsjonene.
I tillegg til registreringen i matdagbøkene ber vi deg om å svare på et kort spørreskjema. Alt vil foregå hjemme hos deg selv.

Når du har gjort dette skal det sendes tilbake til oss. Vi skal bruke noen spesielle dataprogrammer til å regne ut hvor mye du har spist og drukket, og finne ut hvor mye du har fått i deg av de forskjellige næringsstoffene. Du får vite hvordan dette gikk enten ved at vi ringer dere eller ved at du får møte en ernæringsfysiolog neste gang du er på årskontroll.

Alt du registrerer i matdagbøkene lagres på en datamaskin. Her lagres ikke navn og personlige opplysninger. Opplysningene tas bort om du ikke lenger vil være med i prosjektet.

Det er helt frivillig å være med. Om du i løpet av prosjektet finner ut at du ikke har lyst til å være med lengre, er dette helt greit. Lurer du på noe er det bare å ringe oss. Telefonnummer står nederst på arket.

Med vennlig hilsen

Anders Kyte	Linn Helene Stølen	Torill Valderhaug
Overlege	Klinisk ernæringsfysiolog	Masterstudent
Barnenefrologisk seksjon	Barneklinikken	Universitetet i Oslo

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Tilleggsinformasjon til foreldre/foresatte:

I Norge har nyretransplantasjon vært en etablert behandling siden slutten av 1960-tallet. Det første barnet ble transplantert i 1969. Etter 1970 har barn med terminal nyresvikt i alle aldere fått tilbud om transplantasjon på Rikshospitalet.

Den norske gruppen av barn har aldri tidligere vært studert i sin helhet og skiller seg fra andre land ved at de fleste har fått sin transplanterte nyre fra levende giver. Barneklinikken Rikshospitalet har derfor satt i gang Helse Etter Nyre Transplantasjon "HENT" studien. Hovedmålet med HENT-studien er å få en samlet oversikt over helsetilstanden til norske pasienter nyretransplantert i barn- og ungdomsalder. Målet er å identifisere risikofaktorer og utfall som kan forebygges på kort og lang sikt.

*Som et **tillegg til HENT-studien**, som allerede er godt i gang, ønsker vi nå å **se på kostholdet til de nyretransplanterte barna**.*

Vi ser at flere av pasientene har et ensidig sammensatt kosthold før transplantasjonen. Dette kan skyldes dårlig matlyst, kvalme, endret smaksopplevelse samt restriksjoner i forhold til inntak av ulike matvarer og næringsstoffer. Det viktigste i denne perioden er ofte å få i barna nok mat.
Etter transplantasjonen er imidlertid situasjonen en helt annen. Restriksjonene gjelder ikke lenger, smaksopplevelsene endres og matlysten blir dessuten betraktelig bedre. De fleste opplever en plutselig forandring i kosten i forbindelse med transplantasjon.

Mange pasienter går opp i vekt, særlig de første måneder etter transplantasjonen. Dette skyldes først og fremst medisinering, men også fravær av ubehag knyttet til nyresvikten. Vi vet at nyretransplanterte pasienter har en høyere risiko for hjertekarsykdom sammenlignet med befolkningen for øvrig. Man vet også at nyresvikt samt medisinering etter transplantasjon kan medføre svakheter i skjellettet. Et tilpasset kosthold vil trolig kunne redusere disse uheldige bivirkningene.

*Kostveiledning i etterkant av nyretransplantasjon inngår nå dessverre ikke som del av behandlingen og oppfølgingen. **Dette prosjektet har som mål å kartlegge kostholdet til nyretransplanterte barn og ungdommer i alderen 11-15 år samt å komme med eventuelle forslag til individuelle kostmessige tiltak.***

Vi ønsker også å se om det er samsvar mellom inntak av ulike næringsstoffer og blodprøveverdier (vitamin D og fettstoffer). Blodprøvene er allerede tatt – enten i forbindelse med HENT-studien eller i forbindelse med årskontroll.

Så, hva er det vi ber dere om å gjøre:
Kostholdsundersøkelsen vil foregå hjemme. Vi ber deltakerne om at de i fire dager skal registrere sitt matinntak så nøyaktig som mulig og notere dette ned i en "matdagbok". De/dere fyller ut en dagbok for hver dag. Sammen med dagbøkene får dere tildelt en skriftlig veiledning for utfylling, samt en **bildebok for bestemmelse av porsjonsstørrelser**. Det vil

også være mulig å ringe masterstudent Torill Valderhaug på telefon 92451299 mellom kl 08-21 de dagene registreringen pågår for eventuelle spørsmål. Hvis Torill ikke kan ta telefon, legg igjen telefonnummer så ringer hun tilbake så raskt som mulig.

I tillegg til registreringen vil deltakerne bli bedt om å besvare et kort spørreskjema.

Det er viktig at alle deltakerne leser veiledningen før de starter registreringen for å sikre riktig utfylling av matdagbøkene. Her står også hvilke ukedager vi ber om at dere registrerer kosten. Foreldre må hjelpe til med å fylle ut matdagbøkene.

*Pasientene vil på bakgrunn av registreringen få **individuell tilbakemelding** og **eventuelle konkrete råd om endringer i kosten**.*
Prosjektet utføres av en masterstudent i klinisk ernæring og klinisk ernæringsfysiolog ved Barneklinikken Rikshospitalet Linn Helene Stølen.

Prosjektleder for kostprosjekt i HENT-studien og kontakt:

Anders Kyte
Overlege
Barnenefrologisk seksjon
Rikshospitalet
0027 Oslo
Tlf: 23074565/23070000

Med vennlig hilsen

Anders Kyte	Linn Helene Stølen	Torill Valderhaug
Overlege	Klinisk ernæringsfysiolog	Masterstudent
Barnenefrologisk seksjon	Barneklinikken	Universitetet i Oslo

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HENT studien

Samtykkeerklæring:
Til foreldre/foresatte

Sendes inn sammen med kostdagbøkene.

Jeg/vi har lest informasjonsskrivet om forespørsel om å delta i forskningsprosjektet:

Kostholdsundersøkelse blant nyretransplanterte barn
-tillegg til Helse Etter Nyre Transplantasjon "HENT" studien

og gir min tilslutning til at _____ kan delta i undersøkelsen.

Navn: _____

Dato: _____ **Signatur:**_____

UNIVERSITETET I OSLO
DET MEDISINSKE FAKULTET

Seksjonsoverlege dr. med Anna Bjerre
Barneklinikken
Rikshospitalet, Rikshospitalet-Radiumhospitalet HF
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Regional komité for medisinsk forskningsetikk
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Dato: 16.11.09
Deres ref.:
Vår ref.: S-07245b

S-07245b Oppfølging av barn som ble nyretransplanterte i Norge i perioden 1970-2006 [2.2007.19]

Vi viser til amendment til HENT-studien datert 28.10.09 og e-posthenvendelse fra Trine Tangeraas datert 08.11.09 med spørsmål om tillatelse til å kontakte potensielle studiedeltakere per telefon.

Ad amendment av 28.10.09:
Det søkes om å gjøre en kostholdsundersøkelse blant nyretransplanterte barn fra 11-15 år som et ledd i HENT-studien. Bakgrunnen er at transplanterte pasienter ofte går opp i vekt etter transplantasjonen. Undersøkelsen vil foregå hjemme ved bruk av en fire dagers prekodet kostdagbok. Det er utformet et eget informasjonsskriv for tilleggsundersøkelsen.

Vedtak
Komiteen har vurdert endringsmeldingen og godkjenner endringen.

I tillegg til vilkår som fremgår av dette vedtaket, er tillatelsen gitt under forutsetning av at prosjektet gjennomføres slik det er beskrevet i søknad og protokollen, og de bestemmelser som følger av helseforskningsloven med forskrifter.

