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Psychosocial factors related to sodium adherence among patients with chronic kidney disease

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Table of Contents

Table of Contents	2
Abstract	3
1. Introduction	4
1.1 Background	4
1.2 Chronic Kidney Disease	4
1.2.1 Measuring kidney function	4
1.2.2 Stages of kidney function	5
1.2.3 Symptoms and consequences	6
1.2.4 Risk factors and causes	6
1.3 CKD and salt intake	7
1.4 Assessing salt intake	8
1.5 Adherence to a low sodium diet	8
1.6 Aim of the thesis	9
1.7 Perceived autonomy support, self-efficacy, motivation	10
1.8 Research hypotheses	12
2. Method	14
2.1 Patients	14
2.2 Design and procedure	14
2.3 Questionnaire	14
2.4 Medical record research	16
2.5 Data analysis	17
2.5.1 Data exploration	17
2.5.2 Analysis research questions	17
3. Results	18
3.1 Socio-demographic variables	18
3.2 Description of dependent and independent variables	20
3.3 Description of the correlations of all variables	20
3.4 Associations between the independent variables and perceived adherence	21
3.5 Associations between the independent variables and urinary sodium excretion	23
4. Discussion	25
4.1 Limitation, strength and future research	27
4.2 Conclusion	30
References	31

Abstract

Objective:

The incidence and prevalence of chronic kidney disease (CKD) is increasing worldwide. As kidney disease is irreversible, it is important to slow down the progression of kidney failure in order to prevent comorbidities, dialysis, transplant or even early death and this can be achieved by reducing dietary sodium intake. However, despite medical recommendations to cut down on sodium intake, non-adherence to a low sodium diet is common among patients with CKD. To gain more insights into this issue, relations are examined between self-efficacy, motivation, perceived autonomy support and sodium adherence.

Methods:

In total, 101 patients with CKD, who were not on dialysis or had a transplant, completed a questionnaire. The independent variables were assessed by validated questionnaires: The Partner in Health assessed self-efficacy, the Treatment Self-Regulation Questionnaire assessed intrinsic as well as extrinsic motivation, and the Modified Health Care Climate Questionnaire assessed perceived autonomy support. The dependent variable adherence was measured by a visual analogue scale, as well as by a single 24-hour urinary sodium excretion measurement. To investigate the relations between the independent and dependent variables Pearson Correlation and Multiple Regression Analyses were used. Adjustments were made for age and gender.

Results:

No significant relations were found between self-efficacy, motivation or perceived autonomy support with respect to perceived adherence. Only a trend was observed for perceived autonomy support ($\beta = .21, p = .06$) as well as for self-efficacy ($\beta = .21, p = .08$).

With respect to urinary sodium excretion only intrinsic motivation was significantly and negatively related, meaning that higher intrinsic motivation is positively associated with better adherence ($\beta = -.19, p = .04$).

Conclusion:

Interventions aimed at increasing sodium adherence in patients with CKD should focus on enhancing intrinsic motivation.

Psychosocial factors related to adherence among chronic kidney patients

1. Introduction

1.1. Background

Chronic Kidney disease (CKD) is a condition in which reduced kidney function is caused by damaged kidneys (Center for Disease Control and Prevention, 2014). At present, a worldwide effort is going on to include CKD in national programs to prevent and control noncommunicable diseases, the so-called NCDs (Tonelli et al., 2013). NCDs comprise four major diseases: cardiovascular diseases, diabetes, cancers and chronic respiratory diseases (World Health Organization, 2010). NCDs push up the disease burden on top of the major infectious diseases like HIV by taking the lead as biggest killer, even in many developing countries (Nissinen, Berrios, & Puska, 2001). These chronic diseases account for more than 60 percent of all deaths worldwide, exceeding all other causes of death taken together (World Health Organization, 2007). Considering the worldwide growing patient population, CKD should be seen as a major health problem as well (Nissenson et al., 2001). The Center for Disease Control and Prevention (CDC) estimates that more than 20 million adults in the United States, corresponding to more than 10 percent of the adult population, may have a reduced kidney function (CDC, 2014). With respect to the Netherlands, more than one million people suffer from this disease (Rabelink, 2014).

1.2. Chronic Kidney Disease

1.2.1. Measuring kidney function

The degree of severity is classified into five stages, based on the capacity of renal blood function and indicated by the Glomerular Filtration Rate (GFR). GFR stands for the rate of blood flow through the kidney; an ongoing process of blood cleansing which takes place hundreds of times each day. Most of the fluid is reabsorbed after the kidney filtration process, and a minor part is excreted as urine together with waste products (Karriem-Norwood, 2012). Usually, the waste product creatinine, built up as a result of a natural breakdown process of muscle tissue, is filtered out in the kidneys and almost entirely excreted in the urine. Due to insufficient kidney function, less creatinine is filtered out and is consequently reabsorbed into the blood. Thus, the more creatinine is found in the blood, the less the kidney filtrates. The extent to which kidneys are able to handle creatinine is called the creatinine clearance

(Karriem-Norwood, 2012). In clinical practice, creatinine clearance or estimates of it, based on the serum creatinine level, are used to assess GFR.

Chronic kidney disease not only encompasses the gradual loss of kidney function, but it also includes conditions that damage the kidneys. In 2000, the National Kidney Foundation ‘Kidney Disease Outcome Quality Initiative’ (KDOQI) defined chronic kidney disease (NKF KDOQI guidelines, 2000) based on kidney function as well as on kidney damage. National Kidney Foundation (NKF) defines CKD as either (1) kidney damage for three months or more, as established by kidney biopsy or markers of kidney damage, regardless of a decrease in GFR, or (2) GFR < 60 mL/ min per 1.73 m² for three months or more, regardless of kidney damage (Table 1).

Table 1
Criteria for the definition of chronic kidney disease (CKD)

Kidney damage for ≥3 months, as defined by structural or functional abnormalities of the kidney, with or without decreased GFR, that can lead to decreased GFR, manifested by either: Pathologic abnormalities; or markers of kidney damage, including abnormalities in the composition of the blood or urine, or abnormalities in imaging tests

GFR <60 mL/min/1.73 m² for ≥3 months, with or without kidney damage

Abbreviation: GFR, Glomerular Filtration Rate. National Kidney Foundation ‘Kidney Disease Outcome Quality Initiative’ Guidelines (2000)

1.2.2. Stages of kidney function

The NKF has drawn up KDOQI-guidelines defining five stages of CKD based on severity (NKF KDOQI guidelines, 2000). In the first stage, kidney function is normal (GFR > 90 ml/min/1.73 m²) and only slightly reduced in stage two (GFR between 60 and 89 ml/min/1.73 m²). In stage three, kidney function is moderately reduced. Most patients with CKD can be found at these earlier stages of the illness. Illustratively, in the Netherlands, a GFR of less than 60 ml/min/1,73 m² occurs in 5.3 percent of the population compared to 4.3 percent in the US (de Zeeuw, Hillege, de Jong, 2005). Severely reduced kidney function occurs in stages four and five, with dialysis or transplant mostly taking place in stage five, with a GFR < 15 ml/min/1.73 m². Approximately, 61.500 patients in the Netherlands suffer from severe kidney problems (Rabelink, 2014).

