VOL. 8, NO. 4, APRIL 2013 ISSN 1990-6145
ARPN Journal of Agricultural and Biological Science


www.arpnjournals.com

NUTRITIONAL STATUS ASSESSMENT OF HEMODIALYSIS PATIENTS AT REHMAN MEDICAL INSTITUTE PESHAWAR

Bibi Hajira, Muhammad Samiullah and Rattan Kaur Chawla
Department of Human Nutrition, Faculty of Nutritional Sciences, Khyber Pakhtunkhwa Agricultural University, Peshawar, Pakistan
E-mail: hajira_56@yahoo.com

ABSTRACT

A study was conducted to assess the nutritional status of hemodialysis patients visiting Rehman Medical Institute, Peshawar. A total of 66 subjects from both sexes having mean age 49.61±15.28 years undergoing hemodialysis were enrolled for the study. Information regarding disease history and associated comorbidities were collected from patient's files. Nutritional status was assessed by anthropometric measurements using body mass index (BMI). The biochemical results including kidney profile, serum electrolytes and hemoglobin were recorded from the patient's files. Dietary data was obtained by using 24-hour dietary recall and food frequency questionnaire. The results indicated that age, familial predisposition, hypertension, diabetes and heart disease increased the risk for renal failure. Renal failure was more prevalent among male than in female. Actual intake of calories, protein, fats and minerals was lower than the recommended intake for hemodialysis patients. More than 50 percent of patient on hemodialysis were at risk of malnutrition. Malnutrition was related to low nutrient intake. This study suggests that assessment of nutritional status and nutritional management of hemodialysis patients play a central role in preventing malnutrition.

Keywords: hemodialysis, nutritional status, hypertension, diabetes, malnutrition.

INTRODUCTION

Chronic kidney disease is a progressive loss of kidney functions, defined as kidney damage or an estimated glomerular flirtation rate of less than 60 ml/min/1.73m^2 (Levey *et al*., 2005). It is a major public health problem which affects over 500 million people worldwide (Davids, 2007). The national health and nutrition examination survey has estimated the prevalence of chronic kidney disease in the United States as 26 million (Synder *et al*., 2009). Among risk factors diabetes is the leading cause, accounting for about 30% to 40% of the disease (Connell *et al*., 2009). Other factors including hypertension, smoking, hypercholesterolemia, obesity, age, gender and family history also potentially contribute to the development of chronic kidney disease (Levin, 2001; White *et al*., 2005).

Untreated chronic kidney disease leads to a final stage called end-stage renal disease and is defined by a glomerular flirtation rate of less than 15 ml/min/1.73m^2. When a patient reaches end-stage renal disease, renal replacement therapy in the form of dialysis or transplantation remains the sole treatment (NKF, 2010). Whereas acute renal failure is characterized by sudden loss of the ability of the kidneys and also sometimes necessitate dialysis (Robert *et al*., 2004). The estimated global dialysis population for end-stage renal disease is over 1.1 million, increasing at a rate of 7% per year and will be 2 million by the year 2010 (Lystaght, 2002). The third national health and nutrition examination survey estimated 0.3 million end-stage renal disease cases in the United States (Coresh *et al*., 2003). The number of patients with end-stage renal disease in Pakistan is continuously increasing with an estimated annual incidence of 100 per million populations (Sanai *et al*., 2010). The dialysis registry data from 172 centers in Pakistan showed an increase in number of patients from 4393 to 6127 during 2007 to 2008 (PKF, 2008).

Hemodialysis is the long term form of mechanical renal replacement therapy, used to remove waste products from the blood of patients with end-stage renal disease (Ahmad *et al*., 2002; Crowley, 2009). Hemodialysis substitutes for functions of the kidney, by cleaning and filtering blood to temporarily rid body of harmful wastes, extra salt and extra water. It helps control blood pressure and keeps the proper balance of important electrolytes in the body (NKUDIC, 2010). In patient with chronic renal failure who are not undergoing dialysis, if protein-energy malnutrition develops or persists despite vigorous attempts to optimize protein and energy intake and there is no apparent cause for malnutrition other than low nutrient intake, initiation of hemodialysis or renal transplant is recommended (NKF, 2002).