Forskningsprosjektets data skal oppbevares forsvarlig, se personopplysningsforskriftens kap. 2, og Helsedirektoratets veileder for "Personvern og informasjonssikkerhet i forskningsprosjekter innenfor helse- og omsorgssektoren" (http://www.helsedirektoratet.no/samspill/informasjonssikkerhet/norm_for_informasjonssikkerhet_i_helsesektoren_232354)

Prosjektet skal sende sluttmelding på eget skjema (se helseforskningsloven § 12) senest et halvt år etter prosjektslutt.

Ad forespørsel om å kontakte studiedeltakere per telefon:
Det gjøres rede for at deltakerne har mottatt forespørsel om deltakelse og en purring. Av i alt 58 forespurte har 30 svart positivt. 7 har svart nei. Det er følgelig et ønske om å kontakte de 21 som ikke har svart per telefon. I forespørselen refereres det til en samtale med komiteens sekretær som har gitt signaler om at komiteen kan være restriktiv med hensyn til telefonkontakt fordi man ikke ønsker at studiedeltakere skal utsettes for press til deltakelse. Komiteen ber imidlertid om at man utformer en søknad som beskriver hvordan man eventuelt har planlagt å gå frem for å forhindre at deltakere føler seg presset og hvor det gjøres rede for hvordan de etiske sidene ved en slik rekrutteringsform og hvordan frivillighet skal ivaretas på en god måte. Når komiteen har fått forelagt en velbegrunnet søknad vil det la seg gjøre å ta stilling til eventuell godkjenning av en slik henvendelsesform.

Med vennlig hilsen

Stein Opjordsmoen Ilner (sign.)
Leder

Julianne Krohn-Hansen (sign.)
Sekretær

Dokumentet er godkjent elektronisk.

Kopi: Trine.Tangeraas@rikshospitalet.no; anders.kyte@rikshospitalet.no

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Spørreskjema: Kostholdsundersøkelse blant nyretransplanterte barn og ungdom ved Rikshospitalet

Spørreskjemaet besvares av foresatte, gjerne i samarbeid med barnet

Sett kryss:

1. Snakket dere med klinisk ernæringsfysiolog før transplantasjon?

Ja □ Nei □

2. Hvis ja, hvor ofte skjedde dette?

□ 1 gang per år eller sjeldnere
□ 1-2 ganger per år
□ 3-4 ganger per år
□ oftere

3. Snakket dere med klinisk ernæringsfysiolog på sykehuset i forbindelse med transplantasjonen?

Ja □ Nei □

4. Har dere snakket med klinisk ernæringsfysiolog etter transplantasjonen?

Ja □ Nei □

5. Hvis ja, hvor ofte skjer dette?

□ 1 gang per år eller sjeldnere
□ 1-2 ganger per år
□ 3-4 ganger per år
□ oftere

6. For dere som har snakket med en klinisk ernæringsfysiolog, føler dere at dette har vært nyttig?

Ja, veldig nyttig □ Ja, ganske nyttig □ Litt nyttig □ Nei □

7. For dere som **ikke** har snakket med klinisk ernæringsfysiolog. Har dere/har dere hatt behov for eller ønske om å snakke med en klinisk ernæringsfysiolog?

Ja, vi har hatt behov for det □ Ja, vi har behov for det nå □ Nei □

8. Hvor ofte kunne dere tenke dere å snakke med klinisk ernæringsfysiolog før transplantasjon?

- 1 gang per år eller sjeldnere
- 1-2 ganger per år
- 3-4 ganger per år
- oftere
- aldri, hadde ikke behov

9. Hvor ofte kunne dere tenke dere å snakke med klinisk ernæringsfysiolog etter transplantasjon?

- 1 gang per år eller sjeldnere
- 1-2 ganger per år
- 3-4 ganger per år
- oftere
- aldri, har ikke behov

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HENT studien

Råd om utfylling av dagboken:

Råd om utfylling av dagboken:

Takk for at du har sagt ja til å delta!

For å få et best mulig bilde av det du spiser og drikker vil vi vite HVA og HVOR MYE du spiser og drikker i løpet av fire dager.

I mappen/vedlagt finner du :

- Råd om utfylling av dagboken
- Fire dagbøker, en dagbok for hver registreringsdag
- Fire hjelpeark som kan brukes til hjelp ved utfylling av dagboken
- Et bildehefte til hjelp ved beskrivelse av HVOR MYE som blir spist/drukket
- En frankert svarkonvolutt.

Kosten skal registreres følgende dager:

Dag 1 _____

Dag 2 _____

Dag 3 _____

Dag 4 _____

Du skal registrere alt du spiser og drikker fra du våkner om morgenen første registreringsdag til du sovner for natten siste dag i registreringsperioden.

Spis og drikk som du pleier. Det er VELDIG VIKTIG at du IKKE ENDRER noe på vanene dine i forbindelse med denne undersøkelsen.

Det er VELDIG VIKTIG at du skriver ned ALT du spiser og drikker i løpet av disse dagene.

Hvordan fyller jeg ut dagboken?

Bla gjennom dagboken og bildeheftet eventuelt sammen med foreldre/foresatte slik at dere blir kjent med innholdet. På de siste sidene i dette heftet er det eksempler på hvordan dagboken fylles ut.

Dagbøkene skal leses optisk, og det er derfor viktig at de fylles ut på riktig måte. Derfor ber vi dere vennligst lese gjennom dette heftet før dere starter.

Forsiden
På forsiden av hver dagbok skal du fylle inn kjønn, alder, hvilken ukedag det er, dato og om det er en vanlig eller uvanlig dag. På forsiden finner du også en oversikt over hvor du finner de ulike matvarene i heftet.

Tidsbolker
Legg merke til at en dag er delt inn i fem tidsbolker (eks. kl .6-10, kl. 10-14). Fire av disse er på fire timer, mens den siste strekker seg fra kl. 22 om kvelden til kl. 06 neste morgen.
Du skal skrive ned hvor mye du har spist eller drukket i de aktuelle tidsbolkene. Har du begynt å spise i en tidsbolk og sluttet i den neste, skriver du alt i den tidsbolken du begynte.

ABSOLUTT ALT du spiser og drikker skal registreres
For hver matvare/drikke er det oppgitt en enhet. For eksempel skal drikke angis i glass, og brød i antall skiver. Du skal for alle matvarer angi hvor mange enheter du har spist/drukket. Du kan skrive hele tall som 1,2,3 eller deler som ¼ eller 1 ½ for alle matvarer og drikker i dagboken. Antallet skal fylles inn i de sorte rutene.

ABSOLUTT BARE bokstaver i de orange rutene
For noen matvarer må du se i bildeboken, for å angi hvor mye du har spist. Ved disse matvarene er det vist til den bildeserien du må se på.
Bildeserien består av fire alternativer merket A, B, C, D. Velg det alternativet som stemmer best med hvor mye du har spist. Du skriver bokstaven i den orange ruten.
Enkelte matvarer skal du sammenligne med bilder som ikke ligner på det du har spist. Her skal du bruke bildene til å se hvor stor plass matvaren du spiser tar på tallerkenen.
Spiser du flere porsjoner av ulik størrelse, må du tenke hvordan alle porsjonene ville sett ut til sammen. Har du eksempelvis spist to porsjoner av spaghetti, en som ligner på B og en som logner på A, kan du skrive opp 1 ½ B. Skriv det som ligner best med det du spiste til sammen.

ABSOLUTT IKKE kryss i dagboken
Det skal aldri brukes kryss i dagboken. Det skal kun brukes tall og bokstaver.

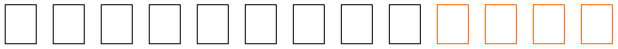
Når matvaren ikke er i dagboken
Spiser du matvarer/matretter som ikke finnes oppført i dagboken, må du beskrive nøye det du har spist, hvor mye og når du har spist. Dette skrives inn i de åpne boksene ”Annet – beskriv best mulig hva , hvor mye og når”.

Praktisk gjennomføring

Om du skriver i dagboken nøyaktig hva du har spist/drukket etter at du har spist, eller om du vil notere på hjelpearket og føre inn på kvelden, er opp til deg. Men ikke vent til neste dag, da kan det være lett å glemme noe.
Hjelpearket kan være greit å ha med seg på skolen og andre steder hvor det kan bli spist/drukket noe. Bruk eventuelt baksiden av hjelpearket om du vil gjøre mer detaljerte notater.

