Nutritional Status Assessment of the Hemodialysis Patients in Riyadh Al-Kharj Hospital

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For my parents who helped me put my best foot forward.

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Chapter I

Introduction

1.1 Background on maintenance hemodialysis

Maintenance hemodialysis (MHD) is the only long term form of mechanical organ replacement therapy utilized today. From its conceptual origin in the laboratory of Abel and Rowntree at Johns Hopkins University in 1913, to the first practical extension of life by repetitive hemodialysis in 1960, hemodialytic therapy has burgeoned through the years to the present, when more than one million people around the world with end-stage renal disease (ESRD) are kept alive (Miles & Friedman, 1997).

According to the 1994 report of the United State Renal Data System (USRDS), people with ESRD were 230,000 in 1991, 59.9% of them are on hemodialysis (HD), and the prevalence of treated ESRD in the United State is growing at approximately 9% per year. The United State has the second highest rate of treated ESRD in the world (735 new patients per million population per year). Japan treats the highest number of new ESRD patient per year, 994 per million population per year, and in Europe these rates average 200 to 300 per million population per year.

In the Arabic countries, according to the available data, it seems that Egypt might have the highest incidence of ESRD, as per Barsoum (1997), who has reported that the estimated incidence of ESRD is 200 new cases per million population per year. There are 300 HD centers with more than 2000 HD machines, and more than 10,000 patients on chronic dialysis.

The estimated incidence of the new cases per million inhabitants per year of ESRD in Jordan, Tunisia, and Syria are 110-120, (Said, 1999), 100-120 (Ayad et al. 1998), 75 (Aysh, 1997) respectively. The numbers of treated HD patients are 900, 863, and 600 patients respectively.

In the gulf countries, the estimated incidence of ESRD in Qatar, Bahrain, Kuwait, and Oman are 122 (Rashid et al. 1998), 100 (Al Arrayed, 1998), 72 (El-Rashaid, 1994), and 120 (Al-Marhuby, 1998) new cases per million population per year respectively. The numbers of treated patients are 187, 120, 232, and 345 respectively.

The data of Saudi Center for Organ Transplantation (SCOT) concerning patients on dialysis in the Kingdom analyzed at the end of December 2002, shows that there is a slight increase (5.5%) of HD patients with a total number (7,391) compared to the previous year. 88.6% of these were Saudis (6,551) and 11.4% were non-Saudi (840 patients). Males ratio slightly higher than females (54.1% vs. 45.9%). About one third of patients (30.4%) is in the socially highly productive age-group of 26 to 45 years, and 17.5% of the them were older than 65 years.

The total number of dialysis centers is 144 at the end of 2002. Seventy five percent of these centers belong to the Ministry of Health (MOH). The total number of HD patients treated in non-MOH hospitals is 1,933 (26% of the total), of whom 651 patients (33.7%) are being treated in the military hospitals of Kingdom. 217 of these 651 are treated in the Riyadh Al-Karj Hospital (RKH).

There has been a constant increase in the number of patients on dialysis over years and at the present rate (9.3%) it is expected that there will be about 10,000 patients needing regular dialysis in Saudi Arabia by the year 2011.

1.2 MHD and nutrition

Due to the kidney's unique role in nutrients metabolism and the nature of disease progression, patients with renal failure are uniquely susceptible to malnutrition. The type and degree of malnutrition depend on the type and length of treatment (Moore & Acchiardo, 1991). The malnutrition is the main cause of high morbidity and mortality among hemodialysis patients (Acchiardo et al. 1983)

The presence of hypoalbuminemia, decreased levels of prealbumin, and decreased levels of other markers indicative of protein malnutrition are potent indicators for morbidity and mortality in patients with ESRD. (Lowrie & lew, 1990).

Guarnieri et al. (1980) had shown that the energy intake tends to be low, and negative nitrogen balance was reported during the days of dialysis therapy. Kopple et al. (1989) have reported in their study that energy intake is usually below both the prescribed intake and the levels apparently needed for the normal sedentary adults or patients with chronic renal failure. Serum transferrin is positively correlated with the level of glomerular filtration rate (GFR) and was significantly low in the patients with a GFR less than 10 ml/min/1.73m2.

Salmowits et al. (1989) have mentioned that the frequently observed low energy intake of maintenance hemodialysis patients may contribute to the high incidence of wasting and malnutrition.

More over, some results suggest that long-term survival could be attained by patients with relatively low body mass index (BMI) who have no serious nutritional problems (Kaizu et al. 1998).

Cross-sectional studies suggest that up to two thirds of the patients on HD are malnourished (Pollock et al. 1996), which shows the seriousness and the magnitude of the problem.

Thus malnutrition is compounded by the fact that these patients lose large amounts of protein in dialysate fluid and are unable to consistently consume the prescribed diet. Furthermore, many patients are malnourished at the beginning of their therapy.

Protein-calorie malnutrition is sometimes considered the most prevalent form of malnutrition in renal patients. Prevention is the most important approach in treating malnutrition and primary to prevention is recognizing the condition.

Determining dietary compliance is important for preventing malnutrition. Methods for monitoring compliance of patients with chronic renal disease should include determination of blood levels of urea, nitrogen, potassium, creatinine and phosphorus, and by observing the amount of weight gained between dialysis treatments (Hoover, 1989).

Compliance with dietary fluid and medication instruction is critically significant factor in the continued health and wellbeing of the patient undergoing chronic hemodialysis. Compliance is defined as the extent to which an individual chooses behavior that coincides with clinical prescription. Compliance in dialysis population is generally poor, with less than 25% of patients meriting a good compliance rating (Eddins, 1985).

1.3 Statement of the problem

Kidney diseases leading to chronic renal failure (CRF) and in many cases progressing to ESRD deserve careful attention from both scientists and service providers alike. ESRD can be a devastating medical social and economic problem for the patients and their families (Said, 1992). The initial diagnosis of the disease and recognition of the need for continued therapy including dietary compliance may make the patient to feel vulnerable and helpless. Patients beginning dialysis have a high incidence rate of malnutrition because their disease has progressed over time till the end stage organ failure (Moore & Acciardo, 1991). Malnutrition often exists despite ongoing efforts to optimize dietary regimens and is one of the main risk factors for morbidity and mortality in these patients (Acchiardo et al. 1983).

1.4 Rational

The information available about nutritional status of dialysis patients in developing countries, including Saudi Arabia, is very little compared to USA and Europe. Therefore this study were carried out to assess the nutritional status of the dialysis patients in the dialysis center in Riyadh Al Kharj Hospital (RKH).

1.5 Objectives

1. To determine the frequency and severity of malnutrition in dialysis patients.
2. To evaluate the dietary approach and dietary compliance of dialysis patients.
3. To recommend an appropriate dietary modality for patients on HD.

Chapter II

Literature Review

2.1 Protein energy malnutrition

Many studies showed patients undergoing maintenance hemodialysis (MHD) are wasted or malnourished (Kopple et al. 1978; Kluthe et al. 1978; Blumenkrantz et al. 1980; Kopple et al. 1984).

MHD patients have a high incidence of protein-energy malnutrition (PEM), which reflects the importance of maintaining an adequate nutrients intake (Thunberg et al. 1981; Wolfson et al. 1984).

Optimal monitoring of protein-energy nutritional status for MHD patients requires the collective evaluation of multiple parameters, particularly using measures that assess different aspects of protein-energy nutritional status.

Large set of data suggest that nutritional status indicators exhibit independent associations with mortality and morbidity in MHD. For example, the serum albumin, serum creatinine, and BMI are independently associated with survival (Lowrie et al. 1995). Data from the USRDS using the serum albumin and BMI confirm these findings (Leavey et al. 1998).

Many causes could lead to malnutrition. However, it seems that the most important one is the decreased nutrients intake. Poor nutrients intake could be due to anorexia from uremia, the dialysis procedure, and/or acidemia. Inadequate intake is also caused by comorbid physical illnesses affecting gastrointestinal function, depression, other psychiatric disturbances, organic brain disease, or socioeconomic factors.

Comment [A1]: DPI

2.1.1 Protein malnutrition

It has been reported that patients on MHD often have low dietary protein intake (DPI). The relationships between DPI and such outcomes as nutritional status or morbidity and mortality have been studied. Protein intake in these studies has been estimated from dietary histories obtained from patient recall or estimated from the protein equivalent of total nitrogen appearance.

A number of studies reported that the mean DPI of MHD patients vary from about 0.94-1.0 g protein/kg/d (Kopple et al. 1969; Acchiardo et al. 1990; Bergstrom et al. 1993; Ikizler et al. 1996).

Protein intakes of less than 0.75 g/kg/d are inadequate for most MHD patients (Bergstrom et al. 1993).

Ingestion of 1.1 g of protein/kg/d (with at least 50% high biological values (HBV)) may maintain good protein nutrition in some MHD patients. However, this is not sufficient to maintain good nutrition in the great majority of clinically stable patients whom intake of energy is 25-35 kcal/kg/d (Bergstrom et al. 1993).

It was suggested that the necessary DPI to ensure neutral or positive nitrogen balancing in most of clinically stable patients is about 1.2 g/kg/d. HBV should form at least 50% of the ingested protein (Kopple et al. 1969; Borah et al. 1978; Bergstrom et al. 1993).

Comment [A2]: DEI

2.1.2 Energy malnutrition

Longitudinal and cross-sectional data often indicate that maintenance dialysis patients frequently have low energy intake and are underweight despite receiving apparently adequate dialysis therapy (Thunberg et al. 1981; Dwyer et al. 1998).

Low body weight (adjusted for height, age, and gender) is associated with increased mortality rate in maintenance dialysis patients (Degoulet, 1982; Leavey, 1998; Fleischmann, 1999; Kopple, 1999). Hence, it would seem important to aggressively attempt to maintain adequate energy intake.

Dietary energy requirements have been studied in MHD patients under metabolic balance conditions. It was found that the mean energy intake necessary to maintain both neutral nitrogen balance and unchanging body composition for patient less than 60 years of age was about 35 kcal/kg/d with a DPI of 1.13 g/kg/d. It was suggested that a daily energy intake of 30 to 35 kcal/kg/d for older patients with more sedentary lifestyles is acceptable (Monteon et al. 1986; Bergstrom, 1993; Schneeweiss et al. 1990; Harty et al. 1995; Ikizler et al. 1996)

Comment [A3]: BMI

2.2 Body mass index (BMI)

As it has been shown above, PEM is a strong predictor of mortality in MHD patients. This association has generally been reported for serum chemistry indicators of PEM.

Fleischmann et al. (1999) studied the influence of excess weight on mortality and hospital stay in 1346 hemodialysis patients and reported that overweight and obese patients (BMI $\geq$ 27.5) had a significantly better 12-months survival than underweight ones (BMI <20) and patients with normal weight (BMI 20–27.5). Further analysis of the data, demonstrated that for every unit increase in BMI the relative risk (RR) of mortality was reduced by 10%. In multivariate analyses, higher BMI remained as a significant factor for better survival even after adjusting for a number of variables commonly linked to dialysis patient's survival.

Kopple et al. (2000) studied the relationship between the weight-for-height and survival among 12,965 MHD patients (both sexes). They found that in both men and women, the mortality rate decreased progressively as the patients' weight-for-height increased. MHD patients who weighed more than normal had the lowest mortality rate. It was concluded that body weight-for-height is an independent predictor of high mortality in those patients who are in the lower 50th percentile for this measurement. It has been suggested that a BMI of 23.6-24 is the best range for survival in MHD patients.

Port et al. (2002) in another large hemodialysis population (45,967 patients) confirmed the association between BMI and survival: patients with the lowest BMI had a 42% higher mortality risk than patients in the highest BMI (BMI were divided into three groups, <23.2, 23.2-27.8, and >27.8). A higher BMI might in turn be an indication of better nutritional status, as biochemical markers of better nutrition co-aggregate with larger body mass (Fleischmann et al. 1999; Leavey et al. 1998).

Overweight patients compared to underweight patients had a significantly lower rate of hospital admissions and lower duration of hospital stay (Fleischmann et al. 1999).

These data show the importance of monitoring serial body weight and BMI, and to be concerned about progressive loss of weight even in overweight patients and to attempt to delineate the cause, and if possible to treat it effectively. This will aim for maintaining high normal BMI, and even with the liberal use of high caloric supplements if necessary.

Comment [A4]: TSF, MAMC

Comment [A5]: PCR

2.3 Urea nitrogen appearance (UNA)

During steady-state conditions, nitrogen intake is equal to or slightly greater than nitrogen assessed as total nitrogen appearance (TNA) (Kopple et al. 1995). TNA is equal to the sum of dialysate, urine, fecal nitrogen losses, and the postdialysis increment in body urea-nitrogen content. Because the nitrogen content of protein is relatively constant at 16%, the PNA can be estimated by multiplying TNA by 6.25 (PNA is mathematically identical to the protein catabolic rate or PCR). In the clinically stable patient, PNA can be used to estimate protein intake.

Comment [A6]: Alb

2.4 Albumin

Although no single ideal measure of nutritional status exists, the serum albumin level is considered to be a useful indicator of protein-energy nutritional status in maintenance dialysis patients. The extensive literature, in individuals with or without renal failure, relating serum albumin to nutritional status, and the powerful association between hypoalbuminemia and mortality risk in the maintenance dialysis population, strongly support this contention. In addition, the measurement of serum albumin level is inexpensive, easy to perform, and widely available. (Blumenkrantz et al. 1980).

The serum albumin correlates reasonably well with other measures of visceral proteins. However, hypoalbuminemia is a relatively late manifestation of malnutrition, since albumin has a relatively long half-life (about 19 days) and the hepatic synthetic reserve is relatively large. Changes in extra cellular volume represent a potential source of error, since volume expansion lowers the serum albumin concentration by dilution. Also the serum albumin levels may decline in response to acute infection or other acute illness. However, some studies have demonstrated a significant negative correlation between serum albumin levels and mortality in the dialysis population (Lowrie & Lew, 1990; Goldwasser et al. 1993).

Hypoalbuminemia is highly predictive of future mortality risk when present at the time of initiation of chronic dialysis as well as during the course of maintenance dialysis (Goldwasser et al. 1993; Owen et al. 1993; Avram et al. 1995; Lowrie et al. 1995; Foley et al. 1996; Klang et al. 1996; Iseki et al. 1996; Soucie & McClellan, 1996; Barrett et al. 1997; Marcen et al. 1997).

A predialysis or stabilized serum albumin equal to or greater than the lower limit of the normal range (approximately 40 g/L for the bromcresol green method) is the outcome goal (McCann , 2002).

Comment [A7]: Creatinine

2.5 Creatinine

Serum creatinine is a predictor of clinical outcome. In individuals undergoing MHD, predialysis serum creatinine is a predictive of and inversely related to survival. This relationship persists even after adjusting for patient characteristics (age, sex, diagnosis, and diabetic status) and dialytic variables. (Degouletet al. 1982; Oksa et al. 1987; Cano et al. 1988; Avram et al. 1994; Avram et al. 1995; De Lima et al. 1995; Lowrie et al. 1995; Avram et al. 1996; Borovnicar et al. 1996)

The serum creatinine concentration that indicates malnutrition has not been well defined. The mortality risk associated with low serum creatinine increases at levels below 796 to 972 µmol/L (9-11 mg/dL) in individuals on MHD. In individuals with negligible urinary creatinine clearance, the nutritional status of individuals undergoing MHD who have a predialysis or stabilized serum creatinine of less than approximately 884 µmol/L (10 mg/dL) should be evaluated. (Lowrie et al. 1995; Avram et al. 1995; Harty et al. 1994; Avram et al. 1994; De Lima et al. 1995).

In MHD patients who are receiving a constant dose of dialysis, the predialysis serum creatinine level will be proportional to dietary protein intake and the somatic (skeletal muscle) mass. Thus, a low predialysis or stabilized serum creatinine level in an MD patient with negligible renal function suggests decreased skeletal muscle mass and/or a low DPI. (Blumenkrantz et al. 1980; Keshaviah, 1994; Borovnicar et al. 1996).

Comment [A8]: Cholesterol

2.6 Cholesterol

Serum cholesterol is an independent predictor of mortality in MHD patients (Goldwasser et al. 1993; Lowrie et al. 1995; Piccoli et al. 1995; Iseki et al. 1997). The mortality rate increases as the serum cholesterol rises above the 5.2 to 7.8 mmol/L range (Lowrie et al. 1995) or falls below approximately 5.2 mmol/L (Degoulet et al. 1982; Goldwasser et al. 1993; Avram et al. 1995; Piccoli et al. 1995). The mortality risk in most studies appears to increase progressively as the serum cholesterol decreases to, or below the normal range for healthy adults (< 5.2 mmol/L) (Degoulet et al. 1982; Goldwasser et al. 1993; Avram et al. 1995; Lowrie et al. 1995; Iseki et al. 1997). However, not all studies of MHD patients show that serum cholesterol levels predict mortality (Cano et al. 1988; Goldwasser et al. 1993; Iseki et al. 1996).