Protein-energy wasting is a common complication and an important predictive factor for mortality in chronic hemodialysis patients (Segall *et al*., 2008). The causes of protein-energy wasting include protein metabolism impairment, amino acid and nutrient losses in dialysate, dialysis-induced muscle catabolism, metabolic acidosis, increased energy expenditure, resistance to anabolic hormones, anorexia and underdialysis (Chazot, 2004). Reduced renal function is associated with a high prevalence of cardiovascular disease risk factors, such as hypertension, diabetes, dyslipidemia, and left ventricular hypertrophy (Minami *et al*., 2008). Anemia occurs because the diseased kidney loses its ability to produce erythropoietin that is essential for the production of hemoglobin (Robinson, 2006). Renal osteodystrophy is a complex disorder of bone associated with end-stage renal failure due to disturbances in mineral metabolism including phosphate retention, hypocalcaemia, vitamin-D deficiency, and hyperparathyroidism (Sprague,

2010). Hyperparathyroidism and hyperphosphatemia in turn associated with increased coronary artery calcification (Chertow, 2003).

Poor nutritional status is one of the main risk factors for mortality in hemodialysis patients and therefore needs to be regularly assessed and treated. Close collaboration between dialysis and dietetic staffs remains essential to handle this challenge. Evaluation of the nutritional status relies on biological parameters and anthropometrics, with food intake records. The recommended intakes are 1.2 g/ kg/day for proteins, and 35 Kcal/kg/day for energy in hemodialysis patients (Chazot, 2004).

Since end-stage renal disease is becoming a major cause of disability and mortality and the information available about the nutritional status of hemodialysis patients in developing countries including Pakistan is very little. The purpose of this study was therefore to assess the nutritional status of hemodialysis patients visiting Rehman Medical Institute, Hayatabad, Peshawar, Pakistan.

MATERIALS AND METHODS

Location of the study

The hospital based study was carried out at the hemodialysis unit of Rehman Medical Institute, Peshawar, with the purpose to observe and undertake the protocol followed in the hospital to assess the nutritional status of the patients visiting for hemodialysis and different wards for the treatment of chief complaints and associated co-morbidities.

Sample size

A convenient sample of 66 adult hemodialysis patients from both sexes was selected for the study.

Collection of data

Demographic and socioeconomic data

Data regarding socioeconomic status like occupation, marital status, education, family type, family size and monthly family income was collected by interviewing the subjects.

Medical history and chief complaints

Questionnaire regarding health status was filled from the subjects and their attendants. After being examined by the consultant, their chief complaints and medical history were collected from the recorded data in patient's file, patient himself/herself or their attendant and details were recorded.

Anthropometric assessment

Weight and height measurements were taken by the following recommended anthropometric procedures (WHO, 1995). Body weight was measured with a digital weighing scale in kg. Height was taken with a measuring tape in centimeters. BMI was obtained by dividing body weight in kg by height in meter square (Wt (kg) / Ht (m)^2.

Nutritional status was assessed by Body Mass Index method (WHO, 1995). Respondents having BMI <18.5 were considered as under-weight, having BMI >18.5-24.9 as normal weight, having BMI 25-29.9 as over-weight, having BMI > 30 as obese and having BMI > 40 as morbid obese. Nutritional status was also assessed by National Kidney Foundation (NKF) criteria that is BMI<23 and BMI>23 because mortality and morbidity rate is high in hemodialysis patients having BMI<23.

Clinical assessment

For clinical assessment, each patient was interviewed for the uremic symptoms (anorexia, nausea, vomiting, headache and others) and examined for the signs of fluid over loaded (edema, chest crackle, raised jugular vein pressure) and responses were recorded on the questionnaire. The recorded responses were then converted into percentages.

Biochemical assessment

About 4 ml blood samples were taken from each patient for the determination of kidney profile (blood urea, serum creatinin and glomerular filtration rate) serum electrolytes (sodium, potassium, chloride, bicarbonate) and 3 ml for Complete blood count (hemoglobin and WBC).

Dietary assessment

For dietary assessment, each patient was interviewed for the consumption of food and beverages using 24-hour recall method and food frequency questionnaire. The responses were recorded on the questionnaires. The portion sizes of foods consumed by each patient were converted into percent CHO, fats, proteins and kcal.

Compilation and statistical analysis of data

The data were compiled from the questionnaire and fed into the Microsoft excel version 2003 and converted into SPSS-12 for statistical analysis. Descriptive statistics were run to check the distribution of the data and to check for errors that had been made in the data entry.