- Det er viktig at du ikke bretter eller krøller dagbøkene.
- Bruk gjerne myk blyant til å skrive med. Du kan også bruke penn.

Du skal skrive tall og bokstaver som vist her:



Lurer du på noe?

Vi ringer andre dagen i registreringsperioden for å oppklare eventuelle spørsmål eller problemer. Dere kan også ringe Torill Valderhaug på telefon 92451299 mellom kl 08-21 hvis det er noe dere lurer på i forbindelse med utfylling av dagboken. Hvis Torill ikke kan ta telefon, legg igjen telefonnummer så ringer hun tilbake så raskt som mulig.

Eksempel

Kari begynner å spise middag kl 17.45. Hun spiser en porsjon med spaghetti og tomatsaus med pølsebiter. I tillegg spiser hun en og en halv skive loff, en halv med soya soft margarin og en uten noe på. Til middag drikker hun ett glass saft. Hun spiser en halv mango til dessert. Kari tar frem dagboken og bildeheftet. Hun blar opp på siden for drikke. Hun finner linjen for ”saft med sukker” og i kolonnen ”kl 14-18” skriver hun ”1” i en av de sorte rutene. Etter å ha sett i bildeheftet skriver hun ”B” i den oransje ruten, da glasset hun brukte lignet mest på B-glasset.

	Antall	kl 6-10	kl 10-14	kl 14-18	kl 18-22	kl 22-6
Saft med sukker (eks. appelsin, solbær)	glass	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐

Kari spiste en og en halv skive loff, en halv med soft soya margarin og en uten. Hun blar opp på siden med brød. Hun finner linjen med ”loff/fint rundstykke” og skriver 1 ½ i de sorte rutene i kolonnen ”kl 14-18”. Hun ser på tykkelsen i bildeheftet og finner at tegning C passer best til brødskivene hun spiste. Hun skriver ”C” i den oransje ruten.

	Antall	kl 6-10	kl 10-14	kl 14-18	kl 18-22	kl 22-6
Loff/fint rundstykke	skiver	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐

Kari finner linjen med margarin og skriver ”½” i kolonnen ”kl 14-18”.

		kl 6-10	kl 10-14	kl 14-18	kl 18-22	kl 22-6
Myk margarin (eks. Soya soft)	til antall skiver	☐☐	☐☐	☐☐	☐☐	☐☐

Deretter ser Kari i bildeheftet og finner at hun brukte samme mengde margarin som på bilde B. Under ”Hvor mye smurte du på brødet?” skriver Kari ”B” i den oransje ruten.

Bildeserie 3	kl 6-10	kl 10-14	kl 14-18	kl 18-22	kl 22-6
	☐	☐	☐	☐	☐

Kari spiste en porsjon med spaghetti og tomatsaus med pølsebiter. Kair blar opp på sidene med andre retter. Det er to pastaretter å velge mellom. Kari velger ”pasta med tomatsaus”. Deretter slår hun opp i bildeheftet for å anslå hvor mye pasta og saus hun spiste. Porsjonen lignet mest på bilde C. Derfor skriver hun ”1” i den sorte ruten og ”C” i den oransje ruten.

		kl 6-10	kl 10-14	kl 14-18	kl 18-22	kl 22-6
Pasta med tomatsaus uten kjøtt	bildeserie 6	☐☐☐	☐☐☐	☐☐☐	☐☐☐	☐☐☐

I tillegg skriver hun hvor mye pølser hun hadde i tomatsausen. Kari finner linjen med ”Grillpølse/wienerpølse vanlig” og skriver ”1” i kolonnen ”kl 14-18”.

	Antall	kl 6-10	kl 10-14	kl 14-18	kl 18-22	kl 22-6
Grillpølse/ Wienerpølse Vanlig	stk	☐☐	☐☐	☐☐	☐☐	☐☐

Kari finner ikke mango blant fruktene som er nevnt i dagboken. I boksen ”Annet” etter frukt skriiver hun ”Mango, ½ stk, kl 1745”.

Annet
Beskriv best mulig hva, hvor mye og når

Send inn de fire utfylte dagbøkene sammen med signert samtykkeerklæring med en gang etter at registreringsperioden er over. Bruk den ferdig frankerte svarkonvolutten.

Hvis du har mistet konvolutten, bruk følgende adresse:

Linn Helene Stølen
Barneklinikken
Rikshospitalet
0027 Oslo

Dagbok

Fyll inn:

Kjønn ☐ Skriv 1 hvis gutt/mann, 2 hvis jente/kvinne

Alder ☐☐ år

Ukedag ☐ 1=mandag, 2=tirsdag, 3=onsdag, 4=torsdag, 5=fredag, 6=lørdag og 7=søndag

Dato ☐☐.☐☐.☐☐

Var denne dagen en vanlig dag? Skriv ja eller nei i rutene.

☐☐☐

Hvis det var en uvanlig dag, forklar hvorfor denne dagen var uvanlig:

Hvor finner jeg matvarene i dagboken?

HUSK:

Alt du spiser/drikker skal skrives opp

Sett ikke kryss i dagboken

Sett bare bokstaver i de orange rutene

Sett bare tall i de sorte rutene

Drikke

For størrelsen på glasset du drikker av, se bildeserie 1.
Fyll inn bokstaven i den orange ruten.

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Vann	glass					
Helmelk, søt/sur (eks. helmelk, kefir)	glass					
Lettmelk, søt/sur (eks. lettmelk, Cultura)	glass					
Ekstra lett lettmelk	glass					
Skummet melk	glass					
Drikkeyoghurt	glass					
Sjokolademelk av helmelk (eks. O'boy, Nesquick)	glass					
Sjokolademelk av lettmelk (eks. Nesquick, Litago)	glass					
Sjokolademelk av ekstra lett lettmelk (eks. O'boy)	glass					
Sjokolademelk av skummet melk (eks. O'boy, Nesquick)	glass					
Litago sjokolademelk	1/2 liter					
Kakao av helmelk	kopp					
Kakao av lettmelk	kopp					
Kakao av ekstra lett lettmelk	kopp					
Kakao av skummet melk	kopp					
Appelsinjuice	glass					
Eplejuice/eplemost	glass					
Nektar (eks. eple, tropisk frukt, annen frukt)	glass					
Brus med sukker (eks. Cola, Solo)	glass					
Brus med sukker (eks. Cola, Solo)	1/2 liter					
Brus, kunstig søtet (eks. Cola light, Solo lett)	glass					
Brus, kunstig søtet (eks. Cola light, Solo lett)	1/2 liter					

Drikke forts.

		Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Saft med sukker (eks. husholdning, appelsin, solbær)	glass						
Saft, kunstig søtet (eks. Fun light)	glass						
Mineralvann (eks. Farris)	glass						
Mineralvann (eks. Farris)	1/2 liter						
Energidrikk (eks. Battery)	boks (330 ml)						
Te, vanlig (eks. Earl Grey, solbær)	kopp						
Fruktte (eks. nype, kamille)	kopp						
Iste/urtete med sukker	glass/pakning (250 ml)						
Kaffe, kokt (eks. presskanne)	kopp						
Kaffe, traktet/filter	kopp						
Kaffe, pulver (instant)	kopp						
Caffe latte, Cappucino	glass/kopp (4dl)						
Espresso	kopp (1dl)						
Sukketter/Natrena/ Canderel	stk						
Sukker til te/kaffe	teskje/ biter						
Melk til te/kaffe	spiseskje						

Annet
beskriv best mulig hva, hvor mye og når:

Øl, vin, brennevin

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Alkoholfritt øl, vørterøl (eks. Clausthaler, Munkholm)	glass					
Lettøl	boks/flaske (330 ml)					
Pilsner	boks/flaske (330 ml)					
Sterkøl	boks/flaske (330 ml)					
Rusbrus (eks. Cider, Bacardi breezer)	boks/flaske (330 ml)					
Hvitvin	glass					
Rødvin	glass					
Brennevin	dram (4 cl)					

Annet
beskriv best mulig hva, hvor mye og når:

Brød m.m.

