IJASRM International Journal of Advanced Scientific Research and Management, Special Issue I, Jan 2018.
www.ijasrm.com
ISSN 2455-6378

Nutritional Status Assessment of Patients Undergoing Hemodialysis

Anshu Singh[1] and Priyanka Arora[2]

[1]Senior Faculty, Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi-110012

[2]Student, Institute of Hotel Management, Catering and Nutrition, Pusa, New Delhi-110012

Abstract

Nearly ten percent of India's 1.24 billion people suffer from Chronic Kidney Disease, a disease in which the kidney slowly loses function and fails.The present study was conducted to assess the nutritional status of patients on hemodialysis during their stay in hospital. The study was carried out on 60 adults with minimum age of 18years. The data on anthropometric measurements was collected and out of total respondents 58% males, 77% females were underweight and only 5 % males, 2% females were overweight and remaining were normal weight. The data on nutrient intake was also computed by 24-hour dietary recall for 3 consecutive days. The significant difference was found ($p<0.05$) between Body Mass Index, MUAC of two different groups, one undergoing on hemodialysis from past less than 24 months and another, going hemodialysis from more than past 24 months. The patients irrespective of age and gender were not able to meet their nutrient requirement as per the Guidelines for Maintenance Hemodialysis in India. India's CKD problems have reached epidemic proportions, thus it is suggested that emphasis on nutrition counselling of such patients is very important to sustain a better livelihood.

Key Words: *Haemodialysis, Anthropometry, Dietary Recall, Nutrition, Chronic Kidney Diseases*

1. Introduction

Globalization of urbanization is seen as one of the most important social changes of the 20th century. The most prominent feature of urbanization in developing countries is the top-heavy urban hierarchy. The size of the Indian urban population is projected to increase to nearly 586 million by 2030. By 2015, more than 50 cities in India are expected to have a population of more than one million. As per the 2011 Census (Office of the Registrar General and Census Commissioner, 2011), the level of urbanization in India have been increased from 28% in 2001 to 31.16% in 2011. Poor people in urban areas of developing countries face a daily struggle to meet their basic needs for shelter, food, water, education, and health. The poverty is an important factor responsible for poor nutrition situation of Indian population, nutritional deficiencies are widespread even in households that are economically well off. However, malnutrition is common among adults in India. Urban areas of India are undergoing a nutritional transition wherein undernutrition and overnutrition coexist in the same population groups.

The mortality increases as body weight decreases (undernutrition) or increases (overnutrition) away from the ideal body weight. The malnourished individual has lower resistance towards infection and overall health is poor. (Salahudeen, 2003)

HD patients are potentially at risk of deficiency of trace elements. These essential trace elements play key roles in multiple biological systems, including immunological defence against oxidation and infection. Due to impaired functioning of nephrons and inspite of providing HD, besides sodium and potassium, phosphorous also start accumulating in blood and their level get raised than the which further disturbs the phosphorous-calcium balance in body. In attempt to maintain the phosphorous-calcium level, the calcium is leached out of bones which leads to a bone disease called osteodystrophy, causing bone pain and bone deformities. The damaged kidney are unable to release an enzyme called renal erythropoietin factor, which plays an important role in synthesis of erythropoietin due to which patient may become anaemic and may suffer from progressive weakness, loss of weight, shortness of breath, anorexia, vomiting or diarrhoea (Gunes et al 2013 and Khanna et al 2005). However due to so many

complications and dietary modifications patient is not able to meet the extra need of other necessary nutrients and fail to maintain an optimum nutritional status.

The above mentioned imbalances demand proper nutrition awareness and counselling in order to maintain good nutritional status for daily chores. Keeping in mind the scenario of CKD patients nutritional imbalance, it is necessary to study and assess the nutritional status so that timely advice can be given to them. Timely intervention in such conditions can help to achieve better livelihood.
The specific objectives of the study are: 1. To perform nutritional assessment of dialysis patients. 2. To screen dialysis patients for the prevalence of malnutrition.

2. Materials and Methods

2.1 Research Design: The research design of current study is descriptive design where an attempt has been made to analyse nutritional status of dialysis patients.

2.2 Locale: The locale selected for the research study was the Bhatia Global Hospital, Paschim Vihar, West Delhi. The criteria for selection of locale were accessibility and permission to interact with the patients, also easy reach from my residence.

2.3 Sampling: In present research study simple random sampling was used to select the samples. The sample comprised of total 60 adults, both male and female (38 males, 22 females).