RESULTS AND DISCUSSIONS

This hospital based study was carried out on 66 adult hemodialysis patients in order to assess their nutritional status. The data regarding demographic and socioeconomic status is presented in Table-1. It is clear from Table-1 that among 66 cases 69.7% (n=46) were male and 30.3% (n=20) were female. The mean age of male was 49.50±15.75 years and that of female was 49.85±14.55 years. Among 66 cases 36 (54.5%) were Pakistani and 30 (45.5%) cases were Afghani. The education level of the subjects shows that 40.9% (n=27) were illiterate, 10.6% (n=7), 12.1% (n=8), 12.1% (n=8), 1.5% (n=1) and 12.1% (n=8) had their education upto primary, middle, intermediate and graduate level respectively. The post graduate were only 10.6% (n=7). The marital status of the clients shows that 15.2% (n=10)

were single and 84.7% (n=56) were married. The economically satisfied were 57.6% (n=38) and 42.4% (n=28) were non-satisfied. The monthly family income of 48.5% (n=32) cases was below 25000 while 15.2% (n=10) had their income in the range of 25000 to 49999. The income of 28.8% (n=19) was in the range of 50000 to 100000 and 7.6% (n=5) had monthly income above 100000.

The data in Table-1 indicated that renal failure was more prevalent among male than in female. This was in agreement with the finding of Neugarten *et al.,* (2000) that man experiences a more rapid decline in renal function and worse outcome than in female. United States Department of health and human services (2000) found that low levels of educational attainment and income have been associated with an increased prevalence of kidney diseases and important kidney disease risk factors, such as hypertension and diabetes. Age was found to be a key predictor of chronic kidney diseases prevalence during an analysis of data from a subpopulation of 15, 625 individuals enrolled in the third National Health and Nutrition Examination Survey (NHANES III) (Coresh *et al*., 2003). The Table-1 shows 42.2% cases with non-satisfactory socioeconomic status (SES). Ward (2008) confirmed that the incidence of end-stage renal disease was greatest in those with lowest SES score and decreased progressively with higher SES.

Patient disease history

The patient's disease history has been presented in Table-2. It is evident from the table that among 66 cases 84.4% (n=56) were hypertensive, 40.9% (n=27) diabetic and 24.2% (n=16) with heart diseases. The mean disease duration was 4.30±6.51 years, 13.9±8.05 years and 3.44±5.76 years for hypertension, diabetes and heart disease respectively. The 95.5% (n=63) cases reached chronically to end-stage renal failure and 4.5% (n=3) were of acute renal failure. Hepatitis-C was found in 27.3% (n=18) cases. Among 66 patients 39.4% (n=26) were taking hemodialysis therapy once a week, 51.5% (n=34) twice a week and 9.1% (n=6) thrice a week. Our results were supported by the finding of Mclellen (2005) who identified the groups at high risk for kidney failure are those with a family history of end-stage renal disease, diabetes, hypertension and cardiovascular disease.

Anthropometric measurements

The post dialysis body mass index (BMI) of cases is presented in Table-3. According to WHO classification for BMI 18.2% (n=12) had BMI below 18.5kg/m^2. The BMI of 56.1% (n=37) was in the range of 18.5-24.9 kg/m^2 while 21.1% (n=8) had their BMI in the range of 25-29.9kg/m^2. The BMI of 9.1% (n=6), 1.5% (n=1) and 1.5% (n=1) were in the range of 30-34.9 kg/m^2, 35-39.9 kh/m^2 and 40 kg/m^2 and above respectively.

The national kidney foundation (NKF) considered the BMI for hemodialysis patients as above 23kg/m^2 and below 23kg/m^2 so according to this category 54.4% (n=36) had BMI below 23kg/m^2 and 43.9% (n=29) had BMI above 23kg/m^2. From the Table-3 it was concluded that most of the patient were at risk of malnutrition. About 54% of patients in this study have a BMI of less than 23, a result that suggest a high risk of mortality and morbidity. In a Brazilain cohort of hemodialysis patients Mafra *et al.,* (2007) confirmed both low BMI (<19 kg/m^2) and hypoalbuminemia as a strong predictive of death. 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 ≥ 27.5) had a significantly better 12-months survival than underweight ones (BMI <20) and patients with normal weight (BMI 20–27.5). In contrast to epidemiological data from general population the hemodialysis patients with a low BMI experienced an increased mortality rate compared to their larger fellow patients (Hirachan, 2008).