Skriv antall skiver i sort rute. For tykkelse på brødskiven se bildeserie 2 og fyll inn bokstaven i orange rute.

1 skive = 1/2 rundstykke

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Loff/fint rundstykke	skiver					
Mellomgrovt brød, grovt rundstykke, kneippbrød	skiver					
Grovt brød	skiver					
Dansk rugbrød, Pumpernikkel	skiver					
Baguette/Ciabatta	stk					
Knekkebrød lyst, skonrok, kavring	stk					
Knekkebrød, mørkt	stk					
Lompe, potetlefse	stk					
Pølsebrød, hamburgerbrød	stk					
Pitabrød	stk					
Flatbrød (eks. Mors flatbrød, Ideal)	stk					

Smør eller margarin på brød.

1 skive = 1/2 rundstykke = 1 knekkebrød
= 2 vaffelhjerter = 2 kjeks = 1/2 ciabatta

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl.22-6
Meierismør	til antall skiver					
Bremykt	til antall skiver					
Brelett	til antall skiver					
Margarin (eks. Soya, Per, Melange)	til antall skiver					
Lettmargarin (eks. Soft light)	til antall skiver					
Annet beskriv best mulig hva, hvor mye og når:						

Hvor mye smurte du på brødet?

Se bildeserie 3 og skriv bokstaven for det bildet som ligger nærmest opp til den smør-/margarinmengden du brukte på brødet. Hvis du hadde forskjellig mengde smør/margarin på de brødskivene du spiste innenfor det angitte tidsrommet, kan du anslå et gjennomsnitt for skivene.

	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Bildeserie 3					

Pålegg

Du skal oppgi mengde pålegg i forhold til brødskiver. Har du spist to typer pålegg på samme brødskive, fører du opp begge (eks. 1 hvitost helfet og 1 skinke). Hvis du bare har spist pålegg og ikke brød, anslå til hvor mange skiver du kunne brukt dette pålegget.

1 skive = 1/2 rundstykke = 1 knekkebrød
= 2 vaffelhjerter = 2 kjeks = 1/2 ciabatta

Kjøttpålegg	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Servelat, vanlig	til antall skiver					
Kokt skinke, spekeskinke, lett servelat	til antall skiver					
Salami, spekepølse, fårepølse	til antall skiver					
Leverpostei, vanlig	til antall skiver					
Leverpostei, mager	til antall skiver					
Kalkun-/ kyllingpålegg	til antall skiver					

Ost	**Antall**	**kl. 6-10**	**kl. 10-14**	**kl. 14-18**	**kl. 18-22**	**kl. 22-6**
Hvitost helfet 27% fett (eks. Jarlsberg, Norvegia)	til antall skiver					
Hvitost halvfet 16% fett (eks. Norvegia lettere)	til antall skiver					
Brunost helfet (eks. Geitost, G35, Fløtemysost)	til antall skiver					
Brunost halvfet, prim	til antall skiver					
Smøreost, vanlig (eks. Baconost, Snøfrisk)	til antall skiver					
Smøreost, mager (eks. mager skinkeost)	til antall skiver					
Kremost (eks. Philadelphia, Gourmetoster)	til antall skiver					
Dessertost (eks. Brie, Gräddost, Ridderost)	til antall skiver					

Fiskepålegg	**Antall**	**kl. 6-10**	**kl. 10-14**	**kl. 14-18**	**kl. 18-22**	**kl. 22-6**
Kaviar	til antall skiver					
Røkt laks/ørret	til antall skiver					
Makrell i tomat, røkt makrell	til antall skiver					
Sardiner, sursild, ansjos	til antall skiver					

Syltetøy/søtpålegg	**Antall**	**kl. 6-10**	**kl. 10-14**	**kl. 14-18**	**kl. 18-22**	**kl. 22-6**
Syltetøy vanlig, gelé, marmelade	til antall skiver					
Syltetøy lett, frysetøy	til antall skiver					
Honning	til antall skiver					
Peanøttsmør	til antall skiver					
Sjokolade-/nøttepålegg	til antall skiver					
Hapå/Litagopålegg	til antall skiver					

Annet
beskriv best mulig hva, hvor mye og når:

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Annet pålegg

1 skive= 1/2 rundstykke= 1knekkebrød
=2 vaffelhjerter= 2 kjeks= 1/2 ciabatta

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Egg, kokt/stekt	til antall skiver					
Majonessalat (eks. italiensk salat, rekesalat)	til antall skiver					
Majonessalat, lett (eks. italiensk salat, lett)	til antall skiver					
Tomat som pålegg	til antall skiver					
Banan som pålegg	til antall skiver					

Annet
beskriv best mulig hva, hvor mye og når:

Pynt på brødskiver

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Majones/remulade, vanlig	til antall skiver					
Majones/remulade, lett	til antall skiver					
Agurk (frisk/syltet)	til antall skiver					
Rødbeter (syltet)	til antall skiver					
Paprika	til antall skiver					

Annet
beskriv best mulig hva, hvor mye og når:

Yoghurt

	Antall	kl. 6-10	kl.10-14	kl.14-18	kl.18-22	kl.22-6
Yoghurt med frukt	beger (175 ml)					
Yoghurt 0,1% fett	beger (125 ml)					
Yoplait frukt	beger (125 ml)					
Litago yoghurt	beger (125 ml)					
Litago yoghurt m/müsli	beger inkl. müsli					
Go'morgen yoghurt m/müsli	beger inkl.müsli					
Piano Duo Yoghurt	beger (125 ml)					

Frokostgryn/grøt

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Havregrøt	bildeserie 5					
Havregryn	bildeserie 4					
Firkorn	bildeserie 4					
Müsli, søtet (eks. Crusli, Solfrokost)	bildeserie 4					
Müsli, usøtet (eks. Go'Dag, Frukt müsli)	bildeserie 4					
Cornflakes	bildeserie 4					
Honnikorn/ Frosties/Chocofrokost	bildeserie 4					
Puffet ris/ havrenøtter/hvetenøtter	bildeserie 4					

Annet
beskriv best mulig
hva, hvor mye og når:

Melk/sukker/syltetøy brukt sammen med frokostgryn og grøt

3 teskjeer=1 spiseskje

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Helmelk, søt/sur	dl					
Lettmelk, søt/sur	dl					
Ekstra lett lettmelk	dl					
Skummet melk, søt/sur	dl					
Syltetøy vanlig, gelé, marmelade	teskjeer					
Syltetøy lett, frysetøy	teskjeer					
Sukker	teskjeer					

Annet
beskriv best mulig
hva, hvor mye og når:

For drikkeyoghurt som tilbehør til frokostgryn og grøt se side 2
For yoghurt som tilbehør til frokostgryn og grøt se side 7

Kjøtt og kjøttretter

Pølse	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Grillpølse/wienerpølse, vanlig	stk					
Grillpølse/wienerpølse, lett	stk					
Kalkun/kyllingpølse	stk					
Middagspølse/ kjøttpølse/medisterpølse	kjøttpølse (15cm)					
Middagspølse/ kjøttpølse, lett	kjøttpølse (15cm)					

Kjøttretter/pizza

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Karbonader	stk					
Kjøttkaker/medisterkaker	stk					
Elg-/reinkarbonader	stk					
Snitzel (eks. ostesnitzel)	stk					
Løvstek	skiver					
Hamburger med brød (eks. vanlig, McDonalds mfl.)	stk					
Tacoskjell med kjøttdeig og salat	fylte skjell					
Pitabrød med kjøtt og salat	fylte pita					
Kebab	fylte pita					
Kjøttdeigsaus/tomatsaus med kjøttdeig	bildeserie 11					
Lasagne	stk (10x8cm)					
Moussaka	stk (10x8cm)					
Pizza, trekantstykker	bildeserie 12					
Pizza, firkantstykker	bildeserie 13					

Annet
beskriv best mulig hva, hvor mye og når:

For lompe, pølsebrød og hamburgerbrød se side 4
For ketchup og sennep se side 14
For kokt pasta (uten saus) se side 13

Kjøtt forts.