Predialysis serum cholesterol is generally reported to exhibit a high degree of collinearity with other nutritional markers such as albumin, prealbumin (Cano et al. 1988) and creatinine as well as age (Avram et al. 1994). In MHD patients, the predialysis serum cholesterol level measured may be affected by non-nutritional factors. Cholesterol may be influenced by the same comorbid conditions, such as inflammation, that affect other nutritional markers (e.g., serum albumin) (Cano et al. 1988).

As an indicator of protein-energy nutritional status, the serum cholesterol concentration is too insensitive and nonspecific to be used for purposes other than for nutritional screening, and maintenance dialysis patients with serum cholesterol concentrations less than approximately 3.9 to 4.7 mmol/L should be evaluated for nutritional deficits as well as for other comorbid conditions.

Comment [A9]: Acidemia

2.7 Acidemia

Acidemia refers to abnormally increased hydrogen ion concentrations in the blood. Acidosis refers to the existence of one or more conditions that promote acidemia. Acidemia, as measured by serum bicarbonate and/or blood pH, is common in individuals who have CRF or who are undergoing maintenance dialysis.

Normalization of the predialysis or stabilized serum bicarbonate concentration can be achieved by higher basic anion concentrations in the dialysate and/or by oral supplementation with bicarbonate salts. Higher concentrations of bicarbonate in hemodialysate (>38 mmol/L) has been shown to safely increase predialysis serum bicarbonate concentrations

(Ahmad et al. 1980; Harris et al. 1995; Borovnicar et al. 1996; Williams et al. 1997; Movilli et al. 1998). An oral dose of sodium bicarbonate, usually about 2 to 4 g/d or 25 to 50 mEq/d can be used to effectively increase serum bicarbonate concentrations (Harris et al. 1995; Graham et al. 1996; Barrett et al. 1997; Kooman et al. 1997; Brady & Hasbargen, 1998).

Correction of acidemia due to metabolic acidosis has been associated with increased serum albumin (Lofberg et al. 1997), and decreased protein degradation rates (Graham et al. 1997; Williams et al. 1997; Brady & Hasbargen, 1998). An increase in plasma bicarbonate levels may promote greater body weight gain and increased mid-arm circumference (Stein et al. 1997). A rise in triceps skinfold (TSF) thickness is also reported but is not a consistent finding (Stein et al. 1997; Williams et al. 1997). Rapid correction of acidemia by bicarbonate infusion has been associated with an increase in serum 1,25(OH)2D3 concentrations (Lu et al. 1994) and a decrease in osteocalcin, suggesting an improvement in osteoblast function (Lin et al. 1994).

However, few studies have failed to show any detrimental effects of mild metabolic acidemia, and some investigators indicated that small increases in serum bicarbonate concentrations were not associated with significant improvements in nutritional or clinical status (Kang et al. 1997; Dumler et al. 1999). However, most trials report that normalizing the predialysis or stabilized serum bicarbonate concentrations is beneficial for protein, amino acid and bone metabolism, and protein-energy nutritional status (Ballmer et al. 1995). Thus, the serum bicarbonate should be monitored regularly at monthly intervals and correction of metabolic acidemia by maintaining serum bicarbonate at or above 22 mmol/L should be a goal of the management of individuals undergoing MD.

2.8 Renal osteodystrophy

Comment [A10]: PO4

The phosphorus has acute effect on parameters of minerals metabolism. The negative effects on vitamin D metabolism have been described (Portaile et al. 1989). Furthermore, an acute phosphate load also causes transient decrease in calcium and increases in parathyroid hormone (PTH) (Reiss et al. 1970). Secondary hyperparathyroidism could result from a resistance to the calcemic effect of the hormone, which in turn could lead to renal osteodystrophy (Morton & Hercz, 1998).

Hemodialysis is not a highly efficient method for removing the ingested load of phosphorus. The gastrointestinal tract absorbance of ingested phosphorus is about 60% (Kopple & Coburn, 1973). On the other hand, around approximately 250 mg of phosphorus only are removed during hemodialysis (Ahmed & Kopple, 1998). Thus, the quantity of phosphorus removed by hemodiylaisys is below that required to avoid severe hyperphosphatemia in most patients.

The effect of the dialyzer type on the removal of the serum PO4 was studied. The comparison of high-flux hemodiafiltration with standard hemodialysis has shown little advantage in terms of phosphorus removal (Albetini et al. 1984). It means that in hemodialysis patients, the mass removal of phosphorus depends on the predialysis serum phosphate level rather than the dialyzer efficiency.

It is recommended that MHD patients should be prescribed <900 mg/day of phosphorus (McCann, 2002). Very-low-phosphorus diets (e.g., less than 800 mg/day) are often unpalatable to the patients, particularly when the dietary protein intake is high (e.g., about 1.2 g/kg/d or greater). For these reasons, phosphorus binders are usually required, in addition to dietary phosphorus restriction, in order to prevent severe hyperphosphatemia.

2.8.1 Phosphate binders

The aluminum gels (hydroxide and carbonate) are very efficient phosphate binders. It has been shown that 100 mL/day of aluminum hydroxide can reduce net phosphorus absorption even to the point where losses in the stool can exceed dietary intake (Clarkson et al. 1972). These agents were considered the phosphate binders of choice. Over the past several years, evidence has accumulated linking aluminum with such problems as encephalopathy, vitamin D resistant osteomalacia and a dynamic bone disease, and microcytic anemia in dialysis patients (Parkinson et al. 1981). Despite the weight of this evidence, the development of aluminum-related toxicity is not inventible. However, some patients appear at significant risk for aluminum accumulation, including those who have undergo parathyriodectomy, those who have failure renal transplant, or those who are anephric or diabetic (Andress et al. 1985; Norris et al. 1985; Andress et al. 1987)

The calcium containing compounds, such as calcium carbonate, calcium citrate, and calcium acetate are other phosphate binders. Calcium carbonate has become the most widely used phosphate binder. The dose required varies considerably form one individual to another. Using doses from 6 to 20 g of calcium carbonate per day. The most obvious drawback is the development of hypercalcemia, which occurs in about 25% of MHD patients (Hercz et al. 1986).

If the dangers of a high calcium/phosphate product in patient receiving calcium-containing phosphate binders are realized, it is likely that resurgence in the use of aluminum compounds will occur.

Magnesium salts can also decrease phosphorus absorption form the gut (Briscoe & Ragan, 1966), but there is a significant concern over the development of hypermagnesemia in dialysis patients.

2.9 Potassium

Most patients with renal problem do not require aggressive dietary potassium restriction. That is, on a normal potassium intake (less than 40-70 mmol/d = about 1500-3000 mg/d), serum potassium will be maintained within the normal range (Ahmed & Kopple, 1998).

Chapter III

Subjects and Methods

3.1 Study Site

The study was conducted at the Dialysis Center of Riyadh Al-Kharj Hospital (RKH).

RKH dialysis center is one of biggest dialysis center in the kingdom with 36 HD machines and more than 200 patients.

3.2 Subjects

Dialyzed patients are grouped into two groups, one is dialyzed on Saturday, Monday, Wednesday, while the other is dialyzed on Sunday, Tuesday, Thursday. At the beginning of dialysis, patient is assigned to one of these tow groups randomly. The first group is selected to be involved in the study. Sixty two (62) patients with ESRD who are admitted to the dialysis center at RKH.

Selection Criteria:

1. Consent to participate in this study.
2. Saudi nationality.
3. Eighteen (18) years of age or older.
4. Receiving HD three times per week

5. The patient has been receiving regular hemodialysis at the RKH Dialysis Center for at least 3 months.
6. Anuric.
7. Patients with no acute illness, such as pneumonia, acute myocardial infraction or septicemia.
8. Has not been diagnosed with clinical depression.

The approval of the ethics committee in the hospital was obtained. All patients were informed about the nature of the study. They were also informed that their participation in this study is voluntary and they have the right to withdraw at any time without any penalization and their refusal to participate and withdraw will not affect their treatment at the Center.

3.3 Demographic- Socio- Economic data

A questionnaire was used to collect the following data from each participant: date of birth, gender, marital status, educational background, social-economical background, type of accommodation and family size (Appendix I).

3.4 Medical history

The following data concerning the medical history was collected (appendix I-II): changes in taste, food allergy, presence of constipation, mastication problem, poor hearing or poor vision, were there any one else in the family has the problem or any other chronic disease such as ischemic heart diseases (IHD), diabetes mellitus (DM), hypertension (HTN), hyperlipidemia, number of hospitalization days, and number of visits to emergency room (ER) over a year..etc. A questionnaire was used for collecting the data and medical file of the patient was examined to check the presence of chronic disease such as DM, HTN, IHD, hepatitis profile, duration of the problem, treatment, for how long is he on (in years), number of dialysis sessions per week, duration of dialysis in hours.

3.5 Anthropometric measurements

3.5.1 Dry weight (Wt.)

Dry weight in dialyzed patient is the weight at the end of dialysis treatment. Electronic weighing chair was used to obtain the weight. The scale was placed on a hard-floor surface. Participants are asked to remove their heavy outer garments, female patients were weighed with Abaya (ladies body cover), and Abaya was weighed and its weight was subtracted from the total. Weight was measured in all participants and taken to the nearest 0.1 kg using weighing scale.

The scale was calibrated at the beginning and end of each examining day. The scale is checked using the standardized weights and calibration is corrected if the error is greater than 0.1 kg. The results of the checking and the recalibrations are recorded in a log book.

3.5.2 Height (Ht.)

Height was measured in all participants, with the patients bare footed and head upright. The height is measured with the measuring rod attached to the balanced beam scale. The floor surface next to the height rule was hard. The height was reported to the nearest 0.5 cm.

3.5.3 Desirable body weight based on body mass index (BMI)

BMI was used to assess the "desired" weight. It was suggested as per Kopple et al. 1999, that BMI from 23.6-24 is the best range for survival in HD patients. The mid point of this range (23.8) was used to calculate the desirable body weight for our subjects.

Adjusted body weight (aBW) was used to calculate the energy and protein requirement for patients with BMI of >25, by using the following formula

aBW = (ABW – IBW) x 0.25 + IBW

Where is

ABW = Actual body weight,

IBW = Ideal or desirable body weight

3.5.4 Mid-arm circumference (MAC)

MAC was measured by using a Ross Inser-Tape^{tm} fiberglass tape. At the dry weight, patient's right or non-access arm was bent at the elbow at 90^{O} angle; palm up, to locate the arm's midpoint on posterior side of the arm.

With the same arm hanging loosely by side, the tape was positioned at previously marked midpoint of upper arm and the circumference was obtained.

3.5.5 Triceps skinfold (TSF)

Ross Adipometer^{tm} skinfold caliper was used to measure TSF to the nearest 1 mm. Three readings were taken and mean was calculated.

3.5.6 Mid-arm muscle circumference (MAMC)

MAMC was calculated as follows:

MAMC = MAC – (TSF X 0.314)

3.5.7 Mid-upper arm muscle area (MAMA)

MAMA was calculated as follows:

$$MAMA = (MAMC)^2 / 12.56$$

3.6 Dietary assessment

3.6.1 Dietary record

A 3 days dietary record was completed by the patient or one of his relatives. The patient or his relative was instructed on the recording method by using the house hold measurements. Dietary record was then reviewed with patients to check the reliability. Protein of high biological value (HBV), as well as total protein and estimates of intake of sodium potassium, calcium and phosphorus were calculated (appendix III).

3.6.2 Food frequency questionnaire (FFQ)

FFQ included the frequency of the most common consumed food per week. The FFQ was used for semi quantitative estimate of the dietary intake and cross-checked using the 3 days food record for validating FFQ.

The patient's family or primary care givers were often good sources of information if patient is unable to do so (Appendix IV).

3.7 Biochemical measurements

Blood was routinely drawn monthly. It was including serum potassium, phosphorus, calcium bicarbonate, parathyroid hormone (PTH), albumin, total protein, total lymphocyte count (TLC), cholesterol, blood urea nitrogen (BUN), and Creatinine.

3.7.1 Urea nitrogen appearance

Urea nitrogen appearance (UNA) was used to estimate net protein degradation or recent protein intake in patients undergoing maintenance hemodialysis. The used method of calculation is described in appendix V.

3.8 Physical activities

The physical activity classification is adopted from Ainsworth et al. (2000) and defined as following:

Light: These may include reading, sitting, driving, eating, carpentry, house cleaning, childcare, ironing, cooking, sweeping, walking (4 km/hr).

Moderate: These may include fast walking (6 km/hr), weeding and hoeing a garden, carrying a load, cycling, tennis, jumping rope, and dancing.

Heavy: These may include bicycle race, boxing, running, jogging (10 km/hr), walking uphill with a load, heavy manual digging, basketball, climbing, swimming and soccer.

3.9 Statistical analysis

Variables were summarized by frequency and measures of central tendency and dispersion. Significant tests were used, including chi square test for measuring difference between discrete variables and student t-test for measuring difference between continues variables.

Correlation and partial correlation tests were used for measuring association between different variables.

SPSS (v. 11) analysis package was used to analyze the data.

Chapter IV

Results

4.1 Socioeconomic data

Table 1 shows that out of the 62 subjects, 56.5% were male and 43.5% were females. The age group distribution of subject shows that most of the patients were in the active age group of 31-45 (32.3%), 27.4% at the age group of 46-60, 27.4% above 60, and 12.9% were below the age of 30 years.

Most of the patients (41.9%) are illiterate, and married (64.5%). 22.6% of patients are employed and 1.6% are businessmen. Most of our subjects (67.7%) have a family income of less than 5,000 SR per month, with a large family size of more than 6 members (73%).

4.2 Medical history

Table 2 shows that 37.1% of the patients visited the ER at least once within the last year and 86.8% of them visited ER 1-5 times, while the rest (13.2%) visited ER 6-10 times. 50% of the patients were admitted to the hospital within the last year, 32.2% of them spent 1-5 days in the hospital, 38.8% lasted for 6-30 days, 16% spent 2-3 months, 13% spent more than 3 months, and the mean of stay was 19.55 ± 41.8 days.

Dialysis treatment session lasted for 3 hours for 29% of the patients, 3.5 hrs for 35.5%, and 4 hrs for 35.5% of them.

Table 1: Demographic, social, and economical characteristics of the patients in RKH

Measure	Categories	N=62	%
Age Groups	18-30	8	12.9
	31-45	20	32.3
	46-60	17	27.4
	>60	17	27.4
Sex	F	27	43.5
	M	35	56.5
Education	Illiterate	26	41.9
	Elementary School	11	17.7
	Intermediate/High School	23	37.1
	University Degree	2	3.2
Working Status	Housewife	27	43.5
	Retired	15	24.2
	Unemployed	5	8.1
	Employed	1	22.6
	Business Man	1	1.6
Marital Status	Single	22	35.5
	Married	40	64.5
Family Income	< 5,000	42	67.7
	5,000-10,000	13	21.0
	> 10,000	7	11.3

Table 2: Medical history

Measure	Categories	N=62	%
Number of Visits to ER over a year	0	39	62.9
	1-5 times	20	32.2
	6-10 times	3	4.9
Admission days over a year	0	31	50.0
	1-5	10	16.1
	6-30	12	19.4
	31-90	5	8.1
	>90	4	6.4
Length of Dialysis (years)	<2	4	6.5
	2-5	23	37.1
	6-10	27	43.5
	>10	8	12.9
Duration of HD session (hrs)	3.0	18	29.0
	3.5	22	35.5
	4.0	22	35.5
Appetite	Poor	10	16.1
	Fair	33	53.2
	Good	19	30.7
Mastication Problems	No	37	59.7
	Yes	25	40.3

Most of the patients (56.4%) have been on dialysis for 6 years or more, 37.1 for 2-5 years, and only 6.5% for less than 2 years.

The family medical history shows that about 18% of the patients have renal disease. 45.2% have a family history of DM, 35.5% with HTN, 21% with CHD, 8.1% with hyperlipidemia, and 4.8% have history of Cancer.

The percentage of patients with DM, HTN, and IHD were 19.4%, 74.2%, and 14.5% respectively. 29% of the studied patients have Hepatitis-C virus, and 6.5% have Hepatitis-B virus.

About 27% of the patients complain of constipation, 17.7% of taste change, and 40.3% of mastication problems. 16.1% had poor appetite, 53.2% had fair appetite, and 30.6% had good appetite.

4.3 Health and nutrition behavior

Table 3 shows that 22.6% of the patients had no previous diet instruction, and only 14.5% of the patients were following the diet all the time, 16.1% were following the diet most of the time, 29.1% follow the diet sometimes, and 17.7% of them had never follow the prescribed diet. 64.5% of the patients eat outdoor at least once a week.

Table 3: Health and nutrition behavior

Measure	Categories	N=62	%
Compliance to Diet	No previous diet instruction	14	22.6
	Always	9	14.5
	Mostly	10	16.1
	Sometimes	18	29.1
	Never	11	17.7
Eating outdoor per week	0	22	35.5
	1-5	37	59.7
	6-10	2	3.2
	>10	1	1.6
Regular intake of medications	No	12	19.4
	Yes	50	80.6
Physical Activity	Light	39	62.9
	Moderate	21	33.9
	Heavy	2	3.2
Regularly exercise	No	59	95.2
	Yes	3	4.8

About 81% of the patients take medication regularly. The majority (about 63%) of the patients has light physical activity; about 34% have a moderate physical activity; and 3.2% of them have heavy physical activity. Only 4.8% have a regular exercise.