1.2.3. Symptoms and consequences

Whereas patients with CKD experience no symptoms in the early stages, symptoms rapidly increase in advanced stages of the disease. Common symptoms include sleep disturbance, muscle cramps and increased urination, as well as nausea, vomiting, weight loss and even anorexia (Bouquegneau, Dubois, Krzesinski, & Delanaye, 2012). Physical changes like pruritus, skin rash, edema in the extremities and around the eyes may also occur. Furthermore, patients with CKD may experience neuropathy, restless legs, poor concentration and change in taste. Overall, they may feel fatigue and experience malaise (Thomas-Hawkins & Zazworsky, 2005).

In later stages, CKD is associated with high rates of morbidity and mortality leading to reduced quality of life and early death (Chen et al., 2011). This assumption is supported by a longitudinal study of Keith and colleagues (2004), wherein increasing mortality rates were found for stages two, three and four with 19.5, 24.3 to 45.7 percent respectively. The increased prevalence of comorbidities over time is associated with additional disease burden. Patients with CKD were more likely to have other diseases, like coronary artery disease, congestive heart failure, hypertension, hyperlipidemia, diabetes mellitus and anemia (Chen et al., 2011). Consequently with this, Keith and colleagues (2004) noticed an increase in prevalence of comorbidities, especially anemia and congestive heart failure, concomitant with increased CKD severity. In general, vascular disease is the key cause of death for patients with CKD rather than kidney failure (Sarnak et al., 2003).

1.2.4. Risk factors and causes

As CKD elevates the risk of hypertension and cardiovascular disease, CKD can be both a cause and a consequence. Causes for CKD are many, but obesity, diabetes and hypertension can be seen as the leading risk factors for CKD. Levey and colleagues (2003) distinguished susceptibility risk factors like old age or race; initiation risk factors such as diabetes or high blood pressure; progression risk factors like obesity, smoking or poor glycemic control in diabetes; and end-stage risk factors e.g. anemia.

A separation can be made beyond this classification by looking at either demographic or modifiable risk factors. The latter, in particular, provides opportunities for intervention. Addressing preventable risk factors associated with unhealthy lifestyle can retard progression of CKD. Delaying the progression of the illness is important because kidney damage is irreversible, which might end up in life-threatening renal insufficiencies necessitating renal

replacement therapy in order to survive. Lifestyle changes, such as sufficient exercise, weight reduction and a healthy diet can be effective to postpone End Stage Renal Disease (ESRD). Interventions and objectives to slow the progression of CKD are: moderate protein restriction and low salt diets, blood pressure control, proteinuria, blood-glucose control in diabetes mellitus and dyslipidemia (Meguid El Nahas, & Bello, 2005).

1.3. CKD and salt intake

Weir and Fink (2005) put emphasis on the intake of salt as a potential changeable risk factor for the progression of kidney disease. It supersedes other risk factors due to great user-friendliness and accessibility. Despite these advantages, salt has been discussed for years as having a possible deleterious effect on health (Jones-Burton et al., 2006). Increasing evidence has been found, which confirms the negative effects of high salt intake on the kidneys leading to progression of the disease (Wright & Cavanaugh, 2010). Cianciaruso and colleagues (1998) have found evidence of a lower decline of GFR and better creatinine clearance in patients with low salt intake compared to patients with a high salt intake. Moreover, a high salt intake also causes hypertension and hereby indirectly effects CKD progression, since hypertension is extremely harmful to the kidneys (Cianciaruso et al., 1998). Therefore, controlling salt intake decreases hypertension and positively affects renal function (Meneton, Jeunemaitre, de Wardener, & McGregor, 2005).

The fact that especially patients with CKD respond strongly to increased salt intake, is caused by sensitivity to salt. Renal salt excretion is determined by arterial pressure. Salt sensitive patients, contrary to salt resistant patients, show huge rises in arterial pressure after increased salt consumption due to a less adaptive mechanism (Weir & Fink, 2004). Therefore, stronger signals are required to prompt renal salt excretion after high levels of salt intake. According to Koomans and colleagues (1982), salt sensitivity could be positively related to the level of renal impairment. The less nephron mass, which is associated with less capacity to excrete salt, the more arterial pressure is required after salt intake.

High levels of blood pressure can also be reached by another mechanism associated with increased salt consumption. The increased amount of salt intake can attenuate the lowering effect of anti-hypertensive drugs (Weir & Fink, 2004). Salt restriction can influence medication in a positive way by enhancing the effect of ACE inhibitors and nondihydropyridine calcium channel blockers resulting in less proteinuria (Heeg, de Jong, van der Hem, & de Zeeuw, 1989).

Furthermore, experimental studies suggest that the anatomical renal structure can be regulated by dietary salt. High salt intake affects physical loss of nephrons, which includes loss of renal mass. The loss of renal mass can trigger glomerular hypertrophy, which precedes glomerular sclerosis (Yoshida, Fogo, & Ichikawa, 1989), which is a mechanism of kidney scarring. Progressive glomerular sclerosis resembles atherosclerosis by sharing several risk factors, particularly hypertension (Meguid El Nahas & Bello, 2005). This process is counteracted by low dietary salt intake (Bernardi et al., 2012).

1.4. Assessing salt intake

In patients with CKD, it is important to obtain a clear picture of the salt intake. Estimates of sodium intake can be accomplished by objective and subjective measurements (McMahon et al., 2012a). The latter include retrospective and prospective self-report methods.

Retrospective methods, like recalling the diet or food frequency questionnaires, are often incorrect due to memory problems. Prospective methods, like food records, have the drawback of misreporting food and portion sizes or adjusting diet on record days. Therefore, subjective measures are not very accurate methods of measurement (Bentley, 2006).

The most objective and trustworthy method is 24-hour urinary sodium excretion which is often used in studies, as nearly all sodium intake (95% to 98%) is excreted in the urine (Bentley, 2006). Sodium excretion can differ greatly from hour to hour and because of its diurnal rhythm the assessment is most reliable when carried over 24 hours (Bentley, 2006).

1.5. Adherence to a low sodium diet

Although reducing salt intake seems to be important in the treatment of patients with CKD, changing eating behavior is difficult. Unfortunately, poor adherence to a low sodium diet is found to be common among patients with CKD (McMahon et al., 2012a; McMahon, Campbell, Mudge & Bauer, 2012b; Aybal Kutlugün et al., 2011; Fraser et al., 2013). Sodium intake of patients with CKD remains high despite medical advice (McMahon et al., 2012a). Approximately, between 80 and 90 percent of patients with CKD ingest more than the dietary advice of five or six grams a day (Aybal Kutlugün et al., 2011; Fraser et al., 2013). Given the large-scale exceeding of prescribed guidelines, strict adherence to a low sodium diet turns out to be challenging.

Several studies have investigated the problems that patients with CKD encounter when following a low sodium diet. McMahon and colleagues (2012b) reviewed eight key trials of salt restriction and found great variability in interventions and measurement procedures of

adherence. Intensive methods with full food provision achieved superb adherence, although the duration of the intervention method was negatively related with the extent of adherence. An intervention period of one week with a total food provision seemed to be very effective to meet the sodium target. Although very effective, these intervention methods are not efficient and therefore not feasible in daily life. Equally effective as intervention with food provision were interventions that focused on tailored dietary education provided by skilled and knowledgeable dieticians.