Rent kjøtt	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Biff (okse, lam, svin)	stykker					
Koteletter (svin, lam, okse)	koteletter					
Stek (svin, lam, okse)	skiver					
Skinke (Bayonne, hermetisk)	skiver					
Elg-/hjort-/reinsdyrstek	skiver					
Grillet kylling	1/4 kylling					
Kyllingfilet	fileter					
Bacon	skiver					

Gryteretter	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Risotto	bildeserie 11					
Fårikål	bildeserie 11					
Lapskaus	bildeserie 11					
Gryterett (basis) med kjøttdeig/pølser	bildeserie 11					
Gryterett med elg-/hjort-/reinsdyrkjøtt	bildeserie 11					
Gryterett med får-/okse-/svinekjøtt	bildeserie 11					
Leverretter	bildeserie 11					

Annet
beskriv best mulig hva, hvor mye og når:

For saus se side 14

Fisk og fiskeretter

Fiskefarse

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Fiskeboller	stk					
Fiskekaker/fiskepudding	stk/skiver					

Ren fisk

Torsk/sei, kokt/bakt	stykke					
Torsk/sei, stekt	bildeserie 14					
Laks/ørret, kokt/bakt	stykke					
Laks/ørret, stekt	bildeserie 14					
Makrell, kokt	stykke					
Makrell, stekt	bildeserie 14					
Flyndre/steinbit, kokt	stykke					
Flyndre/steinbit, stekt	bildeserie 14					

Tillagede fiskeretter og fiskepinner

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Fiskepinner	stk					
Panert fisk	stk					
Fiskegryte/suppe med fisk	tallerken (3 dl)					
Fiskegrateng	stk (10x8cm)					

Reker og fiskeinnmat

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Reker (uten skall)	bildeserie 9					
Torskerogn	skiver					
Fiskelever	spiseskjeer					

Annet
beskriv best mulig hva, hvor mye og når:

Andre retter

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Risengrynsgrøt (For sukker se s. 8 og smørøye s. 5)	bildeserie 5					
Pannekaker (For sukker og syltetøy se s. 8)	stk					
Suppe (eks. blomkål, tomat)	tallerken (3dl)					
Ertesuppe/betasuppe	tallerken (3dl)					
Kjøttsuppe (eks. Trøndersodd)	tallerken (3dl)					
Omelett	antall egg i stykket					
Eggerøre	til antall skiver					
Ostepai	stykke (10x8cm)					
Pasta med tomatsaus uten kjøtt	bildeserie 6					
Pasta med hvit saus (eks. carbonara)	bildeserie 6					

Vegetarrett
beskriv hva (oppskrift), hvor mye og når:

Annet
beskriv best mulig hva, hvor mye og når:

Blandet salat med kjøtt/fisk/skalldyr

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Blandet salat med kjøtt/skinke	bildeserie 10					
Blandet salat med skalldyr/fisk	bildeserie 10					
Blandet salat med tunfisk	bildeserie 10					
Blandet salat med pasta	bildeserie 10					

Annet
beskriv best mulig hva, hvor mye og når:

For dressing se side 14

Potet/ris/pasta

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Potet, kokt	stk					
Potet, bakt	stk					
Potetmos	bildeserie 7					
Gratinerte poteter	bildeserie 7					
Pommes frites	bildeserie 8					
Potetsalat med majones/rømmedressing	spiseskjeer					
Potetsalat med oljedressing	spiseskjeer					
Ris, kokt (eks. parboiled, naturris)	bildeserie 6					
Ris, kokt (eks. jasmin, basmati, hurtigris)	bildeserie 6					
Pasta, kokt (eks. spaghetti, makaroni, tagliatelle)	bildeserie 6					
Nudler (eks Mr.Lee)	pose					

Annet
beskriv best mulig hva, hvor mye og når:

Grønnsaker

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Gulrot	stk					
Kålrot	skive					
Brokkoli	bildeserie 9					
Blomkål	bildeserie 9					
Hodekål	skalk					
Surkål	spiseskjeer					
Råkost (gulrot, blandet av flere grønnsaker)	bildeserie 9					
Grønnsaksblanding, fryst (eks. amerikansk blanding)	bildeserie 9					
Blandet salat (eks. kinakål, mais, tomat og agurk)	bildeserie 10					

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Grønnsaker forts.

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Stekte grønnsaker (eks. wokblanding)	bildeserie 9					
Tomat	skiver/båter					
Paprika	ringer					
Mais	spiseskjeer					
Løk, stekt	spiseskjeer					
Ertestuing	spiseskjeer					

Annet
beskriv best mulig hva, hvor mye og når:

Saus/dressing

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Hvit saus	spiseskjeer					
Ostesaus	spiseskjeer					
Brun saus	spiseskjeer					
Smeltet smør/ margarin	spiseskjeer					
Tomatsaus (uten kjøtt)	spiseskjeer					
Ketchup	spiseskjeer					
Sennep	spiseskjeer					
Bernaisesaus ol.	spiseskjeer					
Dressing, vanlig (eks. Thousand Island)	spiseskjeer					
Dressing, lett (eks. Thousand Island light)	spiseskjeer					
Olje- og eddikdressing	spiseskjeer					
Seterrømme 35% fett	spiseskjeer					
Lettrømme 20% fett	spiseskjeer					
Majones/remulade, vanlig	spiseskjeer					
Majones/remulade, lett	spiseskjeer					

Annet
Beskriv best mulig hva, hvor mye og når:

Is/dessert

Is

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl.22-6
Is (eks. vanilje, krokan, sjokolade)	bildeserie 15					
Yoghurtis (eks. Dream, Living Lite)	bildeserie 15					
Ispinne (eks. Gullpinne, Pinup)	stk					
Kremmerhus (eks. Kroneis, Kronevaffel)	stk					
Saftispinne (eks. Lollipop)	stk					

Gelé, pudding, fromasj

Gelé (eks. sitron, jordbær)	bildeserie 15					
Pudding (eks. sjokoladepudding)	bildeserie 15					
Riskrem, multekrem, fromasj	bildeserie 5					
Risifrutti med saus	beger					

Hermetisk frukt, fruktgrøt

Fruktcoctail	bildeserie 5					
Ananas (ring), pære/fersken (halv)	stk					
Fruktgrøt, kompott	bildeserie 5					

Annet
beskriv best mulig hva, hvor mye og når:

Dessertsauser/krem

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Fløte	spiseskjeer					
Krem, pisket	spiseskjeer					
Sjokoladesaus	spiseskjeer					
Karamellsaus	spiseskjeer					
Vaniljesaus	spiseskjeer					

Annet
beskriv best mulig hva, hvor mye og når:

Kaker, gjærbakst

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Boller	stk					
Julekake, kringle	skive/stykke					
Skolebrød, skillingsbolle	stk					
Wienerbrød, wienerkringle	stk					
Vafler (Se syltetøy s. 6, se rømme s. 14)	hjerter					
Eplekake, pai med frukt/bær	stykker					
Formkake, muffins	skive/stk					
Sjokoladekake	stykker					
Marsipankake, bløtkake	stykker					
Fyrstekake, nøttekake	stykker					
Smultring	stk					
Kokosbolle	stk					

Kjeks	**Antall**	**kl. 6-10**	**kl. 10-14**	**kl. 14-18**	**kl. 18-22**	**kl. 22-6**
Kjeks (eks. Mariekjeks, Gjende), småkaker	stk					
Fylte kjeks (eks. Ballerina, Monaco, Pepita)	stk					
Havrekjeks (eks. Bixit, Sibas)	stk					
Smørbrødkjeks (eks. Kornmo, GoldenCrisp)	stk					
Smørbrødkjeks (eks. Kaptein, Start)	stk					
Salte kjeks (eks. Ritz, Salinas)	stk					
Kjeks med sjokolade (eks. Maryland cookies, Bixit med sjokoladetrekk)	stk					

Annet
beskriv best mulig hva, hvor mye og når:

31963

Frukt/bær	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Eple	stk					
Banan	stk					
Pære	stk					
Appelsin	stk					
Mandarin/klementin	stk					
Druer	stk					
Fersken/nektarin	stk					
Melon, vann	skive					
Melon, eks. cantalup	skive					
Jordbær (friske/frosne)	stk					
Rosiner	neve					
Kiwi	stk					

Annet
beskriv best mulig hva, hvor mye og når:

Snacks	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Potetgull, vanlig (1 neve= 8 flak)	neve					
Potetgull, vanlig	pose (300g)					
Potetgull, lett/ potetskruer (1 neve= 8 flak)	neve					
Potetgull, lett/ potetskruer	pose (300g)					
Ostepop (1 neve= 8 ostebuer)	neve					
Maischips (1 neve= 8 flak)	neve					
Peanøtter	pose (100g)					
Popcorn	neve					
Dip (eks. rømme m/dipmix)	spiseskjeer					

Annet
beskriv best mulig hva, hvor mye og når:

31963

Godterier

Sjokolade/konfekt	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Melkesjokolade (Melkesjokolade, Firkløver, Helnøtt)	plate (100g)					
Melkesjokolade (Melkesjokolade, Firkløver, Helnøtt)	ruter					
Mørk kokesjokolade	staver/4 ruter					
Marsipan med sjokolade (eks. Gullbrød, marsipangris)	som Gullbrød (65g)					
Sjokoladebiter (eks. Twist, konfekt)	biter					
Kinderegg	stk					
Snickers, Japp	stk (85g)					
Kjekssjokolade (eks. Kvikklunsj, Twix)	som Kvikklunsj (46g)					
Gelesjokolade (eks.Troika)	stk					
New Energy	stk					

Smågodt	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Lakris (eks. "salte sild", lakrisbåter)	stk					
Gelégodt (eks. seigmenn, vingummi, "colaflasker")	stk					
Skumgodt (eks. "viskelær", "sopp", marshmellows)	stk					
Syrlige drops (eks. "bringebær", salte og sure bomber)	stk					
Karamell (eks. Fudge, Smørbukk, Fox)	stk					
Godteripose (Godt & blandet, Søppeldynga, Partymix)	pose (150g)					
Kjærlighet på pinne	stk					

Annet
beskriv best mulig hva, hvor mye og når:

31963

Drops/pastiller

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Drops/pastiller med sukker (eks. kamferdrops, Halslinser, Doc)	stk					
Pastiller, kunstig søtet (eks. Dent)	stk					
Tyggegummi med sukker	stk					
Tyggegummi, kunstig søtet (eks. Extra, V6)	stk					

Annet
beskriv best mulig
hva, hvor mye og når:

Tran/kosttilskudd

1 barneskje= 5 ml

	Antall	kl. 6-10	kl. 10-14	kl. 14-18	kl. 18-22	kl. 22-6
Tran	barneskje					
Trankapsler	stk					
Sanasol	barneskje					
Biovit	barneskje					
Multivitamin (eks. Vitaplex, Vitamineral)	stk					
Fluortabletter	stk					
Jerntabletter (9mg)	stk					
Folat (400 µg)	stk					

Annet
beskriv best mulig
hva, hvor mye og når:

Tillegg til matdagbok

Dagbok-nummer:

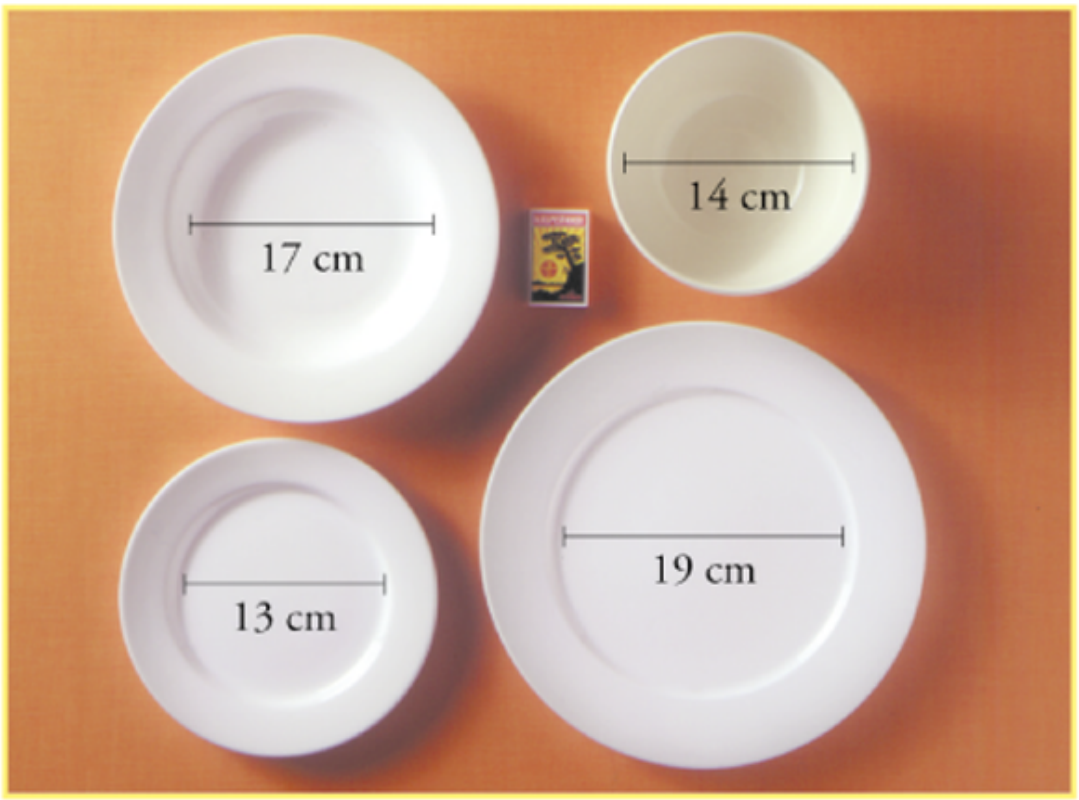
Skriv fullstendig navn på produkt og produsent samt mengde per dag på alle eventuelle kosttilskudd du tar i løpet av de fire dagene som vist i eksemplene nedenfor. Flytende kosttilskudd angis som barneskje (bs), spiseskje (ss), eller teskje (ts).

I siste kolonne angis hvor ofte du VANLIGVIS tar de enkelte tilskuddene med følgende koder:
1 = hver dag, 2 = annen hver dag, 3 = 1-3 ganger per uke, 4 = av og til, 5 = en sjelden gang

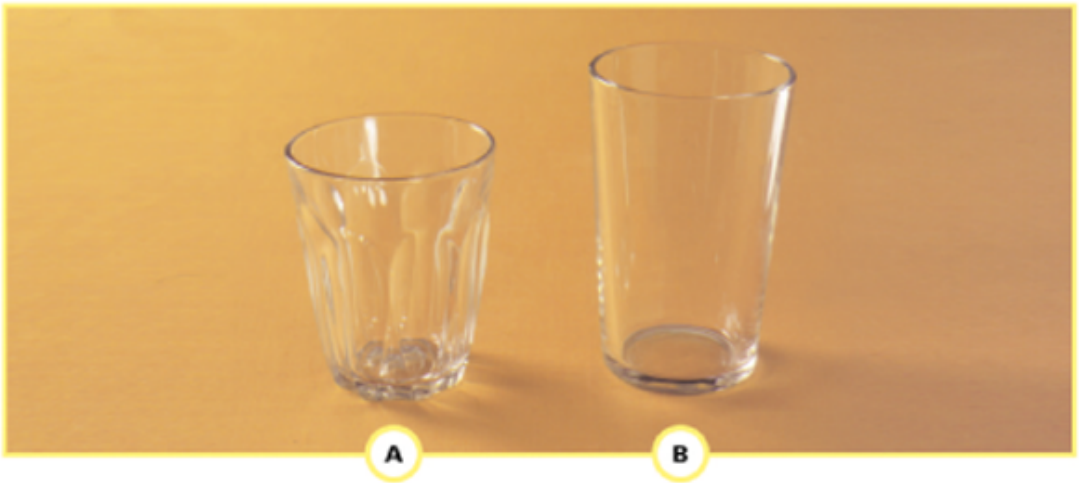
Produktnavn	**Produsent**	**Dag 1**	**Dag 2**	**Dag 3**	**Dag 4**	**Vanlig bruk**
Eks: Vitaplex Alt i ett	Cederroth	1 kapsel		1 kapsel		2
Eks: Møller's Omega-3 flytende	Peter Møller		1 bs		½ bs	2