4.4 Anthropometric measurements

Table 4 shows that 12%, 35%, 21% of the patients have a TSF, MAMC, MAMA <5 percentile, respectively.

45.1% of the patients have a BMI <23.6, 8.1% with a BMI of 23.6-24, and 46.8% with a BMI >24.

4.5 Biochemical measurements

Table 5 represents the patients with biochemical indicators of malnutrition. Only 1.6% of the patients showed serum potassium of ≥ 6, 32.3% serum phosphorus of >1.94 mmol/L, 22.6% serum total protein <64 g/L, 16.1% TLC <1200 mm3, 30.6% serum cholesterol >4.70, while 50.0% has a serum cholesterol <3.9, 45.2% with serum calcium of ≤ 2.37, 48.4%. Bread is the main starch item that patients consume as 82.3% of with creatinine <884, 21.0% BUN >28.5 mmol/L, 91.9%, 66.1% with albumin <40 g/L.

Table 4: TST, MAMC, and MAMA percentile

Percentile	TSF		MAMC		MAMA	
	N=62	%	N=62	%	N=62	%
<5	8	13	22	35	13	21
٥	٠	٠	3	5	2	3
10	1	2	11	18	4	6
15	3	5	0	0	5	8
25	16	26	7	11	9	14
50	16	26	11	18	11	18
75	9	14	4	6	11	18
85	3	5	0	0	2	3
90	2	3	2	3	1	2
95	0	0	1	2	0	0
>95	4	6	1	2	4	6

Table 5: Biochemical indicators for malnutrition

Biochemical tests (serum)	Abnormal renal range*	N=62	%	Mean ±SD
Potassium	≥ 6 mmol/L	1	1.6	4.8 ± 0.7
Bicarbonate	<22 mmol/L	54	87.1	17.9± 2.6
Phosphorus	>1.94 mmol/L	20	32.3	1.71 ± 0.60
Calcium	≤ 2.37 mmol/L	28	45.2	2.33 ± 0.23
PTH (Pg/mL)	>300	23	37.1	489 ± 656
Albumin	<40	41	66.1	38 ± 3
Total Protein	<64 g/L	14	22.6	68 ± 6
TLC	<1200 mm^3	10	16.1	1729 ± 554
Cholesterol	<3.9 mmol/L	31	50.0	4.1 ± 1.1
BUN	>28.5 mmol/L	13	21.0	24.3 ± 6.4
Creatinine	<884 µmol/L	30	48.4	922 ± 296

* McCann, 2002.

4.6 Dietary assessment

Table 6 reveals the analysis of 3 days dietary record. It showed that about 82% of the patients ≤ 60 years of age are taking less than 35 kcal/kg/day, and the mean energy intake is 26±10, while 88% of the patients > 60 years of age are taking less than 30 kcal/kg/day, with a mean energy intake of 22±9.

Only 30.6% of the patients taking ≥ 1.2g/kg/d of protein, 24.2% of them with a dietary protein intake of 1-1.2g/kg/d, while 45.2% of them taking <1 g/kg/d, the mean is 1.1±0.6. Most of the ingested protein (82.3% of the patients) comes from HBV; the mean is 60.5%±12.7. When the patients' dietary nitrogen intake was compared to their calculated UNA, 85.5% of them showed a negative nitrogen balance.

Only 3.2% of the patients are with a dietary potassium intake of more than 3000 mg/d, 4.8% with a sodium intake of >3000mg/d.

55% of the patients are with dietary phosphorus intake of ≥ 900 mg/day, and 8.1% of them are with calcium intake of > 1600 mg/day only. About 37% of them with an estimated fluid intake of more than 1 L/d.

The food frequency table analysis showed that 50% of the patients consume chicken ≥ 4 times/week (T/W), and 67.4% take red meat 1-3 T/W. 53.2% of them take egg 1-3 T/W.

Table 6: Dietary indicators for malnutrition

Indicator		Categories	N=62	%
Energy Intake Kcal/kg/day	≤ 60 Years	<35	37	82.2
		≥ 35	8	17.8
	>60 Years	≤ 30	15	88.2
		>30	2	11.8
Protein Intake g/kg/day		<1	28	45.2
		1<1.2	15	24.2
		>1.2	19	30.6
HBV (%)		≥ 50	51	82.3
		<50	11	17.7
Nitrogen Balance		-ve Balance	53	85.4
		+ve Balance	9	14.5
Sodium Intake mg/day		≤ 3 g/d	59	95.2
		> 3 g/d	3	4.8
Potassium Intake mg/day		<3000	60	96.8
		>3000	2	3.2
Phosphorus Intake mg/day		<900	34	54.8
		≥ 900	28	45.2
Calcium Intake mg/day		≤ 1600	57	91.9
		> 1600	5	8.1
Fluid Intake L/day*		≤ 1	39	62.9
		>1	23	37.1

* Estimated by using the Interdialytic weight increase/day

Bread is the main starch item that patients consume as 82.3% of them take it ≥ 7 T/W, the rice is the second preferable one, about 60% of the patients take it ≥ 7 T/W.

Dates, which are rich in potassium, were the main fruit consumed by the patients as 51.6% of them consume it ≥ 7 T/W, apple and orange were consumed ≥ 7 T/W by 14.5% and 6.5% respectively. Banana and other fresh fruits were less consumed.

About 63% of the patients take vegetables casserole (Edam) ≥ 1T/W; about 44% of the patients take Margoug and Goursan 1 T/W or more. These food items are rich in potassium also, as it contains tomato paste.

Among the phosphorus rich food items, cheese intake is considered the highest. About 69% of the patients take it ≥ 2 T/W. Legumes such as Foul, Golaba, and Adas, come in the second place of consumption as 30.7% of the patients take it ≥ 1 T/W, followed by nuts, (24.2%).

4.7 Correlation of different variables

4.7.1 Association between energy, protein intake and sociodemographic and economical variables

Table 7 shows that no significant association is detected between all sociodemographic variables and energy and protein intake. Although the difference is not significant, females show lower energy intake (<35 kcal/kg/d) and lower protein intake (<1.2 g/kg/d) than males. Regarding marital status, married couples showed higher energy intake (≥ 35 kcal/kg/d) and higher protein intake (≥ 1.2 g/kg/d) compared to single ones.

4.7.2 Correlation between albumin and medical history

Table 8 shows the correlation between albumin and medical history. No significant correlation was found between length of dialysis (r=0.192, P<0.136), duration of HD (r=0.078, P<0.547) and albumin.

A significant negative relationship was observed between albumin and days of admissions (r=-0.39, P<0.002), and albumin with the number of visits to emergency room (r = -0.305, P<0.016).

A significant positive relationship (r=0.271, P<0.033) was found between pre-BUN and length of hospitalization. No significant association was detected between pre-BUN and number of visits to ER (r=0.042, P<0.745). Also a non significant negative association was observed between pre-BUN and length of dialysis (r=-0.081, P<0.531), and the duration of HD (r=-0.061, P<0.635).

Table 7: Association between energy, protein intake and sociodemographic and economical variables*

Variable		Energy ≥ 35 kcal/kg/d	Energy <35 kcal/kg/d	Energy P Value**	Protein ≥ 1.2 g/kg/d	Protein <1.2 g/kg/d	Protein P Value
Sex	M	6(60%)	29(56%)	0.54	12(63%)	23(54%)	0.34
	F	4(40%)	23(44%)		7(37%)	20(46%)	
Age	18-30	2(20%)	6(11%)	0.18	4(21%)	4(9%)	0.16
	30-45	5(50%)	15(29%)		5(26%)	15(35%)	
	46-60	1(10%)	16(31%)		8(42%)	9(21%)	
	>60	2(20%)	15(29%)		2(11%)	15(35%)	
Education	Illiterates	2(20%)	24(46%)	0.17	8(42%)	18(42%)	0.71
	Elementary school	2(20%)	9(17%)		4(21%)	7(16%)	
	Intermediate + high School	6(60%)	17(33%)		7(37%)	16(37%)	
	University	0	2(4%)		0	2(5%)	
Marital status	Single	3(30%)	19(37%)	0.49	19(32%)	43(37%)	0.45
	Married	7(70%)	33(63%)		13(68%)	27(63%)	
Family Income	<5000 SR	6(60%)	36(69%)	0.41	13(68%)	29(68%)	0.77
	5000-10000 SR	2(20%)	11(21%)		3(16%)	10(23%)	
	>10000 SR	2(20%)	5(10%)		3(16%)	4(9%)	

*X^2 was used for statistical analysis

** P≤ 0.05 is considered statistically significant.

Table 8: Correlation between albumin and medical history

Medical history	Albumin	
	r	**P**
NO of visits to ER over a year	-0.305	0.016
Admission days over a year	-0.391	0.002
Length of dialysis (year)	0.192	0.136
Duration of HD (hrs)	0.078	0.547

4.7.3 Correlation of total energy intake, total protein intake and some biochemical variables

Table 9 shows association of total energy intake and some biochemical variables. A high significant positive correlation (r=0.87, P<0.001) was noticed between total energy and total protein intake. Also significant positive correlations were observed between total energy intake and albumin (r=0.602, P<0.001), Pre-BUN (r=0.497, P<0.001), UNA (r=0.469, P<0.001), and TLC (r=0.356, P<0.004). A non significant positive correlation is noticed with creatinine (r=0.240, P<0.06).

The table also shows a significant relationship between total protein intake and albumin (r=0.533, P<0.001), TLC (r=0.296, P<0.02), Pre-BUN (r=0.554, P<0.001), and UNA (r=0.467, P<0.001). No significant relationship between energy intake and serum creatinine (r=0.181, P<0.16) was detected.

When we controlled for total energy intake we found a significant positive relationship between protein intake and pre-BUN (r=0.284, P<0.027), but no relations with UNA (r=0.133, P<0.308) or albumin (r=0.018, P<0.89), table 10.

Table 9: Correlation of total energy intake, total protein intake and some biochemical variables.

Variable	Total energy intake		Total protein intake	
	r	P	r	P
Total Protein intake	0.873	<0.001	-	-
Albumin	0.602	<0.001	0.533	<0.001
TLC	0.356	0.004	0.296	0.02
Pre-BUN	0.497	<0.001	0.554	<0.001
UNA	0.469	<0.001	0.467	<0.001

Table 10: Partial correlation between some biochemical variables with total energy intake controlling for total protein intake and vice versa

Biochemical variables	Total energy intake (controlling for protein)		Total protein intake (controlling for energy)	
	r	**P**	**r**	**P**
Albumin	0.333	0.090	0.018	0.890
Pre-BUN	0.034	0.795	0.284	0.027
UNA	0.144	0.270	0.133	0.308

The table also shows that no correlation was detected between total energy intake and albumin (r=0.333, P<0.09) when we controlled for total protein intake, also no correlation was detected with UNA (r=0.144, P<0.27) or Pre-BUN (r=0.034, P<0.795).

4.7.4 Correlation of albumin and some other biochemical variables

Table 11 shows no significant relationship between serum albumin and serum TLC (r=0.194, P<0.13), UNA (r=0.134, P<0.299) and Pre-BUN (r=0.214, P<0.095). A significant positive relationship was exhibited between serum creatinine and serum albumin (r=0.44, P<0.001).

No correlation was detected between Pre-BNU and TLC (r=0.011, P<0.933), but a significant positive relationship was noticed between pre-BUN and UNA (r=0.552, P<0.001), and serum creatinine (r=0.355, P<0.005).

4.7.5 Correlation between BMI and some anthropometric and medical history variables

Table 12 shows high significant positive correlation was observed between BMI and MACF (r=0.75, P<0.001) and TSF (r=0.656, P<0.001), while a negative relationship was detected between BMI and the number of visits to ER ($r=-0.286$, $P<0.024$). A negative non-significant relationship was shown between BMI and number of admission days ($r=-0.236$, $P<0.065$).

Table 11: Correlation of albumin and some other biochemical variables

Measure	Albumin	
	r	P
TLC	0.194	0.130
UNA	0.134	0.299
Creatinine	0.433	<0.٠٠١
Pre-BUN	0.214	0.095

Table 12: Correlation between BMI and some anthropometric and medical history variables

Measure	BMI	
	r	P
MACF	0.751	<0.001
TSF	0.656	<0.001
Admission days over a year	-0.236	0.065
NO of Visits to ER over a year	-0.286	0.024

Chapter V

Discussion

Comment [A11]: PEM

5.1 Dietary protein intake

The 3 days dietary record showed that the mean DPI is 1.1±0.6 g/kg/day; the mean of HBV is 60.5%±12.7. 69.4% of the patients showed an intake of DPI lower than 1.2 gm/kg/d.

Acchiardo et al. (1983, 1990) showed in two different studies that protein intake of less than 1.2 g/kg/d is associated with lower serum albumin levels and higher morbidity. On the other hand, not every epidemiological study showed a significant relationship between morbidity or mortality and normalized protein equivalent of total nitrogen appearance (PNA) (Movilli et al. 1993; Movilli et al. 1995).

The significant correlation reported by some studies (Nakao et al. 2003; Guarnieri et al. 1980) between protein intake and pre dialysis blood urea nitrogen (Pre-BUN) in patients undergoing MHD was also observed in our patients ($r=0.554$, $P<0.001$) and this relation remain significant even with control for energy ($r=0.284$, $P<0.027$). This significant correlation can be used to monitor dietary intake of protein ((Kopple & Swendseid, 1975).

A significant positive relation was also detected between protein intake and UNA ($r=0.467$, $P<0.001$), this relation hasn't been found when we controlled for energy ($r=0.133$, $P<308$), and vice versa, a significant positive relationship was found between energy intake and UNA ($r=0.469$, $P<0.001$) and when controlled for protein no relation was detected (r=0.144, P<0.27), suggesting that UNA in our patients is affected by a combination of low protein and low energy intake.

5.2 Dietary energy intake

Most patients in this study failed to attain this recommended energy intake. The mean energy intake of the patients ≤ 60 year old was 26±10 kcal/kg/d, 82.2% of the patients had an energy intake of less than 35 kcal/kg/d. The percentage of patients >60 years old whom their energy intake is <30 kcal/kg/d is 88.2% with a mean energy intake of 22±9.

The data reflect a high incidence of protein energy malnutrition among patients at RKH, and its even more than what it has been reported by similar Cross-sectional studies which suggest that up to two thirds of the patients on HD are malnourished (Pollock et. al. 1996) . It seems that the incidence of energy malnutrition is more severe than protein malnutrition, and this finding is an agreement with the epidemiological studies which suggest that low energy intake is probably more common and severe than low protein intake (Bansal et al. 1980; Blumenkrant et al. 1980; Thunberg et al. 1981; Young et al. 1982; Wolfson et al. 1984; Dwyer et al. 1995).

There is a significantly positive relationship between the amounts of protein intake and energy intake in our patients (r=0.873, P<0.001), a finding similar to that of Nakao et al. (2003). This relation reflects a general poor food intake, as about 70% of our patients had poor to fair appetite. High calorically dense meal plan is required to achieve the patient's energy requirement.

5.3 Anthropometric measurements

About 45% of our studied patients have a BMI of less than 23.6; (mean is 24.8 ± 6), a result that suggests a high risk of morality. Very strong positive relationship between BMI and MACF ($r=0.751$, $P<0.0001$), and TSF ($r=0.656$, $P<0.001$) was found reflecting the content of body adipose tissue. A significant negative relationship between BMI and number of visits to emergency room ($r=-0.286$, $P<0.024$), and also between BMI and number of admission days ($r=-0.236$, $P<0.065$) was found, suggesting that the patients with a low BMI in this study are at high risk of morbidity.

Overweight patients have an increase in adipose tissue and are therefore, less likely to suffer from energy deficits. Arguably for this reason, underweight patients on hemodialysis might be more likely to fall ill or tend to recover more slowly from illness than the normal or overweight patients (Fleischmann et al. 1999; Salahdeen, 2003), which is in agreement with our findings.

The percentage of patients below 5th percentile for mid-arm muscle circumference (MAMC) were 35.5%, suggesting a marked reduction in muscle bulk and somatic protein stores. Likewise, 12.9% of patients were below the 5th percentile for triceps skinfold thickness (TSF), suggesting substantial loss of fat (i.e., energy) stores. These findings are close to the finding of National Cooperative Dialysis Study (NCDS) (Schoenfeld et al. 1983).

5.4 Nitrogen balance

The estimated nitrogen lose by using the equations used to estimate urea nitrogen appearance (UNA) that are shown in Appendix V, and comparing it to the nitrogen intake we have found that the majority of the patients (85.5%) had a negative nitrogen balance, which reflects the low DPI and dietary energy intake (DEI), and suggesting that those patients are catabolic or at high risk of catabolism.