Apparently, two things seem to be important. First, in order to achieve the requirement of feasibility, the intervention should be as close as possible to everyday life; second, it should be tailored to the patient's needs. Therefore, it is necessary to get an insight in the perceived barriers and benefits of the CKD-patient when a low sodium diet is prescribed. Welch, Bennett, Delp and Agarwal (2006) explored difficulties with adherence to a low sodium diet by investigating the perceived benefits and the perceived barriers. Although most participants believed that salty food was not good for them, they still had difficulties maintaining a low sodium diet. Patients mentioned away from home as most perceived barriers. McMahon and colleagues (2012b) mentioned also lack of knowledge and problems with identifying low sodium foods.

1.6. Aim of the thesis

As perceived barriers are found to be high and steady, a lot of effort is required to reduce those barriers (Welch et al., 2006). It turns out that knowing about, understanding and being convinced that a low sodium diet is helpful, is not sufficient to reduce barriers. As less salt intake is of vital importance for patients with CKD, it is crucial to examine factors influencing poor adherence.

Literature suggests that a motivated and confident person should be able to overcome barriers (Bandura & Locke, 2003; Lorig & Holman, 2003). Therefore, motivation and self-efficacy can play an important role in addressing the barriers in salt intake reduction. As motivation is a multiple phenomenon (Ryan & Deci, 2000), we examined the roles of both intrinsic as well as extrinsic motivation.

In addition to self-efficacy and motivation, it is important to consider the role of the medical staff in the support of adherence behavior. Such adherence support is positively associated to adherence (Williams, Rodin, Ryan, Grolnick, & Deci, 1998b), since it encourages patients and keeps them motivated, leading to better illness control (Williams, McGregor, King, Nelson, & Glasgow, 2005).

Ultimately, the aim of this thesis is to examine the relations between self-efficacy, motivation, perceived autonomy support and adherence, both subjective and objective, to a low sodium diet of patients with CKD. In the following sections, I will present the concepts and research questions, as well as the hypotheses.

1.7. Self-efficacy, motivation and perceived autonomy support

Self-efficacy

The likelihood of following a salt restricted diet will increase when a person believes to be able and competent in changing behavior. Self-efficacy, a key concept in the *social cognitive theory* of Bandura (1977), is “the core belief that one has the power to produce desired effects” (p. 87). Self-efficacy is required for initiating as well as maintaining new behavior, while it regulates the effort toward a goal and the amount of perseverance required to face difficulties (Bandura, 1977). The stronger a person’s perceived self-efficacy, the more persistent and proactive the effort will be (Maes & Karoly, 2005).

Literature suggests that enhancing self-efficacy will improve adherence (Schechter & Walker, 2002; Barlow, Sturt, & Hearnshaw, 2002). Likewise, research has confirmed that higher self-efficacy is associated with higher adherence (Senécal, Nouwen, & White, 2000; Zrinyi et al., 2003; Wallston, Rothman, & Cherrington, 2007; Mishali, Omera, & Heymann, 2010). Along with higher adherence, enhanced self-efficacy is related to improved health outcomes in chronic illness patients. In this context, Lorig, Chastain, Ung, Shoor, and Holman (1989) have found evidence that self-efficacy plays a mediating role in health outcomes for patients with arthritis. Patients experienced less pain, were less depressed and physically more active than the controls, though disability remained unchanged. Patients with Diabetes Mellitus type 2 with higher levels of self-efficacy had better glycemic control as well as better health outcomes (Al-Khawaldeh, Al-Hassan, & Froelicher, 2012; Mishali et al., 2010). Zrinyi and colleagues have (2003) found evidence that patients with ESRD with higher levels of diet self-efficacy had lower weight gain and serum potassium levels.

As shown, higher levels of self-efficacy are related, both directly and indirectly, to improved adherence and health outcomes in chronic diseases. Although widely studied, these relations have not been explored yet in earlier stages of CKD with respect to a low sodium diet. In this thesis, the question will be examined whether more self-efficacy is related to higher perceived adherence to a low sodium diet, corresponding with lower urinary salt excretion, indicating higher objective adherence.

Motivation

Besides self-efficacy, it is important that patients be motivated. Motivation is important as loss of motivation can be seen as predicting non-adherence (Singh et al., 1999; Williams, Freedman, Deci, 1998a; Williams et al., 1998b). However, to remain motivated is difficult because often the long-lasting nature of CKD leads to frustration (Chen et al., 2011).

The concept of motivation has been elaborated in the *self-determination theory*. A main distinction has been made between autonomous and controlled behavior regulation (Williams et al., 1998a, 1998b). Autonomous regulation, as prototype of the self-determination concept, is a strong motivator in behavior, because the person wants to be engaged in the desired behavior initiated by him- or herself (Deci, Eghrari, Patrick, & Leone, 1994). Besides the sense of self-initiating people experience a sense of volition (Williams et al., 1998a). Hereafter, autonomous regulation will be referred to as intrinsic motivation. This contrasts with controlled behavior regulation, where people's behavior is guided by external factors such as pressure from other people. Also controlled behavior regulation will be referred to as extrinsically motivated behavior. Extrinsically motivated people aim at outcomes outside the behavior itself.

Adherence and health outcomes depend on how a person is motivated. Only intrinsic motivation will respond to the expectations of creativity and long-term persistence needed to reach and maintain personal goals (Deci & Ryan, 1987). Extrinsic motivated behavior shows poor maintenance once the pressure has receded (Deci & Ryan, 2000). Evidence for this is found in various health domains. Scholars have found a positive relation between intrinsic motivation and adherence among HIV patients (Södergård, 2006) as well as among adolescents with type 1 diabetes (Greening, Stoppelbein, Moll, Palardy, & Hocking, 2004). In the field of diabetes, better glycemic control is found for patients with type 1 diabetes, who were intrinsically motivated (Williams et al., 1998a; Austin, Guay, Sénécal, Fernet, & Nouwen, 2013). Extrinsic motivation turned out to be very weak and negatively related to perceived adherence (Williams et al., 1998b) as well as to outcome (Williams et al., 1996; Judge, Erez, Bono, & Locke, 2005). In the current thesis the research questions were examined as to whether higher intrinsic motivation is related to higher subjective (Sénécal et al., 2000; Williams et al., 1998b) as well as to higher objective adherence to a low sodium diet, among patients with CKD. With respect to extrinsic motivation the expectation was that subjective and objective adherence are both unrelated to extrinsic motivation.

Perceived autonomy support

In addition to self-efficacy and motivation, it is important to consider the role of the nephrologist in supporting the patient's autonomy. The *self-determination theory* stresses that social context has a substantial impact in facilitating or impeding intrinsic functioning (Deci et al., 1994). It is important for patients to experience autonomy in their relation with the nephrologist instead of the feeling of being controlled. Being in control and staying autonomous are important factors to implement and maintain dietary behavioral change.

Perceived autonomy support has been described by Williams and colleagues (2004) as the engagement of health care providers in stimulating and accepting a patient's perspective, supporting and welcoming a patient's initiative, offering choices about treatment alternatives and providing appropriate information while diminishing control, pressure and coercion. Moreover, dissatisfied patients, who were not involved in decision-making, did not adhere to medication recommendation (Kaplan, Greenfield, & Ware, 1989). Consequently with this, Harris, Luft, Rudy and Tierney (1995) have found that decreased perceived autonomy support is associated with more medication related symptoms, higher blood pressure, more proteinuria and decreased medication compliance.