2.3.1 Inclusion Criteria: The inclusion criteria for the selection of patients was formulated which is as follows-

1. Age >18 years
2. Duration of Dialysis = $\geq$6 months
3. Patients should be ambulatory

2.3.2 Exclusion Criteria: The exclusion criteria for the selection of patients was formulated which is as follows-

1. Coma
2. Dementia
3. Multiple organ failure or undergone any surgical hospitalisation in last 30 days

2.3.3 Period of Investigation: The duration of study was December 2012- February 2013

2.4 Tools And Technique: The failure to diagnose malnutrition leads to neglect of nutritional support during illness. However it is very necessary to diagnose nutritional status of individual as early as possible. An active nutritional support has been shown to improve outcomes and reduce cost of treatment in severely malnourished patients (Shirodkar et al, 2005). There are numerous tools and scoring methods which are used to screen for malnutrition in the community and hospitals (Jones et al, 2002 and Kondrup et al, 2003).
The tools used for data collection are-

2.4.1 General background performa
2.4.2 Nutritional assessment techniques:

A. Anthropometry
B. Dietary recall

The patients were contacted in hospital with the help of nephrologist and doctor present there. They were informed in the initial phase of study.

2.4.1 General Background Performa:

It is comprised of a set of general questions related to the demographic, socio-economics details and as well as the medical history of a patient. It involves the information regarding the family background, monthly salary, education and occupational details of a patient. Medical history consists of the details of dialysis sessions, its length and as well as co-morbidities if patient is suffering from any other disease/condition such as hypertension, diabetes mellitus, cancer, etc.

2.4.2 Nutritional Assessment:

It is the evaluation of an individual s' nutritional status whose main purpose is to determine the level of nutritional support that individual needs and continuously monitoring the changes in nutritional status helps to identify the effect of nutritional intervention. Nutritional assessment is based on the interpretation of information obtained from the medically history, physically examination includes anthropometric measurements, dietary history and nutrient intake which includes 24-hour diet recall.
Anthropometry- Nutritional Anthropometry is the science of measuring size, weight and proportion of human body at various ages and level of nutritional status. It involves obtaining physical measurement of an individual and relating them to standards that reflect the growth and development of an individual. Anthropometric approach is for the most important part, relatively non-invasive methods that assess the size or body composition of an individual. It is considered to be the most economical tool and gives useful information about nutritional status (Vijayaraghvan et al 2009). The anthropometric measurements that are valid for assessing nutritional status are:

- Height
- Weight
- BMI
- MUAC

B. Dietary Assessment

Dietary assessment helps in assessing the nutritional status of people and also determining the relationship between nutrient intake and deficiency disease (Vijayraghavan et al 2009). There are various techniques to determine the food intake of patient. The current study involves the use of 24- hour dietary recall. This technique aims to quantify the dietary intake over the previous 24 hour. The information on total cooked amount of each preparation was noted in terms of standardized cups. The intake of each food item by subject or one of his family members was assessed with the help of standardized cups. An account of raw ingredient used for each preparation was obtained. The per day consumption of calories and intake of protein, sodium, potassium and phosphorus were calculated on the basis of dietary record with the help of Nutritive Value of Indian foods (Gopalan,2007) and similarly was computed for next two days and then compared with the required intake of nutrients as per the recommendation.

Statistical Analysis

Mean and standard deviation values of anthropometric measurement and dietary nutrients were calculated. Pearson's correlation and t- Test were used to further apply to analyse the test.

3. Results and Discussion

Present study was carried out to assess the nutritional status of patients undergoing hemodialysis by taking anthropometric measurements, dietary recall and by using a malnutrition screening tool namely SGA. The present chapter presents the findings and inferences drawn with respect to specific objectives of study on the basis of analysis by using relevant statistical method. The chapter is divided under following headings:

3.1Demographic details and Medical History details
3.2Anthropometric Assessment
3.3Dietary Assessment

3.1 Demographic and Socio-Economic Details:

After analysing the data, demographic and socioeconomic details of subjects are presented in the table given below, which describes the background of all the subjects.

Table 3.1 Demographic Profile of Subjects

CATEGORY	NUMBER (N=60)	PERCENTAGE (%)
Age		
18-38	12	20
39-58	25	42
59-78	23	38
Gender		
Male	38	63
Female	22	37
Education		
Iliterate	30	50
Senior secondary	3	5
Graduate	27	45
Marital status		
Unmarried	7	12
Married	51	85
Widow	2	3
Family type		
Nuclear	30	50
Joint	30	50
Working status		
Working	10	17
Non-working	42	70
Retired	8	13
Monthly income		
< 15,000	5	8
15,000-20,000	20	33
>20,000	35	58

3.1.1 Age and Gender

In the present study, subjects were categorised in three age groups i.e.18-38 years, 39-58 years and 59-78 years. Out of total subjects 20% belonged to age group 18-38 years, 42% belonged to age group 39-58 years and remaining 38% belonged to 59-78 years age group. The data revealed that majority of them were male (63%) and remaining 37% were female. Suman et al 2007 conducted a study at Karnataka Institute of Medical Sciences, to assess the nutritional status of pre-dialytic and HD patients which also revealed that majority of dialytic patients (84%) were male and rest were female.