5.6 Hypoalbuminemia

Due to high incidence of PEM among our patients in RKH, about (70-90%), it is not surprising to find a high incidence of hypoalbuminemia among these patients. About two thirds of the patients (66.1%) have low serum albumin (<40 g/L, with a mean of 38 ± 3) which is similar to most reported studies (Thunberg, 1981; Lowrie & Lew, 1990; Rao et al. 2000; Kalantar-Zadeh et al. 2003).

As expected significant positive relationship between serum albumin and protein intake (r=0.533, P<0.001), and between serum albumin and energy intake (r=0.602, P<0.001) was found. These relations were not detected when controlling for energy or protein, as serum albumin level may fall modestly with a sustained decrease in dietary protein and energy intake and may rise with increased protein or energy intake (Keys, 1950).

No correlation was found between duration of HD and serum albumin level (r=0.078. P<0.547) or length of dialysis (r=0.192, P<0.136, whereas a significant inverse correlation between serum albumin with number of visits to ER (r=-0.305, P<0.016) and admission days (r=-0.391, P<0.002) suggesting that those patients with hypoalbuminemia are at high risk of morbidity. Significant positive relationship was detected between TLC with energy intake (r=0.356, P<0.004) and protein intake (r=0.296, P<0.02), 16% of patients showed a low TLC (1200 mm^3). Synthesis of TLC requires adequate calories/protein intake. Low TLC decreases the immunity and may predispose the patients to infection. TLC is a good indicator for malnutrition especially if it's accompanied with low serum albumin.

5.7 Serum creatinine

It has been found that the percentage of the patients with serum creatinine level of <884 is 48.4%. A predialysis or stabilized serum creatinine of less than approximately 884 µmol/L among patients with negligible urinary creatinine clearance who are on MHD could be an indicator of a nutritional deficit (Lowrie et al. 1995; Avram et al. 1995; Harty et al. 1994; Avram et al. 1994; De Lima et al. 1995). This result supports the other findings of high incidence of PEM among our MHD patients.

A positive significant relationship between serum creatinine and the serum albumin (r= 0.433, P<0.001) as well as with pre-BUN (r=0.355, P<0.005) has been shown. This finding is similar to the finding of other studies (Jones et al. 1994; Han, 1996; Sreedhara, 1996).

The increase of dietary protein and energy intake will increase the pre-BUN and albumin, thus the creatinine level will increases.

5.8 Serum cholesterol

The patients showed that the mean serum cholesterol is 4.1 ± 1.1 mmol/L, while 50% of the patients have serum cholesterol of <3.9 mmol/L. maintenance dialysis patients with serum cholesterol concentrations less than approximately 3.9 migh indicate a nutritional deficits. this finding also support the high prevalence of PEM among our patients.

5.9 Serum bicarbonate

87.1% of our patients showed a low serum bicarbonate of <22 mmol/L, (mean 17.9± 2.6). A low serum bicarbonate concentration in a maintenance dialysis patient generally indicates metabolic acidosis.

Acidemia due to metabolic acidosis is associated with increased protein degradation (Movilli et al. 1998) and PNA (Bastani et al. 1996; Uribarri, 1997) and decreased albumin synthesis (Lowrie et al. 1998). Similarly, a direct correlation between serum bicarbonate and albumin concentrations has been observed in MHD patients (Bastani et al. 1996; Brady and Hasbargen, 1998). Acidemia may have detrimental effects on vitamin D synthesis and bone metabolism. (Sonikian et al. 1996)

5.10 Renal osteodystrophy

The mean dietary phosphorus (PO4) intake of our patient's is 988±612 mg/day, about 45% of the patients with a phosphorus intake of ≥ 900 mg/d. The mean serum PO4 is 1.71±0.60 mmol/L, which is relatively lower than the upper recommended value (≤ 1.94 mmol/L) for MHD patients. However, 32.3% of patients showed a serum value of PO4 >1.94 mmol/L. Similar results were found with serum serum calcium, as 45.2% of patients showed a value of ≤ 2.37 mmol/L. On the other hand, a high PTH was observed among 37.1% of patients who showed a value of >300

Pg/mL. These findings suggest that these patients are at a high risk of renal osteodystrophy.

Dietary data (dietary record and food frequency table) in this study showed that the dietary phosphorus content is directly related to the quantity and type of protein, legumes such as Foul, Golaba and Adas, nuts, and dairy products, especially cheese, in the diet.

Control of hyperphosphatemia and secondary hyperparathyroidism are vital to the long-term well-being of renal failure. Dietary restriction of phosphorus intake and adequate dialysis therapy form the basis for management, but are usually insufficient to bring about adequate control. Since the phosphorus intake is closely related to the protein intake, and since dialysis is relatively inefficient in phosphorus removal, most patients on replacement therapy require the use of phosphate binding agents to reduce the intestinal absorption of dietary phosphorus.

5.11 Serum potassium

Only 1.6% (one patient) showed hyperkalemia (serum K $\geq$ 6 mmol/L). This very low percentage is clearly related to the low intake, 1546±632 mg/day (40 ± 16 mmol/L), of dietary potassium that was observed among our patients.

Chapter VI

Summary, Conclusion, and Recommendations

6.1 Summary

Malnutrition is common in hemodialysis patients and closely related to morbidity and mortality. Therefore, assessment of nutritional status and nutritional management of hemodialysis patients play a central role in everyday nephrological practice. This study was carried out in the dialysis center of Riyadh Al-Kharj Hospital (RKH), to determine the frequency and severity of malnutrition in dialysis patients, to evaluate the dietary approach and dietary compliance of dialysis patients, and to recommend an appropriate dietary modality for patients on MHD.

In a cross-sectional study, a group of 62 Saudi patients were assessed using demographic, socioeconomic, medical history, anthropometric indices including dry weight, height, Triceps Skinfold thickness (TSF), and Mid-Arm Muscle Circumference (MAMC), biochemical measurement including Urea Nitrogen Appearance (UNA), estimation of dietary pattern and intake using 3 days dietary record and food frequency questionnaire.

The 3 days dietary record showed that most of the patients fail to attain the recommended energy (more than 82%), and protein intake (about 70%), 85.5% of the patients showed negative nitrogen balance, and about 55% of the patients showed a high phosphorus intake.

Anthropometric measurements showed that percentage of the patients with TSF, MAMC and MAMA of <5th percentile are 12%, 35% and 21% respectively. 45.1% with a BMI of less than the recommended (23.6 – 24 kg/M2) for hemodialysis patients.

It has been found that more than two third of the patients in RKH showed a biochemical malnutrition indicators, these include hypoalbuminemia (66.1% of the patients), low bicarbonate (87.1%), low serum cholesterol (50%). 32.3% of the patients showed high serum phosphate, 45.2% with hypocalcaemia and 37.1% with hyperparathyroidism.

Moderate to Significant negative correlation has been found between the increase of hospital stay and repeated need for emergency room care with serum albumin ($r= -0.391$, $P< 0.002$; $r= -0.305$, $P<0.016$ respectively) and low BMI ($r=-0.236$ $P<0.065$; $r=-0.286$, $P<0.024$). Also a significant positive correlation between hypoalbuminemia and energy ($r=0.602$, $P<0.001$) and protein intake ($r=0.533$, $P<0.001$) was found.

The data suggests that the patients are at a high risk of morbidity and mortality.

6.2 Conclusions

- Most of the patients on maintenance dialyses failed to maintain the required dietary energy and protein intake
- Malnutrition is a strongly associated with morbidity and mortality, the attendance complications of PEM, malaise, wasting, and decreased immunity, may predispose patients to infection and increase the need for hospital care, visits to ER and increasing the hospital stay.
- Dietary interviews and/or diaries are clinically useful for measuring dietary protein and dietary energy intake in our maintenance dialysis patients.
- Urea nitrogen appearance has been found to be clinically useful measure of nitrogen balance and protein intake in our maintenance dialysis patients.
- Anthropometric measurements (body mass index, skin fold thickness, estimated percent of body fat, and mid-arm muscle area, circumference, or diameter) are clinically useful indicators of protein energy nutritional status in our maintenance dialysis patients.

- Hypoalbuminemia was associated with a combination of low dietary energy and protein intake, improvement of serum albumin needs an increase intake of both energy and protein.
- Pre-BUN can be used to monitor the dietary protein intake.
- Correcting of acidemia (low Serum Bicarbonate) may help in improving protein-energy intake in HD patient.

6.3 Recommendations

1. Improvement of nutritional status of patients on maintenance hemodialysis is needed.
2. Every maintenance dialysis patient needs an intensive nutritional counseling based on an individualized plan of care developed before or at the time of commencement of maintenance dialysis therapy.
3. Regular assessment of nutritional status of patients undergoing maintenance hemodialysis every three to six months, to identify patients at malnutrition risk, and allow for early nutritional intervention.
4. Education and dietary counseling should be the first step in attempting to maintain adequate energy and protein intake. If this approach is unsuccessful, nutritional support such as supplementing formula, tube feeding, or intradialytic parenteral nutrition is recommended.
5. Monitor serial body weight and body mass index aiming to maintain high normal body mass index, and to be concerned about progressive loss of weight even in overweight patient.

6. Restriction of dietary phosphorus intake with a combination of phosphorus binders, in case of high protein needs or hyperphosphatemia, is recommended.
7. Correction of acidemia and predialysis or stabilized serum bicarbonate level should be emphasized.

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Appendixes

Appendix I: Questionnaire

التقييم الغذائي لمرضى الغسيل الكلوي

رقم الملف: ☐☐☐ ☐☐☐ ☐☐
الاسم:

المعلومات الديموغرافية والاجتماعية والاقتصادية

١- تاريخ الميلاد: / /

٢- الجنس: ☐ ذكر ☐ انثى

٣- التعليم: ☐ لا اقرأ ولا أكتب ☐ حاصل على شهادة ابتدائية
☐ شهادة متوسطة أو ثانوية ☐ شهادة جامعية

٤- الحالة الوظيفية: ☐ ربة منزل ☐ عاطل عن العمل
☐ موظف او يملك عملا ☐ متقاعد

٥- الحالة الاجتماعية: ☐ أعزب ☐ متزوج

٦- الدخل العائلي: ☐ أقل من ٥٠٠٠ ريال
☐ من ٥٠٠٠-١٠٠٠٠ ريال
☐ أكثر من ١٠٠٠٠ ريال

٧- عدد أفراد العائلة اللذين يعيشون بالمنزل(شاملاً الخدم): ____

٨- نوع السكن: ☐ ملك ☐ ايجار

٩- طريقة الانتقال إلى المستشفى: ☐ بنفسي ☐ سائق خاص ☐ احد أفراد العائلة

التاريخ المرضي

١- كم مرة راجعت فيها الطوارئ خلال العام الماضي؟: ____

٢- كم عدد الأيام التي نومت فيها خلال العام الماضي؟: ____

٣- هل عانى أويعاني أحد أفراد العائلة من أحد الأمراض التالية؟:

☐ الكلى ☐ القلب ☐ السرطان
☐ السكري ☐ ضغط الدم ☐ ارتفاع دهنيات الدم

٤- هل تعاني من؟:
☐ الأمساك ☐ تغير في حاسة الذوق ☐ حساسية لبعض الأطعمة
☐ صعوبة في المضغ ☐ ضعف في السمع أو الرؤية

<u>السلوك الصحي والغذائي</u>

١- هل سبق أن وضعت على حمية خاصة؟:
☐ نعم ☐ لا

٢- إذا سبق وأن وضعت على حمية خاصة فمن الذي وصفها لك:
☐ أخصائي الحمية ☐ الدكتور ☐ الممرضة أو فني الغسيل
☐ من زملائي في وحدة الغسيل ☐ من قرائتي الخاصة

٣- إلى أي مدى تتبع الحمية؟:
☐ دائماً ☐ أحيانا ☐ لا اتبعها نهائيا

٤- كم مرة في الاسبوع تتناول الطعام خارج المنزل؟:____________

٥- كيف هي شهيتك للطعام؟:
☐ جيدة ☐ لا بأس ☐ ضعيفة

٦- هل طرأ تغير على وزنك خلال الأشهر الستة الماضية؟:
☐ زاد الوزن ☐ نقص الوزن ☐ لم يتغير

٧- هل تعرف أسماء الأدوية التي تتناولها أو دواعي استعمالها؟: ☐ نعم ☐ لا

٨- هل تتناول الأدوية بانتظام؟: ☐ نعم ☐ لا

٩- هل تتناول أي فيتامينات أو أدوية شعبية أو عشبية؟:
☐ نعم، اذكرها ____________________ ☐ لا

١٠- كيف تقيم حالتك الصحية حاليا؟:
☐ جيدة ☐ لا بأس ☐ سيئة

١١- ما مستوى نشاطك البدني؟:
☐ قليل الحركة ☐ متوسط النشاط ☐ نشيط جدا(كثير الحركة)

١٢- هل تمارس الرياضة بشكل منتظم؟: ☐ نعم ☐ لا

Appendix II: Basic information sheet

Patient name:

Medical No: | | | | | | | | | | |

Anthropometric Data:
Height: _______ Cm; Weight ________Kg.;
MAC _______Cm; TSFT _______Cm;
IBW ______Kg; BMI_______.

Medical History:
□ DM
□ HTN
□ IHD
□ Hepatitis-B virus
□ Hepatitis-C virus

Kidney Problem start on:_________________
First dialysis day:____________________

- Dialysis Wing: □Old □New
- Days of dialysis: □S □S □M □T □W □T □F
- Dialysis Shift: □1st □2nd □3rd
- Duration of dialysis: _________hr.

Medications:
1.
2.
3.
4.
5.
6.
7.
8.

Appendix III: Food record

المفكرة الغذائية

الاسم: ____________________

رقم الملف: __________________

الفترة

من: ___________الموافق_________

إلى: ___________الموافق_________

Front page

هذا المفكرة وضعت للمساعدة في تقييم حالتك الغذائية والصحية بشكل أدق. ولتحقيق الفائدة المرجوة منها، قم بتحري الدقة قدر المكان في تسجيل نوع ومقدار جميع الأطعمة والمشروبات المتناولة خلال الفترة المحددة. ومن المستحسن القيام بالتسجيل بعد الانتهاء مباشرة من التناول وذلك لتفادي النسيان.

للاستفسار

زكي أبو المكارم

أخصائي أول- تغذية علاجية

مستشفى الرياض العسكري

قسم التغذية العلاجية

هاتف ٤٧٧٧٧١٤

تحويلة ٤٠٦٤

Back Page

اليوم: .... التاريخ / / ١٤٢

الوجبة/ الوقت	نوع الطعام أو الشراب	المقدار (ملعقة، بيالة، كوب، حبة، جرام)

The Inner Pages

اليوم: **السبت**. التاريخ ١٤٢٣/١/١٣

الوجبة/ الوقت	نوع الطعام أو الشراب	المقدار (ملعقة، بيالة، كوب، حبة، جرام)
إفطار ٨:٣٠	بيض مقلي	حبة
	شاي مع سكر	كوب + ١ملعقة سكر
	خبز ابيض	½ رغيف
	حليب قليل الدسم	كوب واحد
الضحى١١:٣٠	سندوتش بيض مسلوق	حبة خبز مدور+بيضة
	شاهي مغلي	٢ بيالة
غداء ٣:٣٠	أرز كبسة	٢ كوب
	لحم كبسة	٥٠ جم =بحجم علبتي كبريت
	سلطة خضراء (خس+خيار+جزر)	نصف كوب
	خضار مسلوقة	كوب
	تفاح	حبة
	ماء	واحد كوب
المغرب ٦:٣٠	رطب	٦ حبات
	قهوة عربية	٢ فنجان
العشاء١٠:٠٠	خبز اسمر	واحد رغيف
	ايدام خضار مشكلة (مع الصلصة)	كوب ونصف
	لحم (مع الايدام)	٢٥ جم= حجم علبة الكبريت
	سلطة خضراء	نصف كوب

هذا المثال يوضح لك طريقة التسجيل الصحيحة

The back of the Front Page

Appendix IV: FFQ

Name:____________________, File No.:

الرجاء الإشارة في الخانة الملائمةTick the proper box please

لم أتناولها أبدا Never	مرة واحدة في الأسبوع 1 time Weekly	٢-٣ مرات في الأسبوع 2-3 times Weekly	4-6 مرات في الأسبوع 4-6 times Weekly	٧ مرات أو أكثر 7 times or more	نوع الطعام Type of Food
					Fizzy Drinks مشروبات غازية
					Tea/ Coffee شاي/ قهوة
					Dairy Products ألبان
					Meat لحم أحمر
					Chicken دجاج
					Fish/ Sea Food سمك/مأكولات بحرية
					Liver/Kidney كبدة/كلاوي
					Egg بيض
					Labanah لبنة
					Cheese جبنة
					بقوليات (فول- عدس – قلابة - حمص..الخ) Legumes (Foul- Adas- Golabah- Hommos- ..Etc)
					Nuts -مكسرات
					Rice أرز
					Bread خبز(خبز عربي- صامولي- شابورة – خبز مدور - تميس..الخ) (Arabic Bread-Samloi- Shaborah- Roll- Tamees)
					مكرونة حمراء (بصلصة الطماطم) Macaroni with Tomato Sauce
					Boiled Macaroni مكرونة مسلوقة
					Jareesh جريش
					Margoog/ Gursan مرقوق/ قرصان
					Potatoبطاطس
					Apple تفاح
					Orange برتقال
					Banana موز
					Dates تمر
					Other Fruits فواكه أخرى
					Fresh Fruit Juice عصيرات طازج
					عصيرات معلبة Canned Fruit Juice
					Vegetable Casserole ايدام
					Boiled Vegetables خضار مسلوقة
					Salad سلطة
					Sweets حلويات أو كيك
					Bisckets بسكويت
					Honey/Jam عسل/ مربى
					Cream, Butter or Ghee قشطة سمنة أو زبدة
					مدعمات غذائية (حليب نيبرو او بولموكير او انشور) Nutritional Supplement (Nepro/Pulmocar/Ensure)

Appendix V: Urea nitrogen appearance rate [1-7]

Urea nitrogen appearance (UNA) can be used to estimate net protein degradation or recent protein intake in both nondialyzed, chronically uremic patients and patients undergoing maintenance hemodialysis.