A positive relation has been found between perceived autonomy support and perceived adherence in adolescent patients with diabetes (Kyngäs, 2007) and in patients with ESRD (Kovac, Patel, Peterson, & Kimmel, 2002). Direct links between autonomy support and better health outcomes have been found in patients with CKD (Harris et al., 1995) and in patients with ESRD (Kovac et al., 2002). Williams and colleagues (1996, 1998a, 1998b) have found evidence for an indirect relationship between autonomy support and better health outcomes mediated by intrinsic motivation. It remained undetermined whether perceived autonomy support has any explanatory power over and above that of intrinsic motivation and self-efficacy. In this thesis we examine whether more perceived autonomy support is related directly to higher perceived adherence to a low sodium diet, which in turn results in lower urinary salt excretion indicating better adherence.

1.8. Research hypotheses

The present thesis examines several psychosocial factors in a sample of patients with CKD as these factors may be related to adherence. Based on literature, we assumed positive relations between self-efficacy, intrinsic motivation and perceived autonomy support with subjective and objective adherence. However, no relationship is assumed between extrinsic motivation and adherence.

Perceived adherence

1. Patients with CKD with a higher score on perceived autonomy support perceive themselves as more adherent than patients with CKD with a lower score on perceived autonomy support.
2. Patients with CKD with a higher score on self-efficacy perceive themselves as more adherent than patients with CKD with a lower score on self-efficacy.
3. Patients with CKD who are higher intrinsically motivated perceive themselves as more adherent than patients with CKD who are lower intrinsically motivated.
4. Patients with CKD who are higher extrinsically motivated have the same perceived levels of adherence as patients with CKD who are lower extrinsically motivated.

Adherence assessed by 24-hour urinary sodium excretion

5. Patients with CKD with a higher score on perceived autonomy support have less urinary sodium excretion than patients with CKD with a lower score on perceived autonomy support.
6. Patients with CKD with a higher score on self-efficacy have less urinary sodium excretion than patients with CKD with a lower score on self-efficacy.
7. Patients with CKD who are higher intrinsically motivated have less urinary sodium excretion than patients with CKD who are lower intrinsically motivated.
8. Patients with CKD who are higher extrinsically motivated have equal levels of urinary sodium excretion as patients with CKD who are lower extrinsically motivated.

2. Method

2.1. Patients

The respondents were patients with CKD visiting the outpatient department of the Leiden University Medical Center (LUMC). Included were patients with CKD with an eGFR of more than 20, corresponding with stage one through four of CKD, who were advised to follow a low sodium diet. Kidney transplant patients and patients on dialysis were excluded to limit heterogeneity in treatment characteristics. Patients involved in the project of Effects of Self-Monitoring on Outcomes of chronic kidney disease (ESMO project) were excluded too, because this is an ongoing Dutch study in the LUMC among the same target group.

2.2. Design and procedure

A cross-sectional study was conducted based on a survey technique and medical records research. The questionnaire was designed to collect information about the psychosocial characteristics and experiences with regard to the salt intake of the patients. The most recent data in the last year were collected from the patients' medical records to assess the salt intake by 24-hour urinary sodium excretion. The medical ethics committee approved the study.

After constructing the pen and paper questionnaire, it was pilot tested on nine patients with CKD. The questionnaire was adapted to the feedback of the pilot group regarding acceptability and feasibility. After obtaining their physicians' authorization, selected patients were invited to participate in the study. They received a letter with information regarding the study's procedure. In order to achieve confidentiality and anonymity the respondent's names were coded. Patients returned the completed questionnaire in a pre-stamped reply envelope. Non-repliers received a reminder letter to encourage them to submit their questionnaire. After obtaining patients' informed consent medical data were collected.

2.3. Questionnaire

Socio-demographic variables were assessed partly by means of self-report which included: height, date of birth, level of education, marital status, having children, race, paid work (hours of work per week) and unpaid work. Other socio-demographic variables were retrospectively assessed from the patients' medical file in the LUMC, like gender and 24-hour urinary sodium excretion.

Data were gathered by means of a questionnaire which comprised validated questionnaires in order to assess the independent variables. In the present study, the

independent variables were self-efficacy, intrinsic motivation, extrinsic motivation and perceived autonomy support.

Self-efficacy was assessed by the Partner in Health questionnaire (PIH; Battersby, Ask, Reece, Markwick, & Collins, 2003). This originally Australian questionnaire was used in the Flinders Program of Chronic Care Self-Management' (CCSM) of the Flinders Human Behaviour and Health Research Unit. The internal consistency of the original 12-item scale showed acceptable reliability ($\alpha = .82$; Petkov, Harvey, & Battersby, 2010). In the present study, a 13-item scale has been used to assess patients' self-efficacy; showing acceptable internal consistency and normal distribution (see Table 2). A higher score indicates a higher level of self-efficacy.

Motivation was assessed by the Treatment Self-Regulation Questionnaire (TSRQ) measuring the degree of patients' autonomous and controlled motivation. The TSRQ was first developed by Ryan and Connell (1989) and has been modified in several ways over the course of years, depending on the topic of healthy behavior ("Questionnaires", 2013), such as diabetes (Williams et al., 1998a). The TSRQ was validated in an article by Levesque, Williams, Elliot, Pickering, Bodenhamer and Finley (2006) with a Cronbach's alpha (α) of more than .73 for all subscales, which reflects adequate reliability. In the present study, the Dutch version of the 15-item TSRQ has been used which is part of the ESMO study (2011). Only the items on intrinsic and extrinsic motivation were included, representing separate scales. For both subscales, a higher score indicated higher intrinsic and extrinsic motivation. These subscales exhibited good internal consistency (see Table 2) and were normally distributed.

Perceived autonomy support was assessed by the Modified Health Care Climate Questionnaire. The original 15-item questionnaire (HCCQ; Williams et al., 1996) was a version of the "climate" questionnaires developed in the Rochester SDT lab. The HCCQ has been used in several studies (e.g. Williams et al., 1996, 2004; Williams et al., 2005); all measured exhibited high internal consistencies with alphas between .92 and .96. In this study the Modified HCCQ is used, which is a brief version of the full HCCQ. The alpha for this six-item version in the cross-study sample of Williams and colleagues (2005) was .82, indicating an adequate reliability. In the present study the HCCQ-scale exhibited good internal consistency (see Table 2). It was slightly negatively skewed and somewhat leptokurtic distributed. A higher score indicates patients' perception of greater autonomy support from the nephrologist managing their CKD illness.

Perceived adherence to a low sodium diet, a dependent variable, was also assessed in the questionnaire by using a Visual Analogue Scale (VAS). The respondents rated their scores on a continuous scale from 0 (*never*) to 10 (*always*). Thus, higher scores represented higher levels of adherence.