Clinical findings

The Table-4 shows the clinical findings of hemodialysis patients. About 66.7% (n=44) had anorexia and nausea, 56.1% (n=37) had vomiting, 25.8% (n=17) had heart burn, 56.1% (n=37) had constipation, 54.4% (n=36) had dizziness, 25.8% (n=17) had chest pain, 9.1% (n=6) had dysphagia, 78.8% (n=52) had fatigue, 57.6% (n=38) had headache, 33.3% (n=22) had diarrhea, 34.8% (n=23) had pruritis and 15.2% (n=10) had shortness of breath. Bergstom (1996) revealed anorexia as a contributing factor to malnutrition in hemodialysis patients and is associated with uremia, under dialysis, various comorbidity factors and psychosocial factors and economic factors. The hemodialysis procedure also reduce nutrient intake because of cardiovascular instability with nausea, vomiting and post dialysis fatigue.

Biochemical tests

The Table-5 shows the biochemical results of the subjects. The mean value of urea in male and female was 202.22±46.93 mg/dl and 165.15±49.06 mg/dl respectively. The mean value of creatinin in male was 11.41±4.68 mg/dl and in female was 9.33±2.53 mg/dl. The mean glomerular filtration rate in male was 5.91±3.05 ml/min/1.73m^2 and was 5.15±1.63 ml/min/1.73m^2 in female. The mean value of sodium in male was 135.1±5.68 mmol/l and was 133.8±6.37 mmol/l in female. The mean value of potassium in male was 5.02±1.0 mmol/l and in female was 4.70±1.08 mmol/l. The mean value of chloride in male was 102.52±5.28 mmol/l and in female was 101.31±6.24 mmol/l. The mean value of bicarbonate in male and female was 15.6±4.82 mmol/l and 17.95±4.16 mmol/l respectively. The mean value of hemoglobin in male was 9.21±1.89 g/dl and was 9.79±1.64 g/dl in female. The mean value of WBC in male was 9.16±4.27 × 10^9/l and 18.58±47.19 ×10^9/l was in female. The mean value of calcium in male was 7.8±2.10 mmo/l and in female was 7.22±1.09 mmol/l. The mean value of phosphorous in male was 7.58±4.04 mg/dl and in female was 6.29±1.93 mg/dl. The mean value of albumin in male and female was 6.4±4.73 g/dl and 2.30±0.14 g/dl, respectively.

The P-value shows that there was significant difference in the albumin level of male and female. There was no significant difference among other variable as the P-value for those was above 0.05. The male were slight hyperphosphatemic. These finding suggests that they are at risk of renal osteodystrophy. The urea and creatinine were also higher in both male and female.

A decreased serum albumin is predictive of poor survival in hemodialysis patients; however the cause of hypoalbuminemia is multifactorial and related to poor nutrition, inflammation and comorbid diseases (Cooper *et al*., 2004; Jones *et al*., 2002). The bicarbonate level was lower in both genders and they were suffering from metabolic acidosis. Acidemia due to metabolic acidosis is associated with increased protein degradation (Movilli *et al.,* 1998) and decreased albumin synthesis (Lowrie *et al*., 1998).

Intake of energy, macronutrient and minerals

The Table-6 shows the actual and recommended intake of the respondents. The daily mean caloric intake was 1169.88±594.21 kcal while their recommended caloric intake was 2121.97±558.61 kcal. This implies that they were consuming only 55.13% of the recommended intake. The daily mean carbohydrate intake was 205.38±109.61 g while their recommended intake was 185.97±49.56 g so they were taking 10% more than recommended carbohydrate. The mean actual and recommended intake of protein was 34.42±27.09 g and 72.20±14.16 g respectively and they were taking only 47.67% of the recommended protein. The daily mean consumption of fat was 35.7±43.24 g against the recommended intake of 212.48±37.80 g so it was concluded that they were consuming only 29.15% of the recommended fat intake. The daily mean intake of calcium was 23.39±410.63 mg while the recommended intake was 1193.94±49.23 mg so calcium intake was 19.97% of the recommended. The daily mean and recommended phosphorous was 429.8±297.28 mg and 1026.4±193.92 mg respectively. This was 41% of the recommended intake. The mean daily potassium intake was 806.65±502.57 mg against the recommended intake of 2405.65±479.14 mg. So they were consuming 33.54% of the recommended potassium. Sodium intake was 580.58±492.37 mg while recommended was 2011.52±93.55 mg. This shows they were consuming 28.86% of the recommended sodium.