Since urea is the major nitrogenous product of protein metabolism, UNA correlates closely with total nitrogen output. If the patient is more or less in neutral nitrogen balance, UNA also correlates with nitrogen intake. If both nitrogen intake and UNA are known, nitrogen balance may be estimated from the difference between nitrogen intake and output.

FORMULAS

Formula 1

UNA = urinary urea nitrogen (UUN) + dialysate urea nitrogen + change in body urea nitrogen

Where UNA, UUN, dialysate urea nitrogen, and change in body urea nitrogen are measured in g/day

Since the concentration of urea nitrogen in dialysate is low and difficult to measure accurately, UNA is usually calculated during the interdialytic period.

Formula 1 then becomes:

$$UNA = UUN + \text{change in body urea nitrogen}$$

Formula 2

$$\text{Change in body urea nitrogen} = [BUN_f - BUN_i] \times$$

$$0.6 \times BW_i + [BW_f - BW_i] \times BUN_f$$

Where change in body urea nitrogen is measured in g/day

i and f = initial and final values for period of measurement

BUN = blood urea nitrogen (g/l)

BW = body weight (kg)

0.6 = estimate of the fraction of body weight that is body water.

This estimate may have to be increased in patients who are edematous or lean, and decreased in the obese or very young

Formula 3

Total nitrogen output (g/day) = 0.97 UNA (g/day) + 1.93

Formula 4

Dietary nitrogen intake (g/day) = 0.69 UNA (g/day) + 3.3

Formula 5

Dietary protein intake = dietary nitrogen intake x 6.25

Where dietary protein intake and dietary nitrogen intake are measured in g/day

6.25 = grams of protein per gram of nitrogen

Note – the relationships between UNA and total nitrogen output or nitrogen intake are altered if another major nitrogen output (such as in nephrotic syndrome, peritoneal dialysis, or pregnancy) exists. Acidosis in patients with sufficient renal function to excrete large quantities of ammonia also alters these relationships.

If actual intakes are known, nitrogen balance may be estimated from the difference between nitrogen intake and output. This will allow determination of whether a high UNA reflects a large protein intake, increased net protein breakdown, or both. It can also be ascertained whether a low UNA reflects protein anabolism or a low protein intake.

REFERENCES

1. Bennett N. Urea kinetics: a dietitian's clinical tool in the nutritional management of the patients with end-stage renal disease. Dial Transplant. 1980;9:33.
2. Flucomer F. Kinetic modeling: a nursing perspective. AANNTJ J Am Assoc Nephrol Nurses Technicians. 1981;1:33
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4. Harum P. The feasibility of urea kinetic modeling. CRN Quarterly. 1985;9:16.
5. Kopple JD. Nutritional therapy in kidney failure. Nutr Rev. 1981;39:193.
6. Kopple JD. Profiles in Nutritional Management: The Renal Patient. North Chicago, III: Abbott Laboratories; 1981.
7. Sargent JA, et al. Mass balance: a quantitative guide to clinical nutritional therapy. 1 The predialysis patient with renal disease.2. The dialyzed patient. J Am Diet Assoc. 1979;75:547-551.

Appendix VI: The types of method used in the hospital for certain types of blood chemistry.

Serum Test	Kits	Method	Instrument
Potassium	Roche	Indirect ISE	Roche/Hitachi Modular P
Phosphorus	Roche cat. No. 11730347	Endpoint method with sample blanking	Roche/Hitachi Modular P
Calcium	Roche. Cat. No 11730240	Colorimetric assay with Endpoint determination and sample blank	Roche/Hitachi Modular P
Bicarbonate	Roche Cat. No. 12146045	Kinetic UV assay	Roche/Hitachi Modular P
PTH (Pg/mL)	Roche Cat. No. LKPP1	IMMULITE intact PTH	IMMULITE®/IMMULITE® 1000
Albumin	Roche Cat. No. 1970909	BCG	Roche/Hitachi Modular P
Total Protein	Roche Cat. No. 1929917	Colorimetric assay	Roche/Hitachi Modular P
TLC	Bickman Coulter	Impedance Photometry	Bickman Coulter
Cholesterol	Roche Cat. No. 1491458	CHOD-PAP	Roche/Hitachi Modular P
BUN	Roche Cat. No. 1729691	Kinetic UV assay	Roche/Hitachi Modular P
Creatinine	Roche Cat. No. 11875418	Kinetic Colorimetric assay (Jaffẻ)	Roche/Hitachi Modular P

Appendix VII: Frequency of food consumption of the most common food items for 62 patients, expressed in frequency and percentage.

FOOD ITEMS	≥ 7 T/W*	4-6 T/W	2-3 T/W	1 T/W	Never
	N(%)	N(%)	N(%)	N(%)	N(%)
Fizzy Drinks	13(21)	3(4.8)	26(41.9)	4(6.5)	16(25.8)
Tea/Coffee	47(75.8)	4(6.5)	4(6.5)	3(4.8)	4(6.5)
Dairy Products (Milk, Laban, Yoghurt)	22(35.5)	6(9.7)	17(27.4)	4(6.5)	13(21)
Red meat (Lamb, Camel, Beef, ..etc)	4(6.5)	3(4.8)	25(40.3)	17(27.4)	13(21)
Chicken	20(32.3)	11(17.7)	19(30.6)	3(4.8)	9(14.6)
Fish/Sea food	0	2(3.2)	9(14.5)	14(22.6)	37(59.7)
Liver/Kidney	1(1.6)	1(1.6)	6(9.7)	13(21)	41(66.1)
Egg	3(4.8)	6(9.7)	22(35.5)	11(17.7)	20(32.2)
Labaneh	1(1.6)	1(1.6)	3(4.8)	8(12.9)	49(79.1)
Cheese	14(22.6)	9(14.5)	20(32.3)	6(9.7)	13(21)
Legumes (Foul, Golabah, Hommos, Adas, Falafel ..Etc)	0	1(1.6)	10(16.1)	8(12.9)	24(69.3)
NUTS	2(3.2)	2(3.2)	4(6.5)	7(11.3)	47(75.8)
RICE	37(59.7)	7(11.3)	11(17.7)	1(1.6)	6(69.7)
Bread (Arabic Bread, Roll, Samoli, Shaborah- Tamees)	51(82.3)	4(6.5)	4(6.5)	1(1.6)	2(3.2)
Macaroni with Tomato sauce	1(1.6)	1(1.6)	8(12.9)	12(19.4)	40(64.5)
White Macaroni	0	0	7(11.3)	7(11.3)	48(77.5)
Jareesh	0	0	10(16.1)	7(11.3)	45(72.6)
Margoug/Gorsan	2(3.2)	2(3.2)	7(11.3)	16(25.8)	35(56.5)
Potato	2(3.2)	1(1.6)	9(14.5)	18(29)	32(51.6)
Apple	9(14.5)	9(14.5)	8(12.9)	10(16.1)	26(41.9)
Orange	4(6.5)	5(8.1)	6(9.7)	11(17.7)	36(58)
Banana	1(1.6)	0	9(14.5)	10(16.1)	42(67.7)
Dates	32(51.6)	2(3.2)	9(14.5)	6(9.7)	13(21)
Other fruits	3(4.8)	2(3.2)	14(22.6)	13(21)	30(48.4)
Fresh Fruit Juice	3(4.8)	2(3.2)	9(14.5)	9(14.5)	39(62.9)
Canned Fruit Juice	1(1.6)	1(1.6)	7(11.3)	8(12.9)	45(72.5)
Vegetables Casserole	4(6.5)	8(12.9)	15(24.2)	12(19.4)	23(37.1)
Boiled drained Vegetables	6(9.7)	2(3.2)	7(11.3)	7(11.3)	40(64.5)
Salad	26(41.9)	4(6.5)	13(21.0)	7(11.3)	12(19.3)
Sweets	5(8.1)	2(3.2)	7(11.3)	7(11.3)	41(66.1)
Biscuits	2(3.2)	2(3.2)	10(16.1)	4(6.5)	44(71)
Honey/Jam	13(21.0)	5(8.1)	11(17.7)	10(16.1)	23(37.1)
Cream/Butter/Ghee	6(9.7)	5(8.1)	7(11.3)	9(14.5)	35(29.4)
Nutritional Supplement (Nepro/Pulmocare.. etc)	2(3.2)	1(1.6)	1(1.6)	0	58(93.6)