Table 2
Validated questionnaires to assess the independent variables

Questionnaires	Number of items	Item examples	Possible range	α
PIH	13	“I know and understand what my illness means” “I have a share in decisions made about treating my illness”	1 (<i>very poor</i>) - 9 (<i>very good</i>)	.87
TSRQ-IM	6	“I will follow up the recommendations of my doctor with respect to my kidney disease because I find it a personal challenge to do so”	1 (<i>strongly disagree</i>) - 7 (<i>strongly agree</i>)	.78
TSRQ-EM	5	“I will follow up the recommendations of my doctor with respect to my kidney disease because other people would be upset with me if I didn’t”	1 (<i>strongly disagree</i>) - 7 (<i>strongly agree</i>)	.87
HCCQ	6	“I feel that my nephrologist has provided me choices and options” “I feel understood by my nephrologist”.	1 (<i>strongly disagree</i>) - 7 (<i>strongly agree</i>)	.87

Abbreviation: PIH, Partner in Health Questionnaire; TSRQ-IM, Treatment Self-Regulation Questionnaire - intrinsic motivation; TSRQ-EM, Treatment Self-Regulation Questionnaire - extrinsic motivation; HCCQ, Health Care Climate Questionnaire; α , Cronbach’s alpha

2.4. Medical record research

The 24-hour urinary sodium excretion was measured by means of a urine sample over a period of 24 hours. In this way, the degree of adherence to a low sodium diet could be assessed more objectively. The measurement of 24-hour urinary sodium excretion is seen as the ‘gold standard’ method for collecting data of sodium intake, because the urinary excretion of sodium intake is 95 percent (Chung et al., 2008). Furthermore, according to Day, McKeown, Wong and Bingham (2001), the 24-hour urinary sodium excretion has proven to be a valid and reliable measure of sodium intake. In this thesis, it concerned patients’ most recent one-time 24-hour urine collection in the last year. Obtained data were considered as continuous data and higher scores represented lower levels of adherence. Patients’ clinical data were extracted from medical records from the LUMC.

2.5. Data analysis

2.5.1. Data exploration

The obtained data were managed and analyzed by using the software program Statistical Package for the Social Sciences version 20 (SPSS; produced by IBM). Data exploration was carried out in order to test assumptions of multiple regression. Measures of central tendency, skewness and kurtosis were used to describe the scales' normal distribution. Furthermore, outliers were examined in order to prevent distortion of relations and significance tests. In order to prevent biased estimates, correlations for each pair of independent variables were explored. Only correlations were accepted for each pair of independent variables smaller than $|r| < .9$. However, multi-collinearity might occur without showing high pairwise correlations in case of more than three independent variables. To this end the variation inflation factors (VIFs) were explored as an indication of collinearity. If the VIFs are smaller than five, there is an indication of collinearity. Exploration of the residuals was carried out to explore important abnormalities. The variability of the residuals has been explored looking for homoscedasticity, meaning the residuals may not be related to the independent variables.

2.5.2. Analysis research questions

Descriptive statistics were used to describe the data set. Categorical data were presented as frequencies and continuous data were presented as the mean and the standard deviation. The Pearson Product-Moment Correlation reflected the bivariate correlations between continuous normally distributed background, independent and dependent variables. The Biserial and the Point Biserial are used to estimate the correlation between a continuous variable and a continuous dichotomous variable or between a continuous variable and a true dichotomous variable, respectively. However, in SPSS computationally the Pearson Product-Moment Correlation and the Point Biserial are the same. The Biserial is not supported by SPSS either. Therefore, the Pearson Product-Moment Correlation is used in both cases. The measure of association, known as the Phi coefficient, between two dichotomous variables are estimated by using Cramér's V based on Chi-square.

A series of multiple regression analysis (MRA) was performed to investigate the association between a single independent variable and perceived adherence as well as between that independent variable and urinary sodium excretion, controlled for gender and age.

3. Results

3.1. Socio-demographic variables

A total of 324 patients with CKD received the questionnaire, of which 187 were returned (response rate = 57.72%). After inventory of the required data from the medical files, medical data from 104 persons were obtained. Three respondents were excluded, because they responded to less than 90 percent of all questions. The study ($n = 101$) included 59 men (58.42%) and 42 women (41.58%) with a mean age of 60.09 years ($SD = 13.73$), ranging from 21 to 86 years old. The majority of the respondents had the Dutch nationality. Approximately 60 percent had a low educational level and was unemployed. About 14 percent of all respondents had a full time job. Almost one third of the respondents had comorbidity, of whom twice as many respondents had cardiovascular disease compared to diabetes mellitus. The sample characteristics are shown in Table 3.

Table 3
Socio-demographic characteristics

Characteristics		Frequencies	Percent
Age (years)	Mean	60.09	
	SD	13.73	
	Range	21-86	
Gender	Male	59	58.42
	Female	42	41.58
Race/ Ethnicity	Dutch	92	92
	Non-Dutch	8	8
Marital status	Married, Live together	76	75.20
	Divorced, Widow(er), Alone	25	24.80
Children	No	21	20.80
	Yes	80	79.20
Employed	No	62	62
	Yes	38	38
Educational level	Low	60	59.40
	High	41	40.60
Comorbidity	No	65	64.40
	Yes	36	35.60
	DM	9	8.91
	CVD	18	17.82
	DM+CVD	9	8.91

Abbreviation: DM, Diabetes Mellitus; CVD, Cardiovascular Disease

Table 4
Bivariate Correlations of all Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13
Background variables													
1. age	-												
2. gender	-.25*	-											
3. race	.01	.10	-										
4. civil status	.03	.07	.09	-									
5. children	-.29**	.06	.15	.27**	-								
6. employment	-.54**	.19	.08	.07	.10	-							
7. educational level	-.08	.25*	.20*	.09	.08	.06	-						
8. comorbidity	.34**	.25*	.17	.05	.03	.37**	.15	-					
Independent variables													
9. autonomy support (HCCQ)	.17	-.03	.01	.15	-.18	-.16	-.03	.08	-				
10. self-efficacy (PIH)	-.12	-.11	-.10	.05	.07	.11	.29**	-.11	.27**	-			
11. intrinsic motivation (TSRQ)	.18	-.04	.18	.09	-.13	.08	.08	.09	.37**	.10	-		
12. extrinsic motivation (TSRQ)	-.20*	-.05	-.04	.18	.01	-.31	-.43**	.20*	.20*	-.19	.22*	-	
13. Perceived adherence	-.27*	.17	.01	-.04	.01	-.19	.11	.01	.26*	.11	.16	.04	-
14. 24-h urinary salt excretion	-.18	-.35**	-.04	.17	-.16	-.03	.10	.03	-.12	.01	-.22*	<.01	-.19

Notes. * $p < .05$, ** $p < .001$.

3.2. Description of dependent and independent variables

Before proceeding with the data analysis, all variables were explored for possible violations of the regression assumptions. No large violations were found with respect to linearity, normality and homoscedasticity. Biased estimates based on multi-collinearity were not found, because the largest correlation for each pair of independent variables was .37 (Table 4) and the VIFs showed scores between 1.15 and 1.25. Three outliers were identified ($SD > 2$), but none of them were found to be of significant influence on the regression coefficients. As Cook's distances were only .15, .01 and .03, there was no validity threat. In conclusion, all regression assumptions have been met adequately.

The mean (SD) of the dependent and independent variables are shown in Table 5. The standard deviation of autonomy support and intrinsic motivation tended to be close to the mean referring to lower variability.