From the Table-6 it was concluded that the actual intake of patients was lower than the recommended diet for hemodialysis, so they were at risk of malnutrition. Bergstrom (1995) demonstrated similar that in hemodialysis the intake of protein and energy are frequently low because of the underlying disease, psychosocial factors and uremic anorexia. 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. 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.

Table-1. Demographic and socioeconomic characteristics.

Variable		**Frequency** (n = 66)	**Percentage**
Gender	Male	46	69.7
	Female	20	30.3
Nationality	Pakistani	36	54.5
	Afghani	30	45.5
Subject education	Illiterate	27	40.9
	Primary	7	10.6
	Middle	8	12.1
	Metric	8	12.1
	Intermediate	1	1.5
	Graduate	8	12.1
	Post Graduate	7	10.6
Marital status	Single	10	15.2
	Married	56	84.8
SES	Satisfactory	38	57.6
	Non satisfactory	28	42.4
Family income	<25000	32	48.5
	25000-49999	10	15.2
	50000-100000	19	28.8
	>100000	5	7.6
	(Mean±SD)		
Age	Male	Female	
	49.50±15.75	49.85±14.55	

Table-2. Patient disease history.

Variable		Frequency (n = 66)	Percentage	Years (Mean±SD)
HTN	Yes	56	84.4	4.30±6.51
	No	10	15.2	
DM	Yes	27	40.9	13.93±8.05
	No	39	59.1	
Heart disease	Yes	16	24.2	3.44±5.76
	No	50	75.8	
CRF/ESRD		63	95.5	2.20±2.99
ARF		3	4.5	
HCV +ve	Yes	18	27.3	
	No	48	72.7	
HD		66	100	1.06±1.49
No. of HD per week	1	26	39.4	1.70±0.63
	2	34	51.5	
	3	6	9.1	

Table-3. Post-dialysis BMI.

Variable	Ranges	Frequency (n = 66)	Percentage
Post-dialysis BMI WHO Ranges	<18.5	12	18.2
	18.5-24.9	37	56.1
	25-29.9	8	12.1
	30-34.9	6	9.1
	35-39.9	1	1.5
	40 and >	1	1.5
NKF Ranges	<23	36	54.5
	>23	29	43.9

Table-4. Clinical findings.

Variable		Frequency (n = 66)	Percentage
Anorexia	Yes	44	66.7
	No	22	33.3
Nausea	Yes	44	66.7
	No	22	33.3
Vomiting	Yes	37	56.1
	No	29	43.9
Heartburn	Yes	17	25.8
	No	49	74.2
Constipation	Yes	37	56.1
	No	29	43.9
Dizziness	Yes	36	54.4
	No	30	45.5
Chest pain	Yes	17	25.8
	No	49	74.2
Dysphagia	Yes	6	9.1
	No	60	90.9
Fatigue	Yes	52	78.8
	No	14	21.2
Headache	Yes	38	57.6
	No	28	42.4
Diarrhea	Yes	22	33.3
	No	44	66.7
Pruritis (Itching)	Yes	23	34.8
	No	43	65.2
Shortness of Breath	Yes	10	15.2
	No	56	84.8

Table-5. Mean and standard deviation of biochemical tests.

Variable	Male (Mean± SD)	Female (Mean± SD)	P-value
Urea (mg/dl)	202.22±46.93	165.15±49.06	0.062(>0.05)
Creatinine(mg/dl)	11.41±4.68	9.33±2.53	0.086(>0.05)
GFR (ml/min/1.73m^2)	5.91±3.05	5.15±1.63	0.455(>0.05)
Sodium (mmol/l)	135.1±5.68	133.80±6.37	0.531(>0.05)
Potassium (mmol/l)	5.02±1.0	4.70±1.08	0.398(>0.05)
Chloride (mmol/l)	102.52±5.28	101.31±6.24	0.225(>0.05)
Bicarbonate (mmol/l)	15.61±4.82	17.95±4.16	0.110(>0.05)
Hb (g/dl)	9.21±1.89	9.79±1.64	0.244(>0.05)
WBC	9.16±4.27	18.58±47.19	0.560(>0.05)
Calcium (mg/dl)	7.79±2.10	7.22±1.09	0.070(>0.05)
Phosphorous (mg/dl)	7.58±4.04	6.29±1.93	0.632(>0.05)
Albumin (g/dl)	6.4±4.73	2.30±0.14	0.046(<0.05)

Table-6. Intakes of energy, macronutrient and minerals.