T/W= times per week

Appendix VIII: Figures

Figure 1: Gender distribution

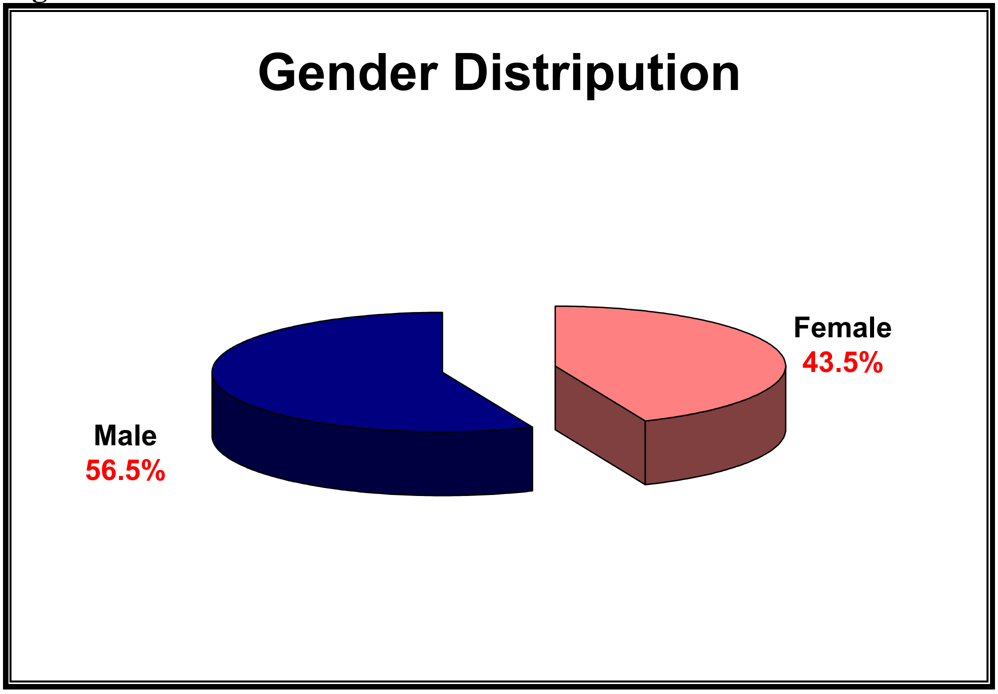


Figure 2: Age groups distribution

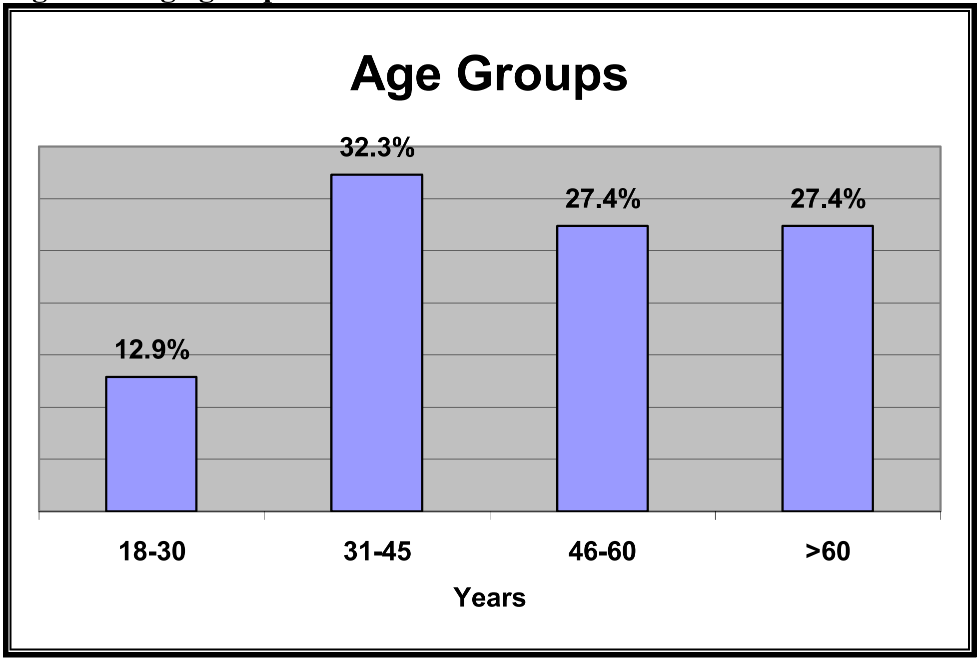


Figure 3: Educational level

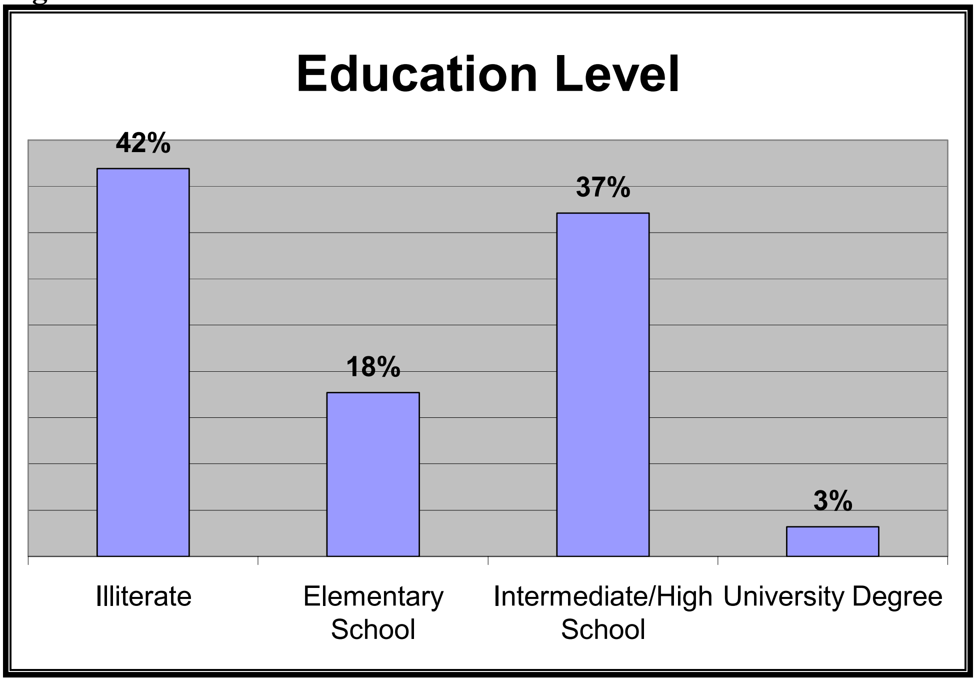


Figure 4: Marital status

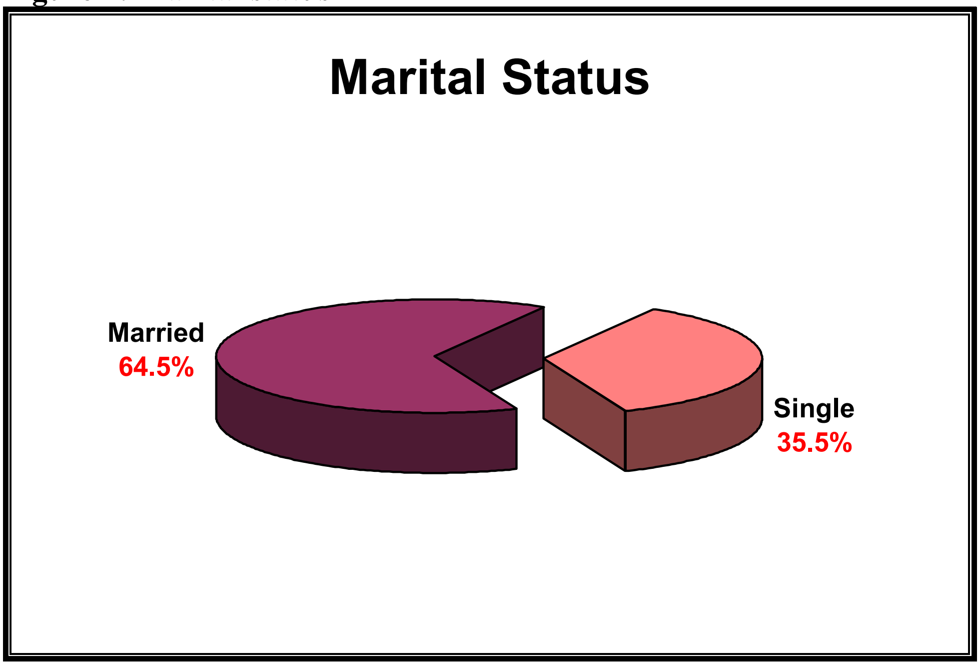


Figure 5: Working status

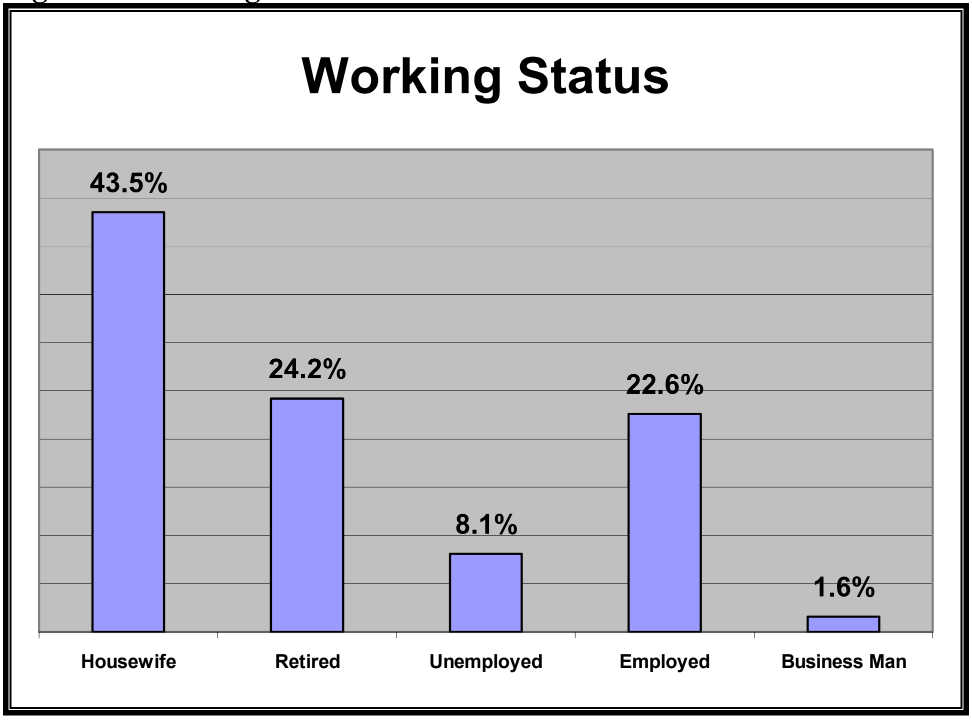


Figure 6: Monthly family income

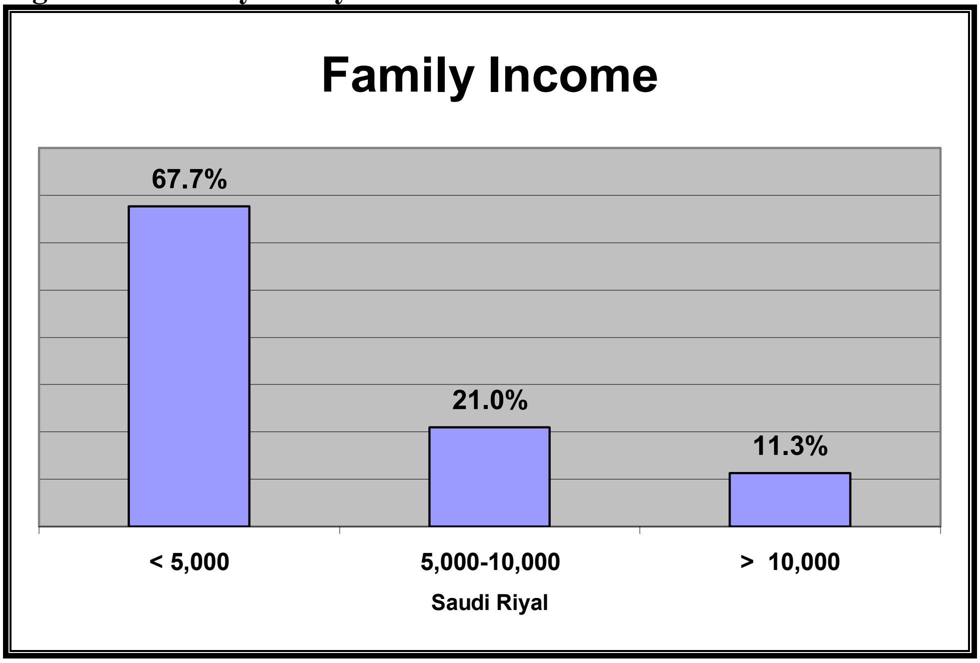


Figure 7: Number family members

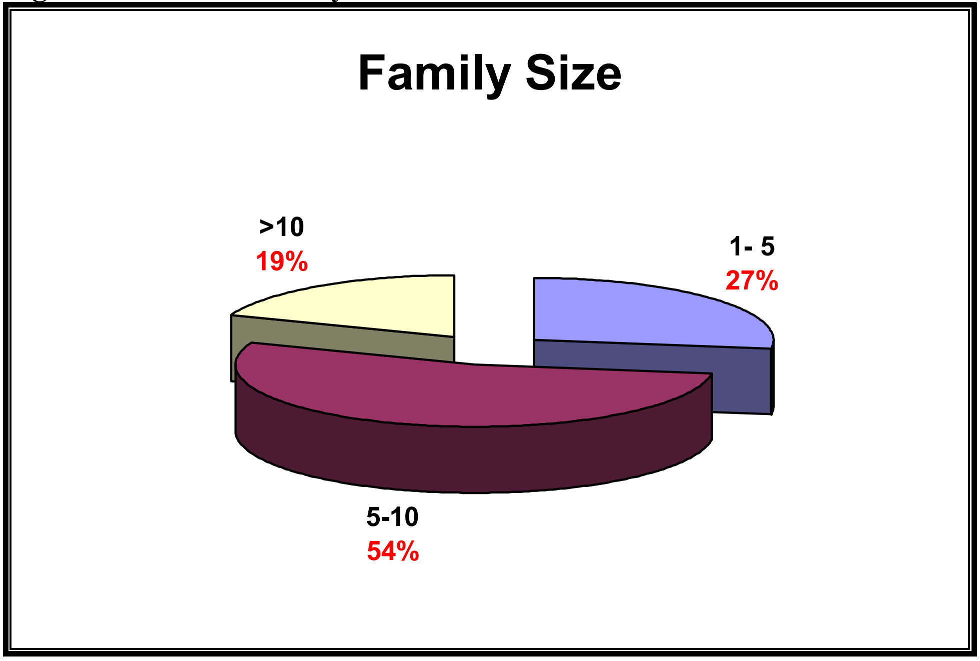


Figure 8: MHD patients visits frequency to emergence room over a year

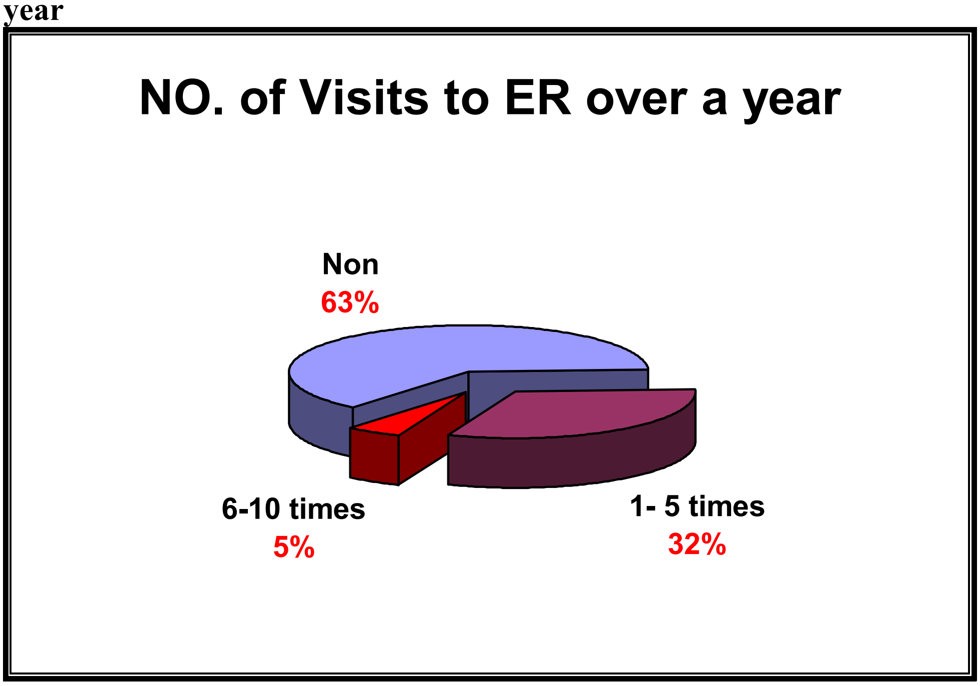


Figure 9: Number of admission days over a year

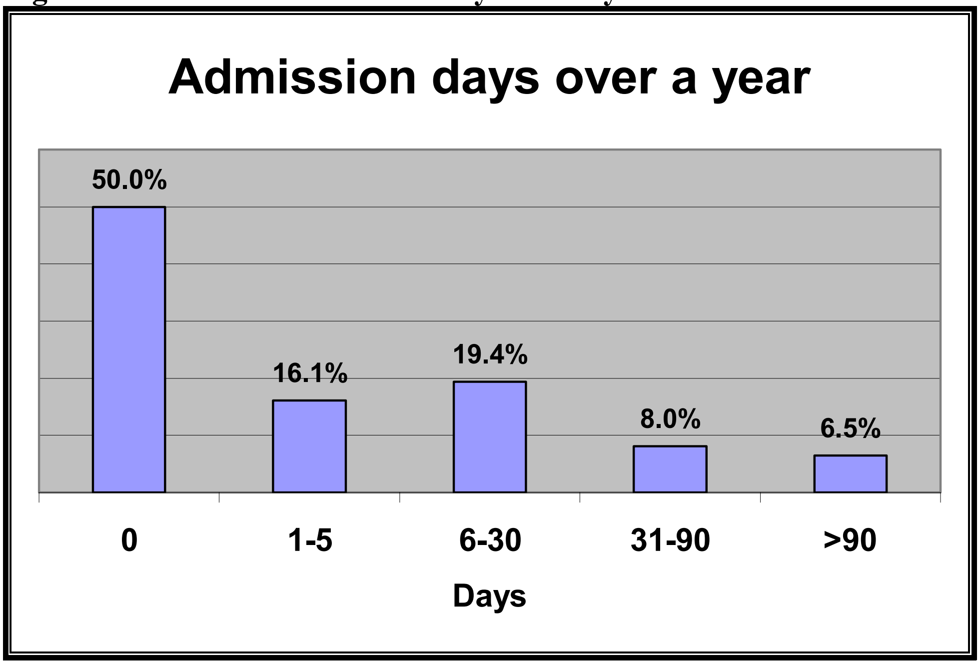


Figure 10: Duration of hemodialysis session

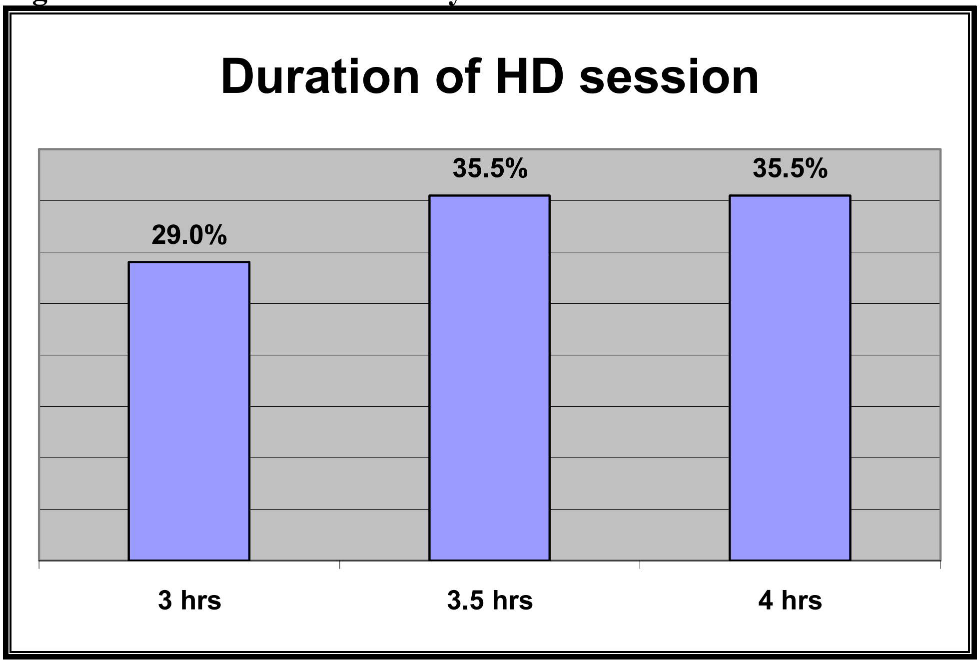


Figure 11: Length of hemodialysis

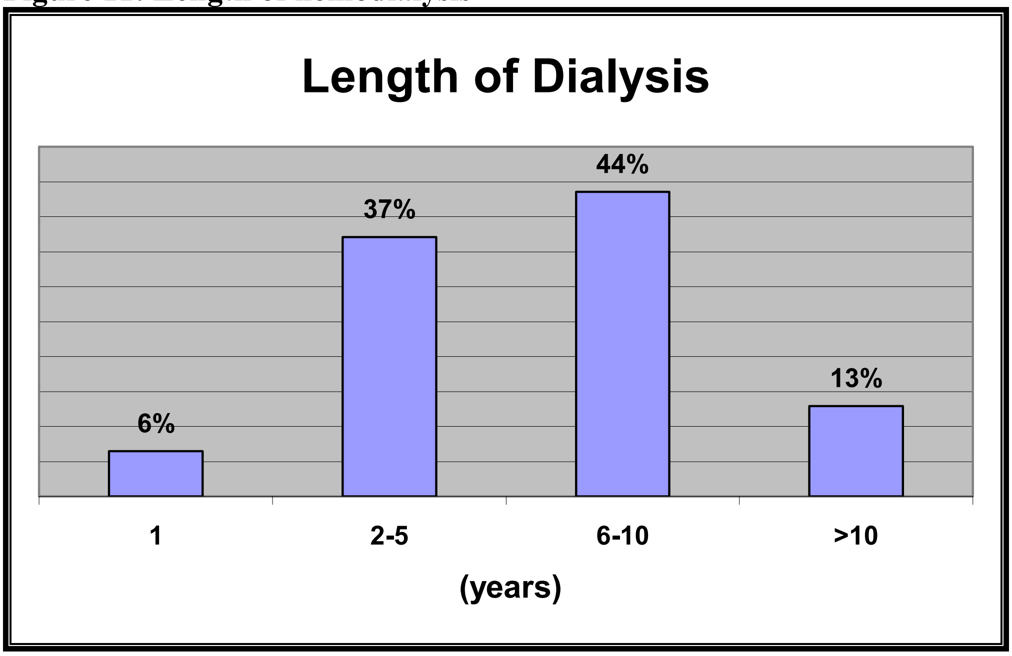


Figure 12: Family medical history

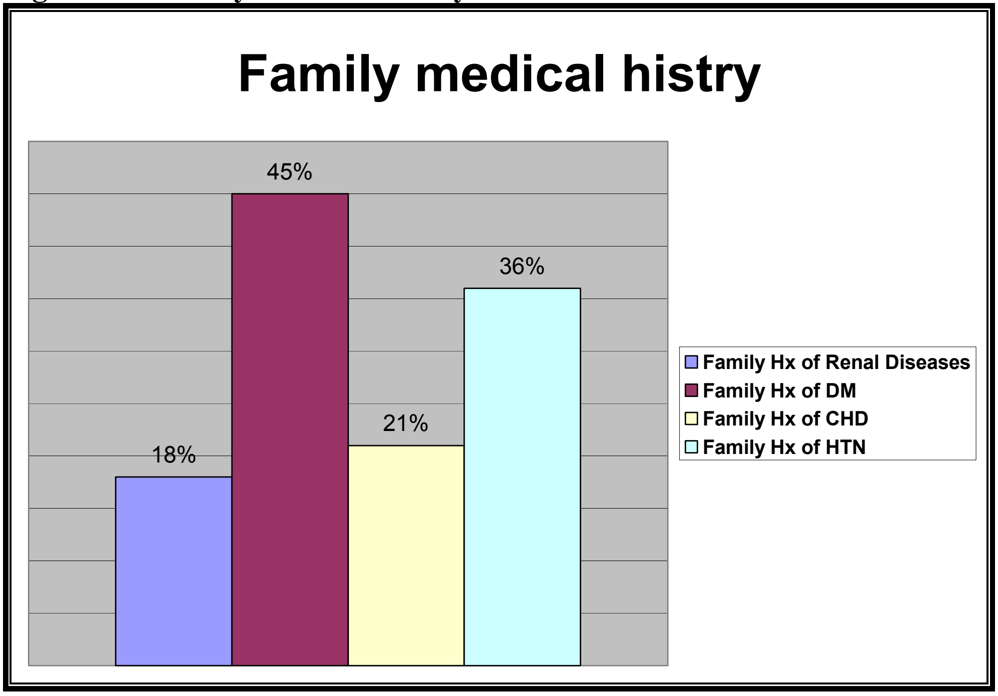


Figure 13: Patients medical history

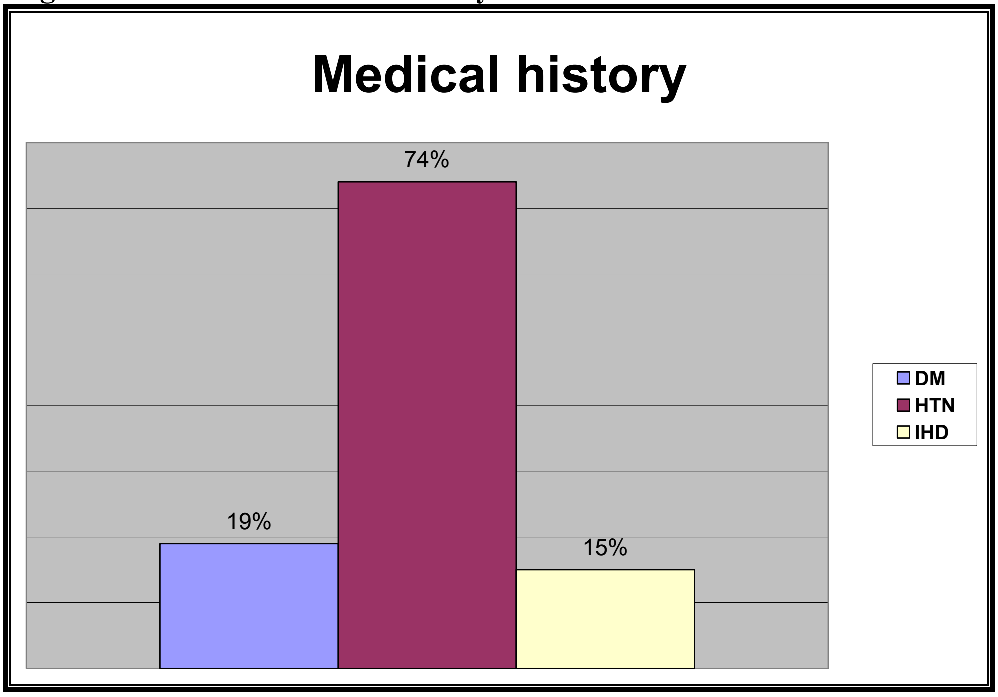


Figure 14: Indicators of poor food intake

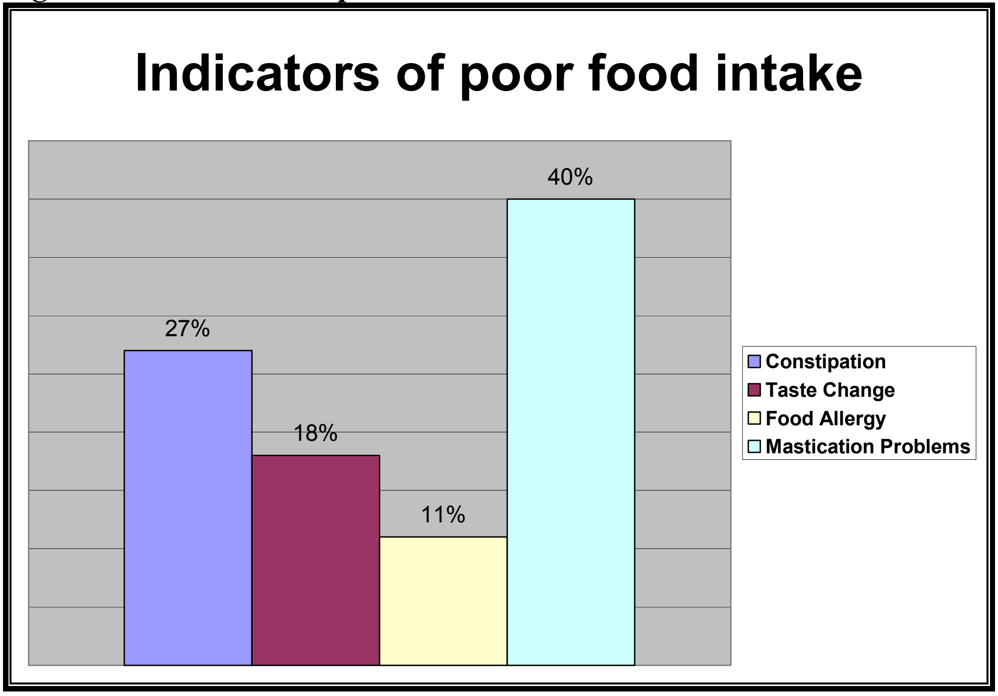


Figure 15: State of appetite

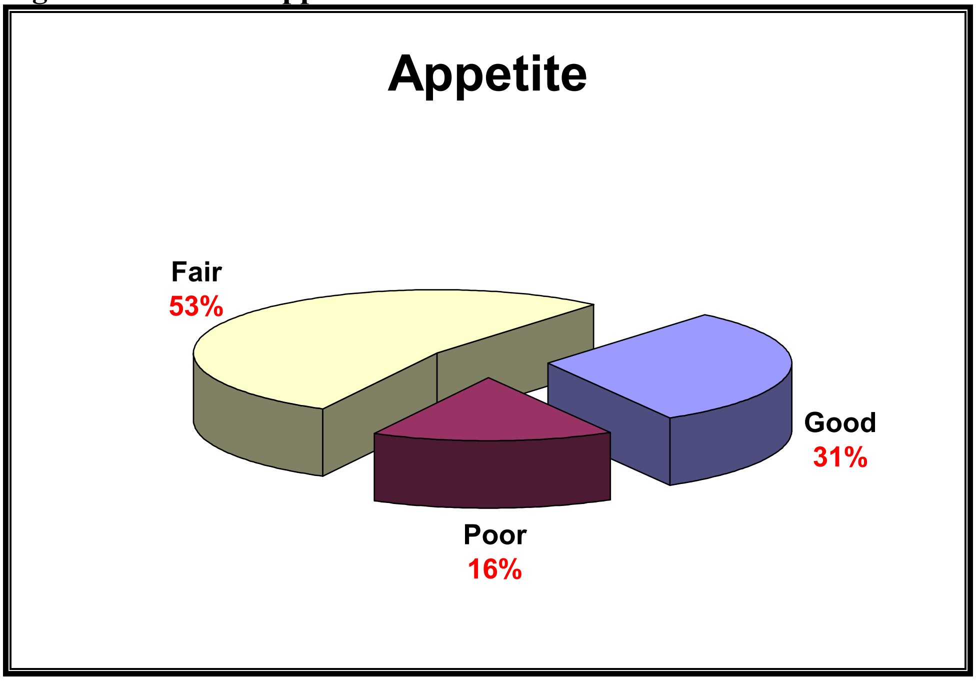


Figure 16: Compliance to prescribed diet

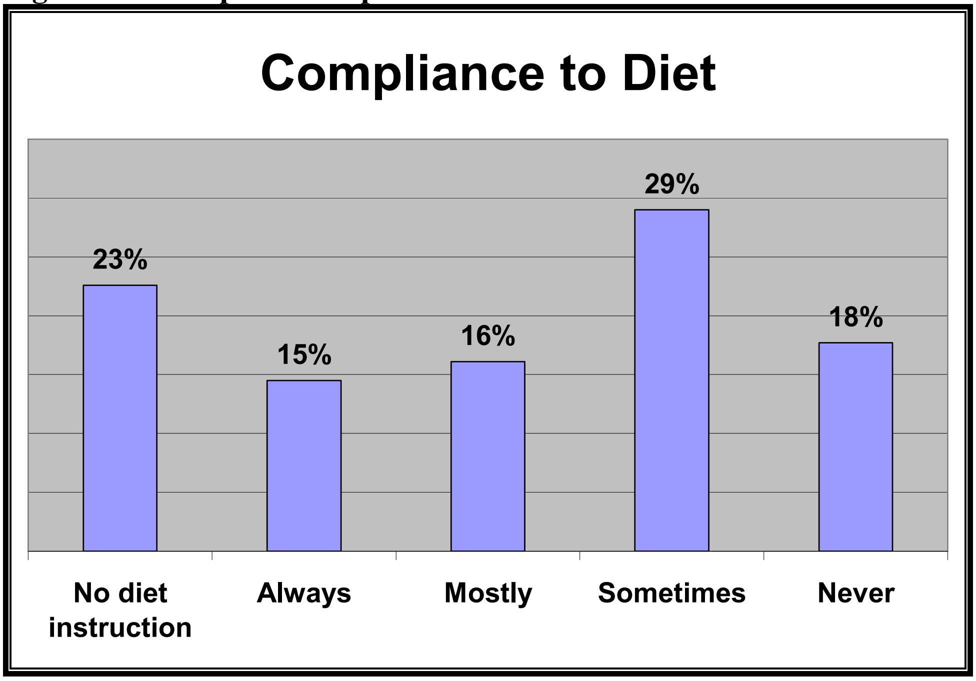


Figure 17: BMI distribution

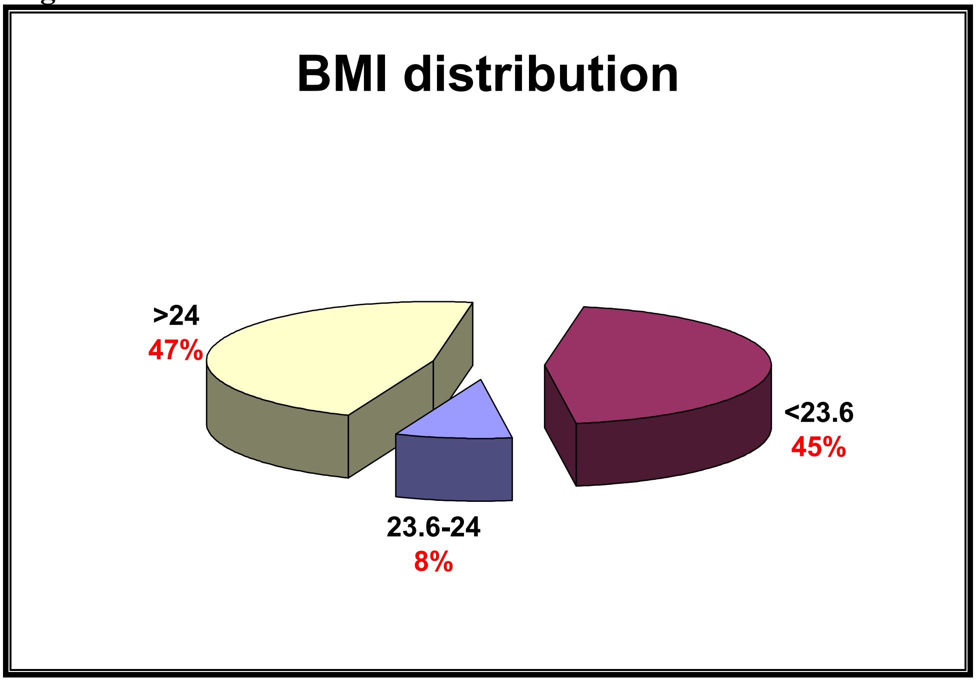


Figure 18: Dietary energy intake for patients ≤ 60 years of age

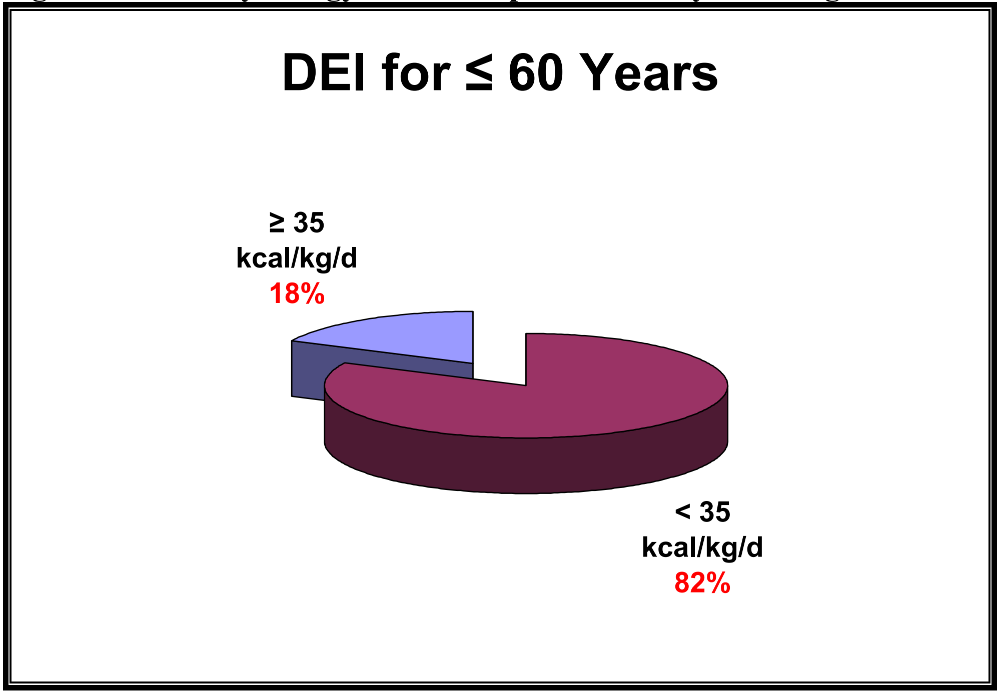


Figure 19: Dietary energy intake for patients >60 years of age

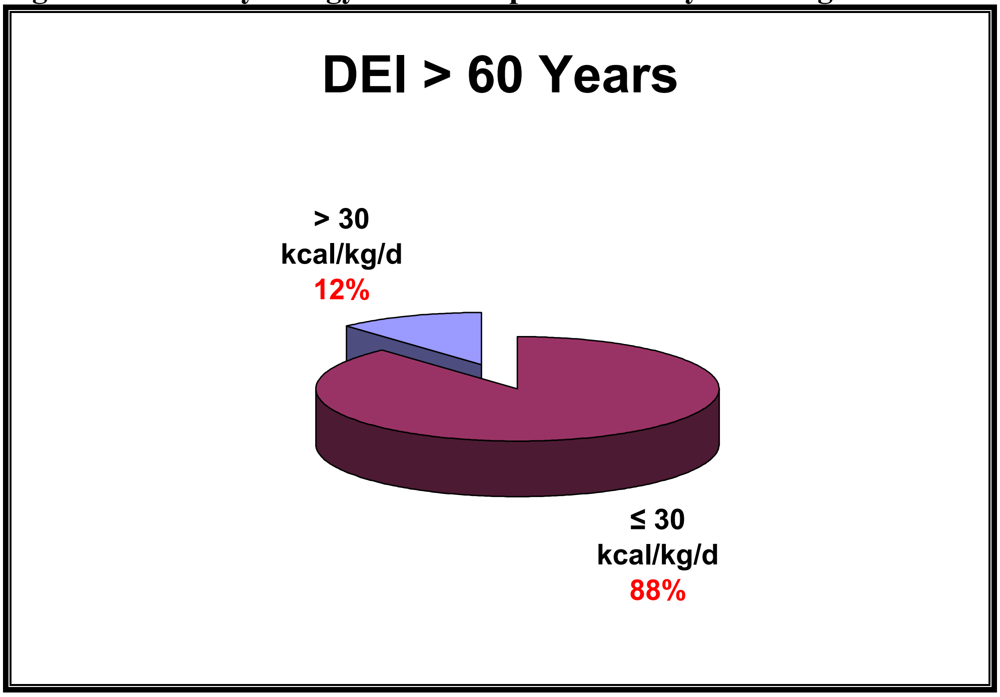


Figure 20: Dietary protein intake of MHD patients in RKH

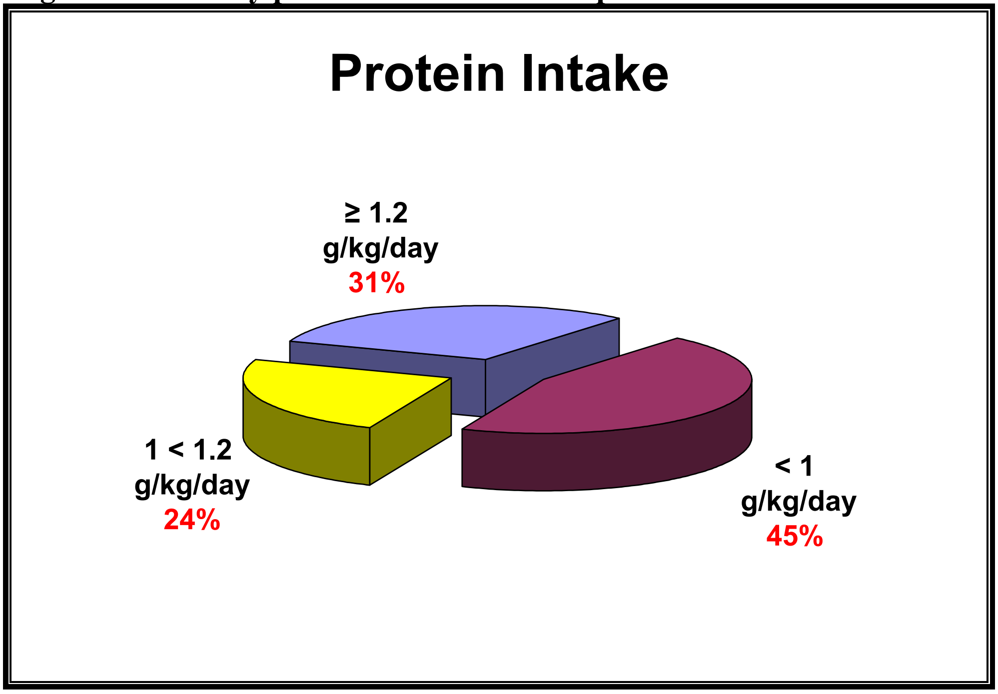


Figure 21: Nitrogen balance of MHD patients in RKH

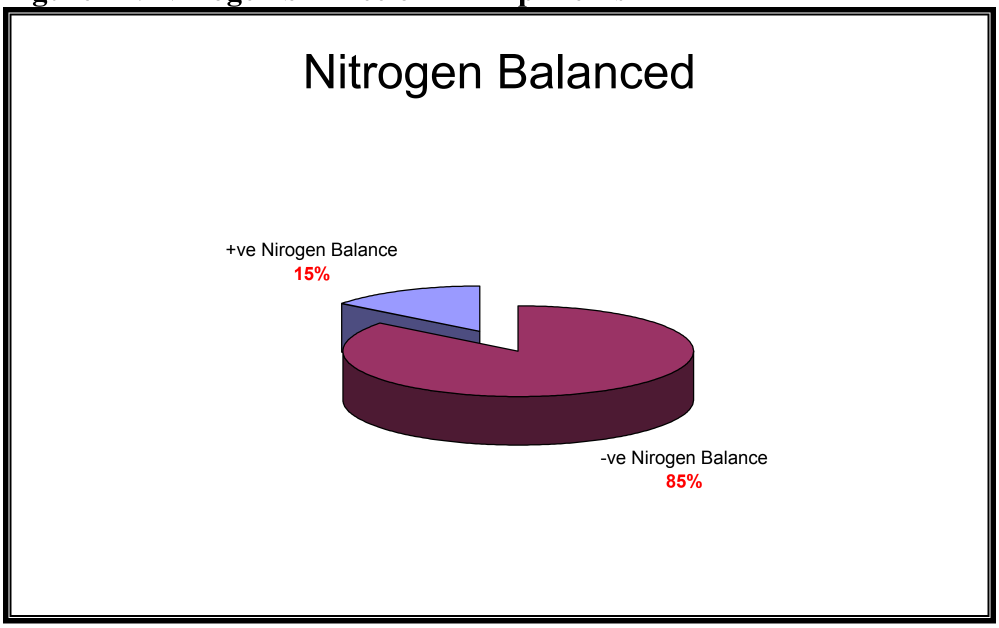


Figure 22: Dietary potassium intake

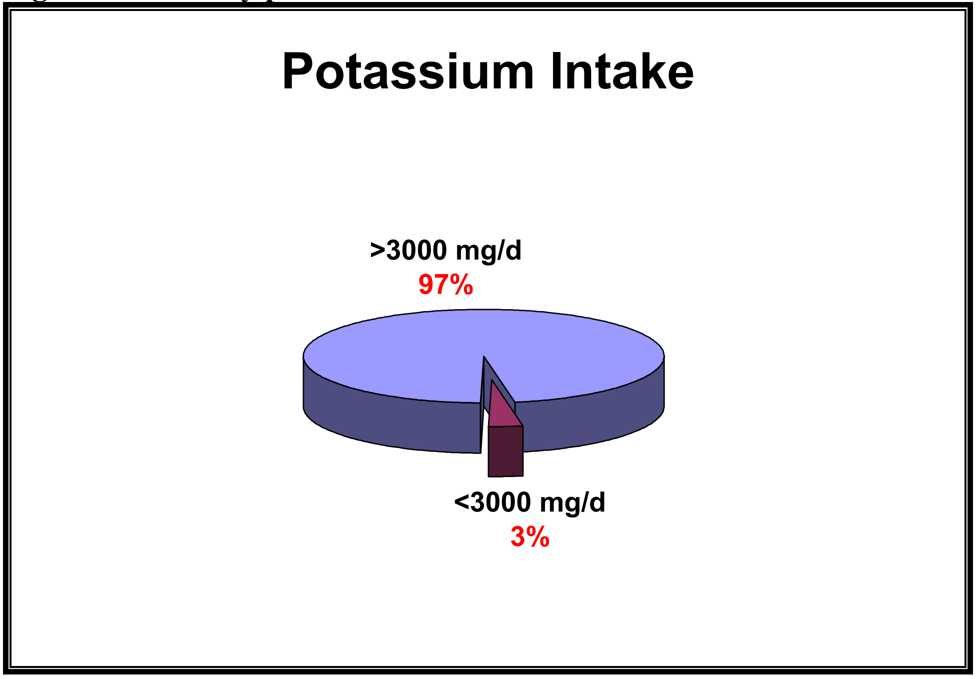


Figure 23: Dietary phosphorus intake

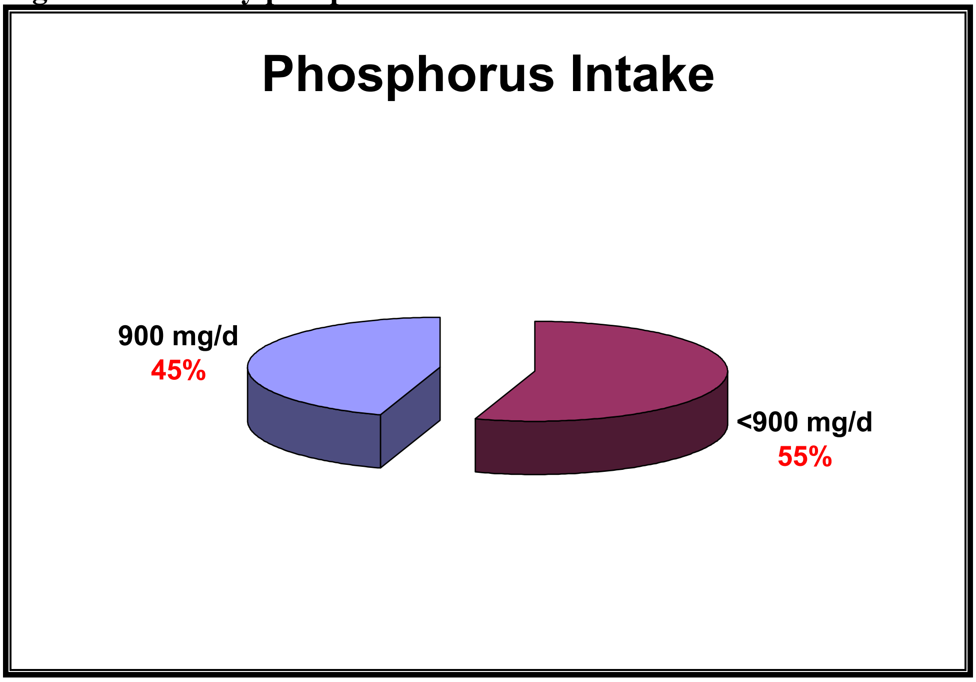
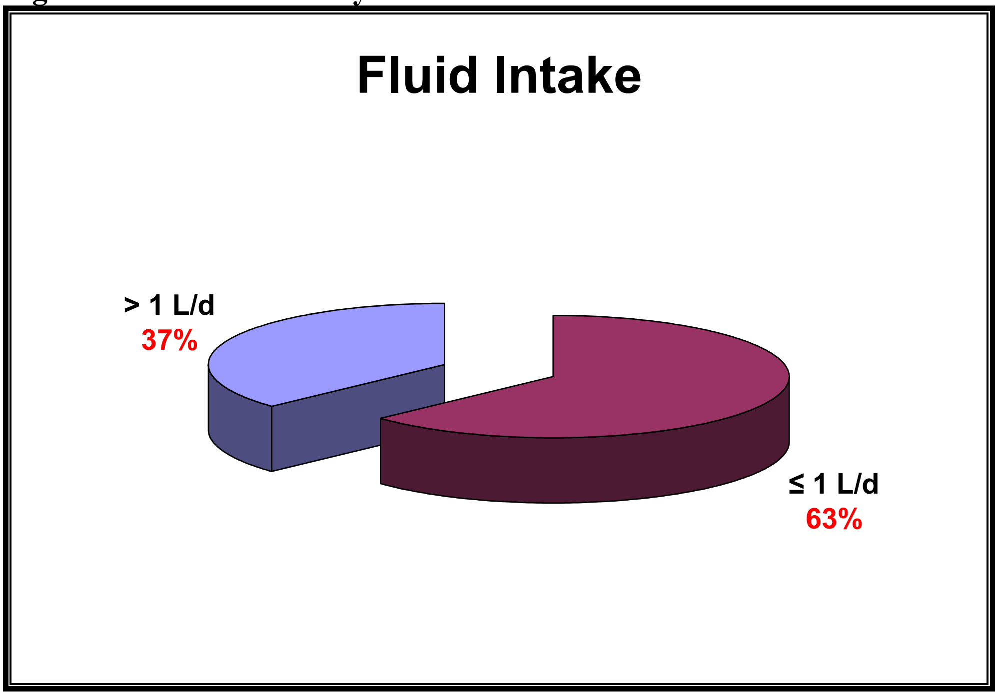


Figure 24: Estimated daily fluid intake



Appendix IX: Used abbreviations

BCG: Bromcresol Green
BMI: Body Mass Index
BUN: Blood Urea Nitrogen