Table 5
Description of dependent and independent variables

Variables	Valid data (n =)	Mean	Standard deviation
Perceived adherence	72	6.81	2.74
24-h urinal sodium	101	146.27	66.33
Autonomy support	99	5.79	0.79
Self-efficacy	101	7.17	1.39
Intrinsic motivation	101	5.87	0.72
Extrinsic motivation	101	4.03	1.63

Investigation of the dependent variable perceived adherence yielded 29 missing and 72 valid data. On average, the respondents scored 6.81 with a standard deviation of 2.74. All data (101) were available on the dependent variable urinary sodium excretion from the medical records, consisting of the most recent 24-hour sodium measurement. The average score was 146.27 mmol/24h with a standard deviation of 66.33 (see Table 5). The 24-hour urinary sodium standard deviation was high as scores ranged from 41 – 424 mmol/24h, meaning high variability. In total, 78 patients excreted more than 100 mmol/24h urinal sodium.

3.3. Description of the correlations of all variables

Relations between background variables and dependent variables were investigated (see Table 4). The Pearson correlation showed that age was significantly related to perceived adherence ($r = -.27, p = .021$). Thus, higher age indicated lower levels of perceived adherence.

Furthermore, gender was significantly related to urinary sodium excretion ($r = -.35, p < .001$). Women were more adherent to a low sodium diet than men, as men ($M = 165.86$) exhibited significantly more urinary sodium excretion than women ($M = 118.74$). No further significant correlations were found. Therefore, the MRA-analyses were controlled for age and gender.

In addition, the relationship between the independent and dependent variables were examined (see Table 4). Pearson's r showed that autonomy support was significantly and positively related to perceived adherence ($r = .26, p = .029$). Thus, more autonomy support seemed to be associated with more perceived adherence. Self-efficacy ($r = .11, p = .373$), intrinsic motivation ($r = .16, p = .191$) and extrinsic motivation ($r = .04, p = .735$) were not significantly related to perceived adherence.

Furthermore, perceived autonomy support ($r = -.12, p = .233$), self-efficacy ($r = .01, p = .964$) and extrinsic motivation ($r = .003, p = .976$) were not related to urinary sodium excretion. A significant negative relation between intrinsic motivation and urinary sodium excretion was found ($r = -.22, p = .027$), meaning more intrinsic motivation was associated with better adherence.

3.4. Associations between the independent variables and perceived adherence

To further test the hypotheses, MRA was applied. The relations between perceived adherence and the independent variables were examined separately, controlled for age and gender. All data are shown in Table 6.

To test hypothesis 1 - *patients with CKD with a higher score on perceived autonomy support perceive themselves as more adherent than patients with CKD with a lower score on perceived autonomy support* – a MRA was applied. The results showed that the overall model was significant, ($F(3,67) = 4.03, p = .011$) and explained 15 percent of the variance in perceived adherence. When adjusted for age and gender, perceived autonomy support did not contribute significantly to explain the variance of perceived adherence ($\beta = .21, p = .064$), although a trend was observed ($p < .10$). Thus, contrary to our expectations, patients with CKD with higher autonomy support scores do not show more adherence than patients with CKD with lower autonomy support scores. Therefore, this first hypothesis was rejected.

To test hypothesis 2 - *patients with CKD with a higher score on self-efficacy perceive themselves as more adherent than patients with CKD with a lower score on self-efficacy* - another MRA was carried out. The R-square of the total model (including age, gender and self-efficacy) was significant ($F(3,68) = 3.92, p = .012$) and explained 15 percent of the variance in perceived adherence. However, self-efficacy did not contribute significantly to

explain the total variance in perceived adherence ($\beta = .21, p = .081$), although a trend was observed ($p < .10$). Thus, unexpectedly, data showed that patients with CKD with higher self-efficacy scores perceive themselves as adherent as patients with CKD with lower self-efficacy scores. Therefore, the second hypothesis was not accepted.

Table 6

Associations between perceived adherence and perceived autonomy support, self-efficacy, intrinsic motivation and extrinsic motivation adjusted for age and gender

	β	t	p
Perceived Autonomy Support			
Age	.25	2.20	.032
Gender	.17	1.48	.145
Perceived autonomy support	.21	1.88	.064
$R^2 = .15, F(3,67) = 4.03, p = .011$			
Self-efficacy			
Age	.33	2.83	.006
Gender	.21	1.87	.066
Self-efficacy	.21	1.77	.081
$R^2 = .15, F(3,68) = 3.92, p = .012$			
Intrinsic Motivation			
Age	.27	2.34	.022
Gender	.19	1.64	.105
Intrinsic motivation	.13	1.18	.243
$R^2 = .13, F(3,68) = 3.26, p = .027$			
Extrinsic Motivation			
Age	.29	2.43	.018
Gender	.18	1.60	.116
Extrinsic motivation	-.04	-.35	.726
$R^2 = .11, F(3,68) = 2.79, p = .047$			

In order to test hypothesis 3 - *patients with CKD who are higher intrinsically motivated perceive themselves as more adherent than patients with CKD who are lower intrinsically motivated* - a MRA was applied. Data showed a significant overall model ($F(3,68) = 3.26, p = .027$), explaining 13 percent of the variance of perceived adherence. After correcting for age and gender, intrinsic motivation did not contribute significantly to the variance of perceived adherence ($\beta = .13, p = .243$). Thus, as expected, data showed that higher intrinsically motivated CKD- patients perceive themselves as adherent as lower intrinsically motivated patients. This hypothesis was not accepted either.

In order to test hypothesis 4 - *patients with CKD who are higher extrinsically motivated have the same perceived levels of adherence as patients with CKD who are lower extrinsically motivated* - another MRA was applied. The results showed a significant overall model ($F(3,68) = 2.79, p = .047$), accounting for 11 percent of the variance in perceived adherence. After controlling for age and gender, extrinsic motivation did not contribute significantly to the variance of perceived adherence ($\beta = -.04, p = .726$). The results were in line with the expectations suggesting that hypothesis four was confirmed. This means that there is a rather slight relation between the extent to which patients with CKD are extrinsically motivated and their level of perceived adherence.

3.5. Associations between the independent variables and urinary sodium excretion

The relations between urinary sodium excretion and the independent variables were examined separately, adjusted for age and gender. All data are shown in Table 7.

With respect to hypothesis 5, concerning perceived autonomy support - *patients with CKD with a higher score on perceived autonomy support have less urinary sodium excretion than patients with CKD with a lower score on perceived autonomy support* - a MRA-analysis was applied. The results showed a significant overall model, $F(3,95) = 7.64, p < .001$, explaining 19 percent of the variance in urinary sodium excretion. Perceived autonomy support did not contribute significantly to the variance of urinary sodium excretion ($\beta = -.09, p = .337$). These data resulted in a rejection of hypothesis five, meaning that patients with CKD both with higher scores and lower scores on perceived autonomy support showed equal levels of urinary sodium excretion.

A separate MRA-analysis was carried out to test hypothesis 6 - *patients with CKD with a higher score on self-efficacy have less urinary sodium excretion than patients with CKD with a lower score on self-efficacy*. The overall model was significant, $F(3,97) = 8.06, p < .001$ and accounted for 20 percent of the total variance in urinary sodium excretion. Self-efficacy did not contribute significantly to the variance of urinary sodium excretion ($\beta = -.07, p = .428$). Thus, the amount of urinary sodium excretion was not related to CKD-patient's levels of self-efficacy. Consequently, hypothesis six was rejected.

Another MRA-analysis was carried out to test hypothesis 7 - *patients with CKD who are higher intrinsically motivated have less urinary sodium excretion than patients with CKD who are lower intrinsically motivated*. The results showed a significant overall model, $F(3,97) = 9.65, p < .001$, explaining 23 percent of the variance in urinary sodium excretion. Intrinsic motivation proved to be a significant contributor to urinary sodium excretion ($\beta = -$

.19, $p = .037$). These results confirmed our expectations that higher intrinsic motivation is significantly negative related to urinary sodium excretion. On basis of these data, hypothesis seven was confirmed.