Variable	**Actual intake** (Mean± SD)	**Recommended intake** (Mean±SD)	**Percentage**
Energy Kcal/day	1169.87±594.21	2121.97±558.61	55.13
CHO (gm/day)	205.38±109.61	185.97±49.56	110.44
Protein (gm/day)	34.420±27.09	72.20±14.16	47.67
Fats (gm/day)	35.704±43.24	122.48±37.80	29.15
Calcium (mg/day)	238.39±410.63	1193.94±49.23	19.97
Phosphorous (mg/day)	429.82±297.28	1026.44±193.92	41.88
Potassium (mg/day)	806.65±502.57	2405.14±479.14	33.54
Sodium (mg/day)	580.58±492.37	2011.52±93.55	28.86

CONCLUSIONS

From the study it was concluded that age, hypertension, diabetes and heart disease increased the risk for renal failure. Renal failure was more prevalent among male than in female and actual intake of calories, protein, fats and minerals was lower than the recommended intake for hemodialysis patients. More than 50 percent of patient on hemodialysis were at risk of malnutrition.

REFERENCES

Ahmad A., Rahim A., Ghulam K., Mustafa and Khan M. I. 2002. The frequency of complications during haemodialysis. 41(3): 90-93.

Bergstrom J., Wang T. and Lindholm B. 1998. Factors contributing to catabolism in end-stage renal disease patients. Miner Electrolyte Metab. 24(1): 92-101.

Chazot C. 2004. Nutrition and dialysis: how to keep adequate nutrition in dialysis? Rev. Med. Suisse Romande. 124(11): 681-688.

Chertow G. M. 2003. Slowing the progression of vascular calcification in hemodialysis. J. Am. Soc. Nephrol. 14 (9 Suppl 4): S310-4.

Connell A. W., Sowers J. R., McCullough P. A., Roberts T., McFarlane S. I., Chen S., Li S., Wang C., Collins A. J. and Bakris G. L. 2009. Diabetes mellitus and CKD awareness: The kidney early evaluation program (KEEP) and national health and nutrition examination survey (NHANES). Am. J. Kidney Dis. 53(4): Suppl 4: pp. S11-S21.

Cooper B. 2004. Protein malnutrition and hypoalbuminemia as predictors of vascular events and mortality in ESRD. Am j Kidney Dis. 43: 61.

Coresh J., Astor B. C., Greene T., Eknoyan G. and Levey A. S. 2003. Prevalence of chronic kidney disease and decreased kidney function in the adult US population: Third National Health and Nutrition Examination Survey. Am. J. Kidney Dis. 41: 1-12.

Crowley L. V. 2009. The urinary system. An introduction to human diseases pathology and pathophysiology correlation. 8th Ed. pp. 478-531.

Davids M. R. 2007. Chronic kidney disease - the silent Epidem. CME. 25(8): 378-382.

Fleischmann E., Teal N., Dudley J., May W., Bower J. D. and Salahudeen A. K. 1999. Influence of excess weight on mortality and hospital stay in 1346 hemodialysis patients. Kidney Int. 55: 1560-1567.

Hirachan P., Thijssen S., Levin N. W. and Kotanko P. 2008. Body composition and outcomes in chronic hemodialysis patients. Contrib. Nephrol. 161: 108-114.

Jones C. H. 2002. The relationship between serum albumin and hydration status in hemodialysis patients. J. Ren Nutr. 12; 209.

Levey A. S., Eckardt K. U., Tsukamoto Y., Levin A., Coresh J., Rossert J., De Zeeuw D., Hostetter T.H., Lameire N. and Eknoyan G. 2005. Definition and classification of chronic kidney disease: a position statement from kidney disease improving global outcomes (KDIGO). Kidney Int. 67(6): 2089-2100.

Levin A. 2001. Identification of patients and risk factors in chronic kidney disease - evaluating risk factors and therapeutic strategies. Nephrol. Dial. Transplant. 16 (suppl 7): 57-60. doi: 10.1093/ndt/16.suppl_7.57.

Lowrie E. G., Zhu X., and Lew N. L. 1998. Primary associates of mortality among dialysis patients: Trends and reassessment of Kt/V and urea reduction ratio as outcome-based measures of dialysis dose. Am. J. Kidney Dis. 32: S16-S31.