Ca: Calcium
CHD: Chronic Heart Disease
Chol.: Total Cholesterol
CKD: Chronic Kidney Disease
cm: Centimeter
CRF: Chronic Renal Failure
DEI: Dietary Energy Intake
dL: Deciliter
DM: Diabetes Mellitus
DPI: Dietary Protein Intake
ER: Emergency Room
ESRD: End-Stage Renal Disease
FFQ: Food frequency Questionnaire
GFR: Glomerular Filtration Rate
g/kg/d: gram/kilogram/day
HBV: High biological value
HD: Hemodialysis
hrs: Hours
Ht.: Height
HTN: Hypertension
Hx: History
IDPN: Intradialytic Parenteral Nutrition
IHD: Ischemic Heart Diseases
ISE: Ion Selective Electrode
K: Potassium
Kcal: kilocalorie
kcal/kg/d: kilocalorie/kilogram/day
Kg: Kilogram
Kg/m2: kilogram per square meter
L: Liter
M: meter
MAC: Mid-arm circumference
MAMA: Mid-Upper arm muscle area
MAMC: Mid-arm muscle circumference

MHD: Maintenance hemodialysis
mm^3: cubic millimeter
mmol/L: millimol per Liter
nPCR: Normalized Protein Catabolic Rate
PCR: Protein Catabolic Rate
PEM: Protein-Energy Malnutrition
Pg/mL: Picogram/milliliter
PNA: Protein equivalent of total Nitrogen Appearance
PO4: Inorganic Phosphates
Post-BUN: Post-Dialysis Urea Nitrogen
Pre-BUN: Pre-Dialysis Urea Nitrogen
PTH: Parathyroid Hormone
RKH : Riyadh Al-Kharj Hospital
SCOT: Saudi Center for Organ Transplantation
SD: Standard Deviation
SR: Saudi Riyal
TG: Triglycerides
TLC: Total Lymphocyte Count
TNA: Total Nitrogen Appearance
TSF: Triceps Skin Fold
T/W: Times per Week
UNA: Urea Nitrogen Appearance
USRDS: United States Renal Data System
WBC: White Blood Cells
Wt: Weight
yr: Year

Arabic Summary

ملخص البحث

يعد سوء التغذية لدى المصابين بالفشل الكلوي والذين يعالجون بالتنقية الدموية أحد القضايا التي شغلت العاملين في هذا المجال، وذلك لما لسوء التغذية من عواقب وخيمة تنعكس على تدهور الحالة الصحية للمريض وارتفاع معدل الوفيات بين هذه الفئة من المرضى. لقد تم دراسة الحالة الغذائية للمرضى المعالجين بالتنقية الدموية في مستشفى الرياض الخرج، وذلك لتحديد نسبة ومدى تردى الحالة الغذائية لدي هذه الفئة من المرضى، ولتقييم مدى التزام المرضى بالحمية الغذائية، ومن ثم الخروج بالتوصيات الغذائية الملائمة.