Table 7

Associations between urinary sodium excretion and perceived autonomy support, self-efficacy, intrinsic motivation and extrinsic motivation adjusted for age and gender

	β	t	p
Perceived Autonomy Support			
Age	-.25	-2.60	.011
Gender	-.40	-4.28	< .001
Perceived autonomy support	-.09	-.97	.337
$R^2 = .19, F(3,95) = 7.64, p < .001$			
Self-efficacy			
Age	-.28	-3.01	.003
Gender	-.42	-4.48	< .001
Self-efficacy	-.07	-.80	.428
$R^2 = .12, F(3,97) = 8.06, p < .001$			
Intrinsic Motivation			
Age	-.24	-2.55	.012
Gender	-.41	-4.50	< .001
Intrinsic motivation	-.19	-2.12	.037
$R^2 = .23, F(3,97) = 9.65, p < .001$			
Extrinsic Motivation			
Age	-.28	-2.94	.004
Gender	-.41	-4.40	< .001
Extrinsic motivation	.04	.40	.691
$R^2 = .20, F(3,97) = 7.86, p < .001$			

Finally, hypothesis 8 - *patients with CKD who are higher extrinsically motivated have equal levels of urinary sodium excretion as patients with CKD who are lower extrinsically motivated* - was tested with MRA as well. Results showed that the overall model was significant ($F(3,97) = 7.86, p < .001$), accounting for 20 percent of the total variance in urinary sodium excretion. Extrinsic motivation did not prove to be a significant contributor to urinary sodium excretion ($\beta = .04, p = .691$), according to our expectations. Therefore, hypothesis 8, that extrinsic motivation is unrelated to urinary sodium excretion, was accepted.

4. DISCUSSION

Reducing salt intake is an important treatment strategy in patients with CKD, because it reduces hypertension (Koomans et al., 1982; Weir & Fink, 2004) and retards kidney failure (Cianciaruso et al., 1998; Meneton et al., 2005; Wright & Cavanaugh, 2010). However, poor adherence to a low salt diet is common among patients with CKD (Aybal Kutlugün et al., 2011; Fraser et al., 2013; McMahon et al., 2012a; McMahon et al., 2012b), indicating the need of additional research and interventions. Up to now, little is known about the relationship between adherence to a low sodium diet and psychosocial factors, which can be altered by means of an intervention. We performed a cross-sectional study among patients with CKD to study the associations between sodium adherence and the psychosocial aspects: self-efficacy, perceived autonomy support, intrinsic and extrinsic motivation. In this study we actually found the same high rates of poor adherence; over 77 percent of our patients used more than the prescribed five to six grams salt a day (WHO, 2010).

The results of this study revealed that self-efficacy, perceived autonomy support, intrinsic and extrinsic motivation, were not significantly related to perceived adherence, although trends were observed for self-efficacy and perceived autonomy support. With respect to urinary sodium excretion, as a measure of sodium intake, the only significant observed relationship was the negative relationship with intrinsic motivation, indicating that people, who stated they were more intrinsically motivated, were more likely to adhere to a low sodium diet. The important role of intrinsic motivation in adherence is consistent with a large body of research on intrinsic motivation that is based on the self-determination theory (i.e. Williams et al., 1998a; Austin et al., 2013). According to this theory, only intrinsic motivation will lead to maintenance of behavior change (Deci & Ryan, 1987), indicating the need to enhance intrinsic motivation.

Strategies to increase intrinsic motivation are based on a patient-centered perspective (Williams et al., 1998a). This implies that the health care provider should understand patient's beliefs, expectations and worries concerning treatment recommendations and health. Thus, it is important to understand the patient and not only his illness (Irwin, & Richardson, 2006). Accordingly, the health care provider's approach can have a great influence on enhancing patient's intrinsic motivation and concomitant improving adherence.

A useable patient-centered intervention strategy, closely related to the principles of the self-determination theory, is motivational interviewing. Although there is a good deal of overlapping, motivational interviewing is not a health related application of self-

determination theory and therefore can be regarded as being complementary (Williams et al., 1998a; Patrick & Williams, 2012). Within the self-determination theory, “respect for patient autonomy is an integral part of all health care interventions” (Patrick & Williams, 2012, p. 4), whereas in their view motivational interviewing can be seen as more directive and therefore might be experienced as less autonomy supportive. Despite the differences, the parallels between motivational interviewing and self-determination theory are evident as the basic premises seem to be similar (Patrick & Williams, 2012). Hence, motivational interviewing can be seen as a set of patient-centered techniques aimed at enhancing intrinsic motivation. Motivational interviewing developed, resulting in multiple studies. Reviews and meta-analyses show that it left behind traditional advice in treatment of diseases in 80 percent of the studies (Rubak, Sandbæk, Lauritzen, & Christensen, 2005) and it showed positive results in patients’ confidence to change and treatment approach (Lundahl et al., 2013).

As it is very important for the maintenance and improvement of the patient’s health to understand the motivation to adhere to health behavior, we examined not only intrinsic motivation, but also extrinsic motivation. As expected, we found no relationship between extrinsic motivation and adherence to a low sodium diet. These results are consistent with previous research in various health related domains (Williams et al., 1998b; Judge et al., 2005; Williams et al., 1996, Koestner, Otis, Powers, Pelletier and Gagnon, 2008). Extrinsic motivation might facilitate short term adherence, by providing rewards (Koestner et al., 2008), but demonstrates poor maintenance once the rewards are withdrawn (Deci & Ryan, 2000). Consequently, the remaining result will end up in a zero relationship between extrinsic motivation and adherence (Koestner, 2008). Therefore, extrinsic motivation will not lead to maintenance of adherence due to lack of permanent availability of rewards.

This lack of relationship between extrinsic motivation and adherence does not automatically mean that extrinsic motivation is not an important issue concerning adherence to a low sodium diet. Extrinsic motivation plays an important role in newly diagnosed as well as in previously diagnosed patients. Mostly, patients make a start with extrinsic motivation in order to cope with their diagnosis and might become more intrinsically motivated over time by acquiring more competence (Grimaldi, 2012). Furthermore, patients might be unwilling to change or might experience ambivalence about changing their eating behavior (Rubak et al., 2005). The strategy of motivational interviewing is particular important at this point. Patients are encouraged to identify and work on their own intrinsic values and goals; they are stimulated to be motivated to change for their own sake, in an equal relationship between health care provider and patient (Rubak et al., 2005).

The process of moving from extrinsic motivation to intrinsic motivation can be supported by the health care provider in giving the patient free choice for setting his or her own goals to experience more autonomy (Deci & Ryan, 1987). Thus, supporting patient's autonomy can be seen as a basic part in patient care and education, leading to more adherent behavior.

Subsequently and consistent with literature, we expected to find a positive significant correlation between perceived autonomy support and adherence (Kyngäs, 2007; Kovac et al., 2002; Harris et al, 1995), but we only observed a trend with respect to perceived adherence. We failed to find a direct relationship between perceived autonomy support and urinary sodium excretion. This finding is consistent with other studies indicating that the link between autonomy support and health outcomes is indirect and the effect of autonomy support is mediated by autonomous motivation (Williams et al., 1996, 1998a, 1998b). This thesis provides some support for this view about mediation, as autonomy support was related to intrinsic motivation and subsequently intrinsic motivation was related to urinary sodium excretion.