Lysaght M. J. 2002. Maintenance dialysis population dynamics: current trends and long-term implications. J. Am. Soc. Nephrol. 13 Suppl 1: S37-40.

Mafra D., Farage N. E., Azevedo D. L., Viana G. G., Mattos J. P., Velarde L. G. and Fouque D. 2007. Impact of serum albumin and body-mass index on survival in hemodialysis patients. Int. Urol. Nephrol. 39(2): 619-624.

McClellan W. M. 2005. Epidemiology and risk factors for chronic kidney disease. Med. Clin. North. Am. 89(3): 419-445.

Minami J., Ishimitsu T., Sudo Y. and Matsuoka H. 2008. Chronic kidney disease (CKD) as an independent risk factor for cardiovascular disease (CVD). Nippon Rinsho. 66(9): 1657-1663.

Movilli E., Bossini N., Viola B. F., Camerini C., Cancarini G. C., Feller P., Strada A. and Maiorca R. 1998. Evidence for an independent role of metabolic acidosis on nutritional status in haemodialysis patients. Nephrol. Dial. Transplant. 13: 674-678.

National kidney foundation (NKF). 2002. Clinical practice guidelines for nutrition in chronic renal failure. Guideline 27. http://www.kidney.org/professionals/kdoqi/guidelins.

National kidney foundation (NKF). 2010. Kidney disease quality outcomes initiative (K/DOQI). http://www.kidney.org/professionals/kdoqi/guidelines.cfm (last accessed 2 June, 2010).

National kidney and urologic diseases information clearinghouse (NKUDIC) guidance. Kidney failure: Choosing a treatment that's right for you). http://kidney.niddk.nih.gov/kudiseases/pubs/choosingtreatment/index.htm.

Neugarten J., Acharya A. and Silbiger S. R. 2000. Effect of gender on the progression of nondiabetic renal disease: a meta-analysis. J. Am. Soc. Nephrol. 11: 319-329. http://www.ajkd.org/article/S0272-6386(07)01609-5/abstract-article-footnote-1#article-footnote-1.

Pakistan Kidney Foundation. 2008. Dialysis registry. http://www.kidneyfoundation.net.pk.

Robert W. S., Wei-Wang, Brian P. and Amit M. 2004. Acute renal failure: definitions, diagnosis, pathogenesis, and therapy. J. Clin Invest. 114(1): 5-14. Doi: 10.1172/JCI22353.

Robinson B. E. 2006. Epidemiology of chronic kidney disease and anemia. J. Am. Med. Dir. Assoc. 7: S3-S6.

Salomowitz L. A., Monteon F. J., Gronsvenor M., Laidlaw S. A., and Kopple J. D. 1989. Effect of the energy intake on nutritional status in maintenance hemodialysis patients. Kidney Int. 35: 704-711.

Sanai M., Aman S., Nadeem M. and Kazmi A. H. 2010. Dermatologic manifestations in patient's ofrenal disease on hemodialysis. J. Pak. Ass. Derm. 20: 163-168.

Segall L., Covic A., Mardare N., Ungureanu S., Marian S., Busuioc M., Nistor I., Enache R., Veisa G. and Covic M. 2008. Nutritional status evaluation in maintenance hemodialysis patients. Rev. Med. Chir. Soc. Med. Nat. Iasi. 112(2): 343-350.

Sprague S. M. 2010. Renal bone disease. Curr. Opin. Endocrinol. Diabetes Obes. 17(6): 535-539.

Synder J. J., Foley R. N. and Collins A. J. 2009. Prevalence of CKD in the United States: A sensitivity analysis using the national health and nutrition examination survey (NHANES). Am. J. Kidney Dis. 53(2): 218-228.

United States Department of Health and Human Services. 2000. Healthy People 2010 (Conference Edition, 2 vols.).

Ward M. M. 2008. Socioeconomic status and the incidence of ESRD. Am. J. Kidney Dis. 51(4): 563-572.

White S. L., Cass A., Atkins R.C. and Chadban S. J. 2005. Chronic kidney disease in the general population. Adv. Chronic Kidney Dis. 12: 5-13.

World Health Organization. 1995. Report of a WHO Expert Committee. Physical status: the use and interpretation of anthropometry. WHO Technical. Report Series No 854. Geneva: World Health Organization.