تم جمع المعلومات الخاصة بالحالة الاجتماعية، الاقتصادية، والتاريخ الطبي، والتحاليل المخبرية لاثنين وستين مريضا. وقد استخدام السجل الغذائي وجدول التكرار الغذائي لدراسة السلوك الغذائي لكل مريض، كما تم إجراء القياسات البدنية والتي شملت وزن الجسم بعد التنقية، الطول، محيط منتصف الذراع، وسمك الجلد.

أظهر تحليل السجل الغذائي أن معظم المرضى عجزوا عن تناول المقدار الموصى به من الطاقة (حوالي ٨٢% من العينة)، أو البروتين (حوالي ٧٠%). ٨٥,٥ % من المرضى أظهروا توازن نيتروجيني سالب، ٥٥% يتناولون طعاما عاليا في الفسفور.
تشير القياسات البدنية إلى أن نسبة المرضى الذين يعانون من انخفاض شديد في سمك الجلد، محيط عضلة الذراع، وكتلة محيط الذراع يشكلون نسبة ١٢%، ٣٥% و ٢١% على التوالي، كما أظهر حساب مؤشر كتلة الجسم (BMI) أن ٤٥,١% من العينة اقل من المستوى الموصى به (٢٣,٦-٢٤ كجم/م^{٢}) لهذه الفئة من المرضى.
لقد أظهرت النتائج المخبرية أن أكثر من ثلثي المرضى في مستشفى الرياض الخرج يعانون من مظاهر سوء التغذية، كانخفاض مستوى ألبيومين الدم (٦٦,١% من العينة)، انخفاض مستوى بايكربونات الدم (٨٧,١%)، انخفاض كولسترول الدم (٥٠%). ٣٢,٢% من المرضى يعانون من ارتفاع فسفور الدم، ٤٥,٢% من انخفاض الكالسيوم، ٣٧,١% من ارتفاع هرمون الغدة الجاردرقية (PTH)، مما يرفع من احتمالية إصابة هؤلاء المرض بهشاشة العظام، وينبه إلى أهمية الحاجة للتحكم بمستوى الفسفور في الدم عبر تقليل تناول الأطعمة الغنية بالفسفور واستخدام الأدوية الخافضة له.
يشير التحليل الإحصائي إلى وجود علاقة عكسية ذات دلالة معنوية بين كل من زيادة طول فترة التنويم في المستشفى ومدى حاجة المريض للتردد على مراكز الإسعاف مع

مستوى الألبيومين في الدم ومؤشر كتلة الجسم. كما يشير إلى وجود علاقة طردية ذات دلالة معنوية بين ألبيومين الدم وكل من كمية الطاقة والبروتين المتناولة.

تشير النتائج إلى أن المرضى محل الدراسة معرضون بشكل كبير لخطر تردي الحالة الصحية ولارتفاع معدل الوفيات بينهم. مما يعكس الحاجة إلى التدخل الغذائي السريع لاحتواء المشاكل الصحية الناشئة عن سوء التغذية، ولتصحيح أوضاعهم الغذائية. ويعد التقييم المستمر لهذه الفئة من المرضى باستخدام المؤشرات والوسائل المتعددة أحد الوسائل المساعدة في اكتشاف المرضى المعرضين لخطر الإصابة بسوء التغذية مبكرا، ومن ثم معالجتهم. كما تبرز النتائج أن هناك حاجة لبناء خطة عمل واضحة للمساعدة في تزويد المريض باحتياجاته الغذائية، ويعد التثقيف الغذائي هو الخط الأول لزيادة تناول الكمية اللازمة للمريض من الطاقة والبروتين، وفي حال فشله، فإن استخدام المدعمات الغذائية أو التغذية الأنبوبية أو الوريدية من الخيارات المطروحة لذلك.