4.1. Limitation, strength and future research

The fact that no further relationships were found with respect to adherence is not always consistent with the literature and may be explained by a number of reasons. First, the measurements of the concepts self-efficacy and adherence, including perceived adherence and urinary sodium excretion, had several shortcomings and will be discussed below in the following subparagraphs. Before proceeding to the discussion, it should first be mentioned that the results from this study were based mainly on data gathered by self-reports. Problems with remembering, social desirability and avoiding embarrassment might provide overestimates (Schechter & Walker, 2002).

The concept of self-efficacy was assessed by using a general self-efficacy questionnaire instead of a specific diet-self-efficacy questionnaire for patients with CKD. As self-efficacy is more behavior-specific than global construct (Bandura, 1986), it would be more accurate to separately assess self-efficacy for diet. The use of an overall assessment of self-efficacy could be a possible explanation for the unexpected non-significant findings, since a study by Griva, Myers, and Newman (2000) only found a moderate correlation between a general self-efficacy questionnaire and a specific diet-self-efficacy questionnaire in diabetic patients. Additionally, Senécal and colleagues (2000) have found a significant correlation between dietary self-efficacy and adherence by using a dietary self-efficacy questionnaire. So, using a general self-efficacy approach may have attenuated the relationship

with adherence in the present thesis by obscuring important differences among behaviors, resulting in limited variability. Thus, the trend we found with respect to perceived adherence could have been a weakened version of a possible significant relationship.

Other relations may be left unnoticed by difficulties in conceptualizing and measuring adherence. On the one hand the degree of adherence seems to be different for specific regimen tasks; it was higher for medication taking than for dieting (Glasgow, McCaul, & Schafer, 1987). On the other hand, estimates of adherence to a low salt diet seem to be less accurate than estimates of medication adherence (Chung et al., 2008). Previous studies focused mostly on medication adherence (Williams et al., 1998b; Kaplan et al., 1989; Harris et al., 1995; Kyngäs, 2007; Kovac et al., 2002), and may be in part accountable for the inconsistencies in our expectations.

An added difficulty with the measurement of perceived adherence is the fact that there are many different measures available with their own strengths and limitations, but none of them is generally accepted. Furthermore, self-reporting adherence to a salt restricted diet seems to be imprecise (Bentley, 2006; Schechter & Walker, 2002). In this study a single-item visual analogue scale has been used, which is a rather constricted assessment of perceived adherence. Therefore, it could be that perceived adherence was not accurately assessed in the study at hand. In future research maybe more criteria can be used, in parallel, to assess perceived adherence, such as self-report, interview/recall and self-monitoring (Glasgow, 1987) or other criteria like appointment keeping, response to treatment and non-threatening inquiry of self-managed behavior (Haynes, 1979).

The assessment of urinary sodium excretion, as the most objective indicator of dietary sodium intake at present, has some disadvantages as well. First of all, there is considerable biological variability among people with a low sodium diet, which can affect the metabolism, such as gender, age, physiological stage (Bates, Thurnham, Bingham, Margetts & Nelson, 1997) and body mass index (Chung, 2008), which we did not take in consideration. Secondly, the variability in sodium excretion in an individual is around 30 percent (Bates et al., 1997). Therefore, it has been suggested that at least seven sodium measurements, in consecutive days, are needed to reach an accurate mean of a patient's sodium excretion. Other confounders, such as difficulty to complete 24-hour urine sample, heavy perspiration, use of drugs, secretion into breast milk and persistent severe diarrhea, also contribute to bias, resulting in an overestimate of adherence (Bates et al., 1997). Finally, the results of a single 24-hour sodium measurement might be influenced by more strictly diet behaviors than usual, resulting in an overestimate of adherence as well (Schechter & Walker, 2002). Despite the

problems associated with the measurement of urinary sodium excretion, assessing sodium excretion from a 24-hour urine sample is still the gold standard.

An alternative statistical approach regarding urinary sodium excretion should be considered. We could have dichotomized urinary sodium excretion and split the scale at 100 mmol/24h, resulting in two distinct groups of individuals: adherent and non-adherent, assuming that individual differences measures are error. This might have resulted in increased correlations, especially as the cut-off point deviates from the mean (MacCallum, Zhang, Preacher, & Rucker, 2002), which was indeed noticeable in our study (146.27 mmol/24h). The only reason to dichotomize is that the groups yielded by dichotomization are real groups; otherwise increased correlations could be attributed only to sampling errors, resulting in decreased correlations in the population (MacCallum et al., 2002). Dichotomization should be allowed, only if it produces a more accurate measure of adherence and non-adherence. Therefore, this interpretation would also be valid with respect to urinary sodium excretion.

Second, besides the problems related to the assessment of the concepts, another shortcoming in our study should be addressed. Many studies referred to, were conducted in different patient populations, such as patients with HIV (Södergård, 2006), patients with diabetes (Greening et al., 2004; Sénécal et al., 2000; Wallston et al., 2007; Mishali et al., 2010), patients with ESRD (Kovac et al., 2002) or patients with haemodialysis (Zrinyi et al., 2003), whereas our study was focused on patients with CKD. The comparability of the different populations may have fallen short, yielding unexpected findings.

Third, a statistical design-related limitation of this study should be addressed as well. This research was based on a cross-sectional design, so causal interpretations are precluded.

Fourth, another limitation is the fact that the patients were recruited from a single hospital. However, the LUMC receives referrals from outside the region of Leiden, which makes the sample more representative for the Dutch CKD-population, who are not on dialysis or transplant.

Despite shortcomings and limitations, it is also important to mention several strengths in the study at hand. Adherence was not merely assessed in a subjective way by self-reports, but was more objectively assessed by medical records too. Additionally, the present study was built on sound theoretical foundations, in which validated questionnaires were used in order to assess the psychosocial factors, resulting in high internal validity as well as high construct validity (Kazdin, 2010). As a consequence, results can be compared with different studies in cross-sectional meta- analyses. To the best of our knowledge, this is the only study among patients

with CKD, who are not on dialysis or transplant, which investigates psychosocial factors related to sodium adherence.

In future research it would be of particular interest to explore the moving from extrinsic motivation to intrinsic motivation in newly diagnosed as well as previously diagnosed patients with CKD. Further understanding of the nature of motivation will lead to interventions focused on enhancing intrinsic motivation, aimed at engaging in, and adhering to, a low sodium diet, which is especially important for patients with CKD. As it becomes clearer that only intrinsic motivation will lead to lifetime behavior change, longitudinal research is needed to explore the causal relations between intrinsic motivation and sodium adherence in order to be able to predict sodium adherence (Kazdin, 2010).

4.2. Conclusion

Overall, the present study results seem to provide evidence that none of the psychosocial factors were significantly related to perceived adherence. Intrinsic motivation was the only psychosocial factor which was significantly related to urinary sodium excretion, as a measure of sodium intake. Therefore, interventions should concentrate on enhancing intrinsic motivation. Finally, research should focus more specifically on patients with CKD in order to create a more complete picture of the psychosocial factors affecting non-adherence to the low sodium diet of this specific target-group.

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