Bildehefte med porsjonsstørrelser

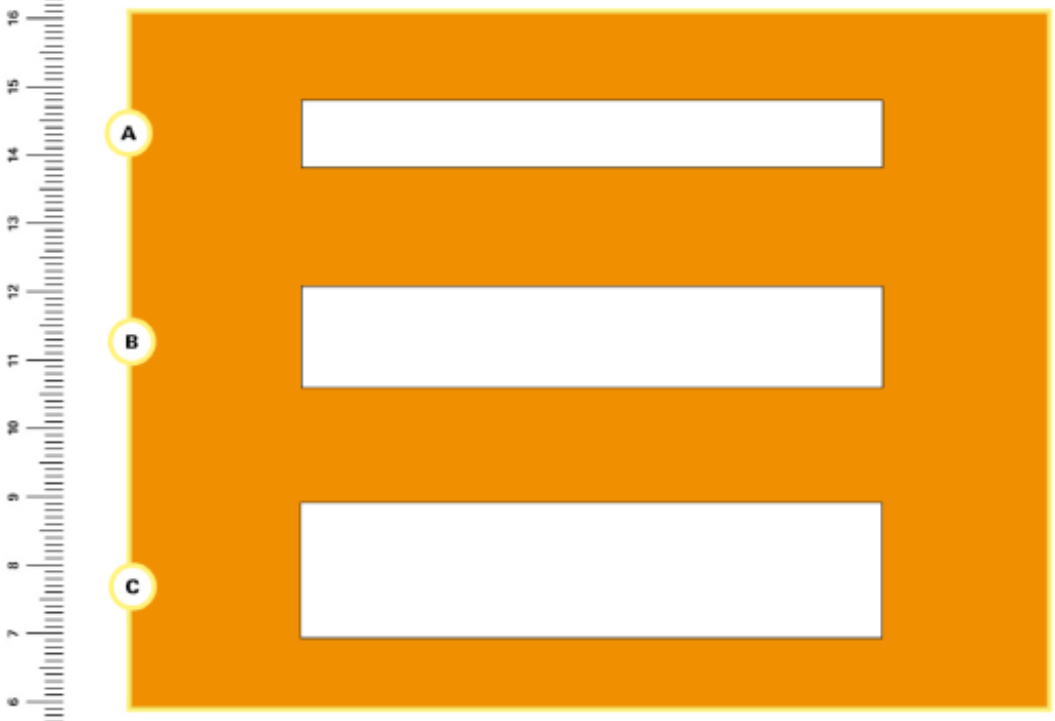
DETTE BILDET VISER STØRRELSEN PÅ TALLERKENENE SOM ER BRUKT I BILDEHEFTET



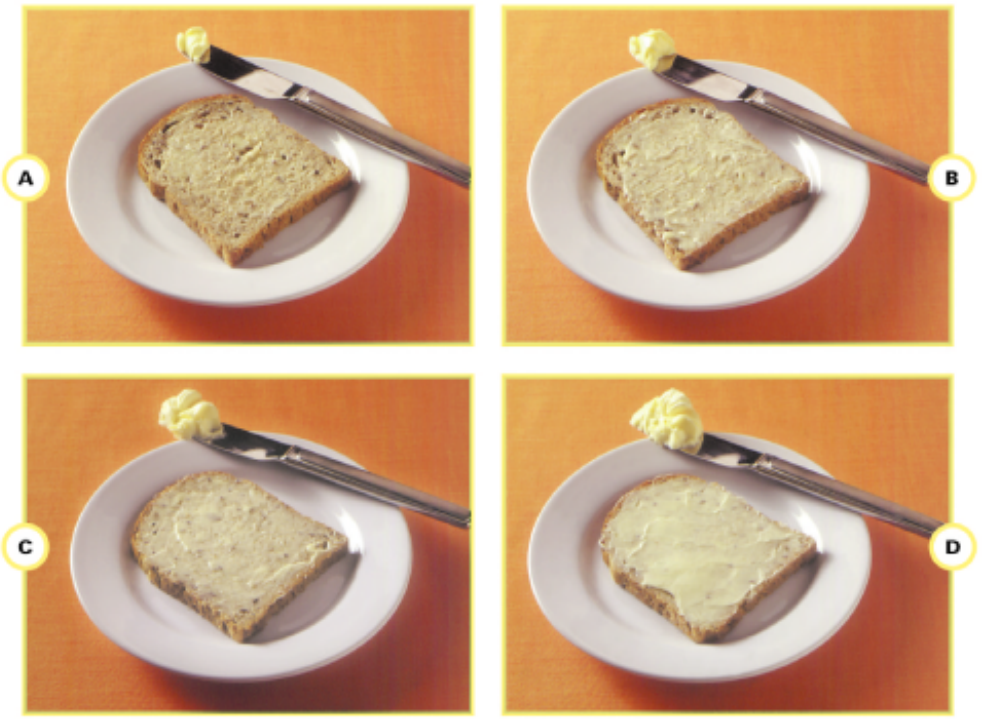
1. GLASS



2. BRØDTYKKELSE

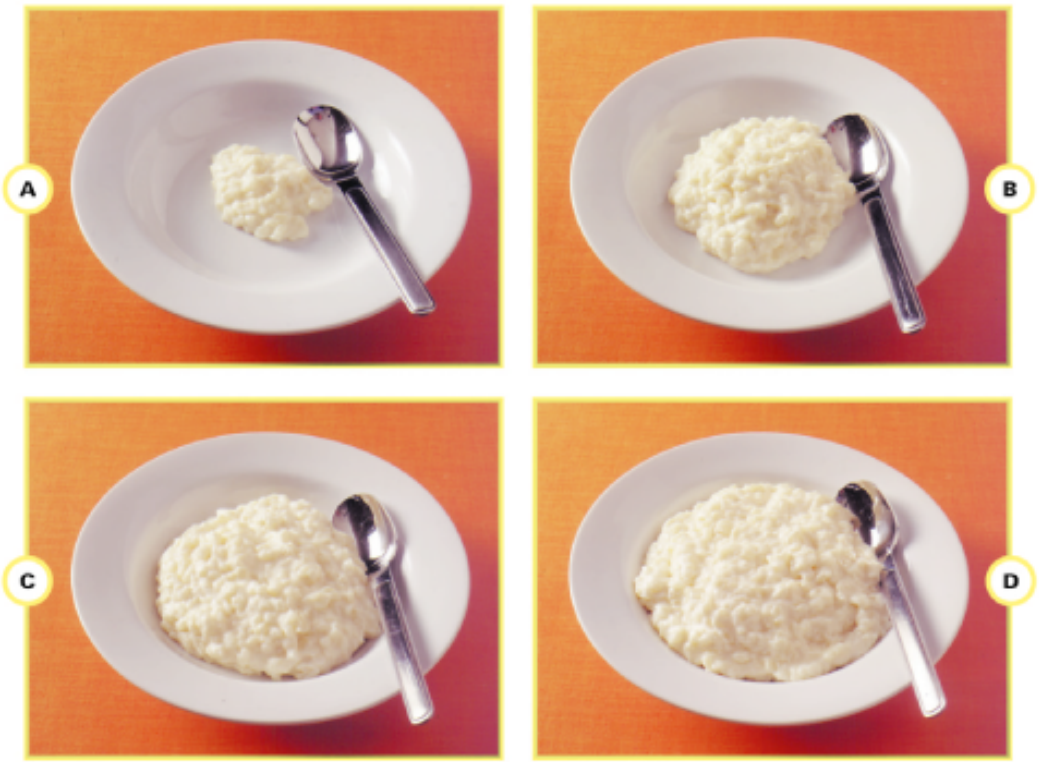


3. SMØR/MARGARIN PÅ BRØD

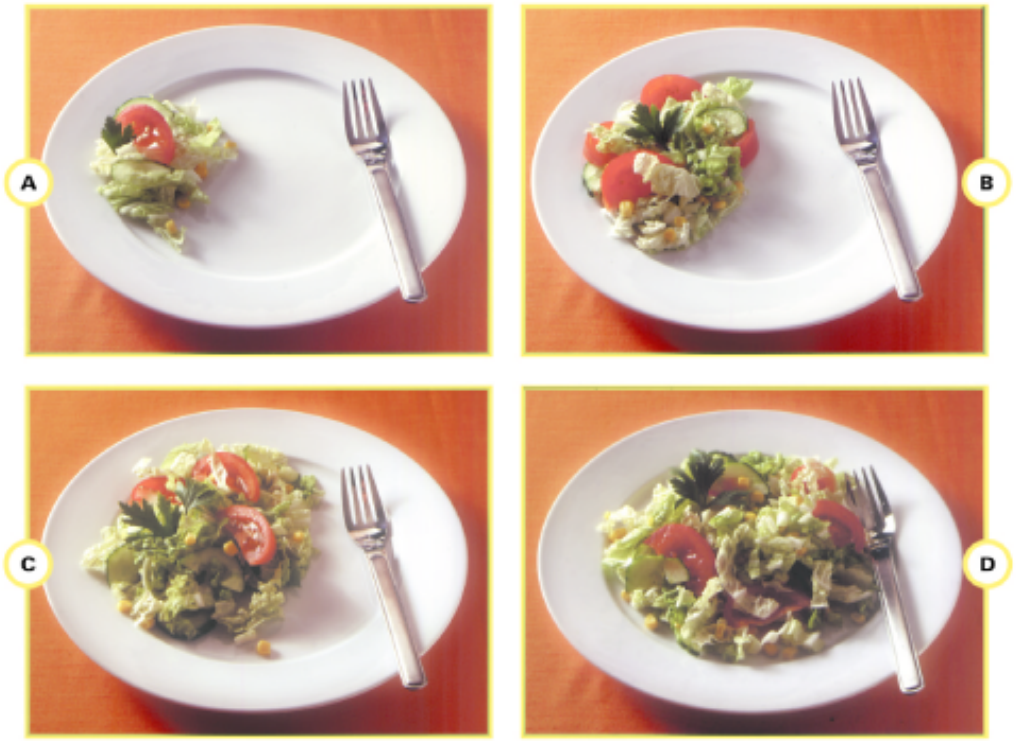


4. CORNFLAKES (FROKOSTBLANDING)

5. GRØT



10. SALAT



11. KJØTTSAUS (LAPSKAUS)

12. PIZZA, TREKANTSTYKKER

13. PIZZA, FIRKANTSTYKKER

UTVIKLET AV:

STATENS RÅD FOR ERNÆRING OG FYSISK AKTIVITET

SNT Statens næringsmiddeltilsyn

INSTITUTT FOR ERNÆRINGSFORSKNING

1. Did you have consultations with a clinical dietician before the transplantation?	Yes 11	No 5			
2 .If so, how often?	≤1[1] 8	1-2[1] 1	3-4[1] 1	More often 1	
3. Did you have consultations with a clinical dietician around the time of the transplantation?	Yes 6	No 10			
4. Have you had consultations with a clinical dietician after the transplantation?	Yes 8	No 8			
5. If so, how often?	≤1[1] 4	1-2[1] 3	3-4[1]	More often	
6. For those who had consultations with a clinical dietician, has this been useful?	Very useful 4	Quite useful 2	Helpful 3	No 1	
7. For those who have not had consultations with a clinical dietician, do/did you need or have/had the wish to meet with a dietician?	do need/ wish 1	did need/had the wish 3	No 5		
8. How often would you like ta have consultations with a clinical dietician before the transplantation?	≤1[1] 6	1-2[1] 2	3-4[1] 2	More often	Never 5
9. How often would you like to have consultations with a clinical dietician after the transplantation?	≤1[1] 8	1-2[1] 4	3-4[1]	More often	Never 3

[1]times per year

Percentage contribution of selected foods to intake of added sugar

	RTR subjects n=16	Control subjects n=1005
	Mean intake 68 g/day	Mean intake 95 g/day
Soft drinks with sugar	42	45
Chocolate and candies	14	20
Dairy products	13	8
Flavoured milk	6	1
Yoghurt	1	3
Icecream	4	2
Cakes	10	8
Sugar	7	3
Jam	5	3
Bread and cereals	3	2
Other food items	6	11

Percentage contribution of selected foods to intake of calcium

	Supplements included		Supplements not included	
	RTR subjects (n=16)	Control subjects (n=1005)	RTR subjects (n=16)	Control subjects (n=1005)
Mean intake, mg/day	975	859	881	858
Supplements	10	0		
Dairy products	36	46	40	46
Low fat milk	21	21	24	21
Flavoured milk	7	4	7	4
Ice-cream	2	2	3	2
Yoghurt	1	5	1	5
Cheese	29	20	32	20
Bread	3	3	3	3
Other cereals	7	13	8	13
Pizza	6	12	7	12
Vegetables, fruit and berries	4	4	4	4
Cakes	2	2	2	2
Other food items	9	12	11	12

Percentage contribution of selected food to intake of iron

	Supplements included		Supplements not included	
	RTR subjects (n=16)	Control subjects (n=1005)	RTR subjects (n=16)	Control subjects (n=1005)
Mean intake mg/day	27.2	10.9	7.7	9.4
Supplements	72 (n=8)	13 (n=109)		
Meat	7	18	26	21
Bread	6	20	21	23
Other cereals	2	12	9	14
Vegetables	2	3	8	4
Cakes	2	4	6	5
Fruit and berries	1	3	4	3
Dairy products	1	4	3	4
Potatoes	1	3	3	4
Sugar and sweets	1	9	2	10
Other food items	5	11	18	12

Percentage contribution of selected foods to intake of vitamin D

	Supplements included		Supplements not included	
	RTR subjects n=16	Control subjects n=1005	RTR subjects n=16	Control subjects n=1005
Total, µg	7.9	4.2	3.7	2.5
Supplements	53 (n=8)	39 (n=179)		
Fish and shellfish	18	15	39	25
Butter and margarine	12	26	27	42
Egg	9	3	19	5
Cakes	4	9	8	15
Dairy products	3	6	6	10

Table x: Intake of selected food items among consumers

	RTR subjects			Control subjects[1]		
	Median[2]	Percentile[3]	Percentage who consume food item[4]	Median[2]	Percentile[3]	Percentage who consume food item[5]
Vegetables, g	78	50-118	100	62	33-107	86
Fruit and berries, g	64	52-205	94	141	58-269	90
Milk and cream, g	305	180-501	100	328	193-518	99
Full fat milk, g	10	5-33	44	49	21-133	52
Low fat milk, g	164	121-339	88	185	75-340	74
Skimmed milk, g	94	74-113	13	58	38-133	28
Yoghurt, g	34	31-45	25	67	44-125	38
Cheese, g	33	25-42	100	24	10-40	80
Egg, g	16	15-33	50	14	sep.28	37
Meat, g	114	86-143	100	90	56-139	99
Fish, g	73	28-108	56	37	20-59	53
White bread, g	32	18-45	63	42	20-73	77
Wholemeal bread, g	50	24-71	44	47	24-90	56
Soft drinks w/sugar, g	443	114-609	63	383	225-603	95
Diet soft drinks, g	343	272-667	50	125	75-250	27
Sugar and sweets, g	20	12-35	88	41	20-70	96

[1]All control subjects included

[2]Subject who has not consumed the different food items are excluded

[3]25th and 75th percentile. Subjects who has not consumed the different food items are excluded.

[4]All RTR subjects included

[5]All control subjects included