3.1.2 Educational Status

As we all know, education plays an important role in selection of healthy meals, the current study is showing a mix trend of illiteracy and literacy. This trend will have major effect on dietary practices. According to the Table 3.1, data obtained on educational status revealed that half of subjects were illiterate, 45% of them were graduate whereas remaining 5% were in senior secondary.

3.1.3 Martial Status

The data on marital status of subjects illustrates that majority of subjects (85%) were married, 12% were unmarried and remaining 3% of subjects had been struggling alone against CKD as they had lost their spouse. Thus, approximate 15% of the population actually had to be correctly advised regarding dietary selection for their own wellbeing.

3.1.4 Family Type

Information on the type of family about the subjects depicts that half of them resides in nuclear family and remaining half, had a joint family which besides supporting them emotionally also supports one another financially.

3.1.5 Working Status and Monthly Income

Today's livelihood depends on the financial backbone of oneself. As per the data obtained, 70% of subjects were non-working and entirely dependent on their other family members for their livelihood. Only 17% were working and remaining 13% had taken early retirement from their work due to their critical condition. 58% of subjects had family monthly income of more than 20,000 which seemed to be sufficient to meet the cost of their weekly dialysis sessions and medications. Whereas 33% subjects had family monthly income ranging in between 15,000-20,000 and remaining 8% were seemed to be adjusting in less than 15,000 only.

3.1.6 Medical History Details:

After analysing the data on medical history which includes the etiology behind CKD commencement of dialysis and the duration of dialysis session the patient is gone through is presented in figure 3.2 given below.

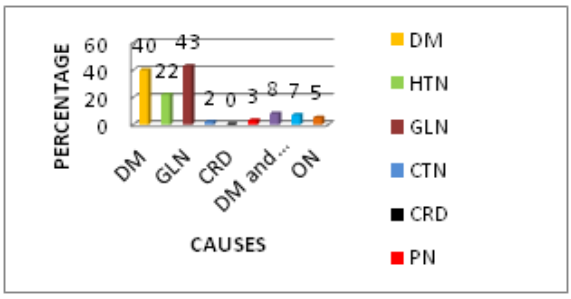

Figure 3.2 Etiology of CKD

The above figure 3.2 illustrates the etiology behind CKD. The study revealed that most common cause of CKD was chronic glomerulonephritis (43%), which may present clinically as acute glomerulonephritis (GLN), nephrotic syndrome, asymptomatic proteinuria or hematuria or both, which in long run causes chronic glomerulonephritis. Another one was DM and hypertension (HTN) found in (40%) and (22%) subjects respectively. The pathogenesis of diabetic nephropathy is undoubtedly multifactorial and includes hemodynamic alterations, level of glycemic control, genetic predisposition and race. Approximate 8% of subjects were found to be suffering from other diseases namely obstructive nephropathy (ON) and pyelonephritis (PN). Only 1 patient was found to be suffering from chronic Tubulointerstitial nephritis, caused due to fibrosis of renal tubules and interstitium. 8% of patients were seen suffering from both DM and as well as chronic GLN. On other hand, there were 7% of patients as well who were diagnosed with DM and HTN both. These complications further worsen the condition of patient suffering from CKD.

A similar trend was observed in a study conducted by the Department of Food Science and Nutrition University of Agricultural Sciences, Karnataka among Chronic Renal Failure (CRF) revealed that the most common cause of CRF was chronic GLN (40%) as the most common cause followed by DM and chronic PN. About 8% had HTN and equal number of patients was found to be suffering from polycystic renal disease and chronic obstructive nephropathy (Suman et al 2007). In another cross sectional study, Malekmakan et al 2009 reported HTN as the main cause behind CKD followed by diabetes mellitus among Iranian HD patients and further concluded that better management of hypertension and diabetes could prevent patients from ending up with ESRD. This shows that HTN and DM are prevalent among patients on dialysis which complicates their disease and affect their nutritional status too.

Besides these complications, the duration of dialysis i.e. commencement of dialysis also affects the nutritional status of patients on HD. The dialysis, may promote wasting by removing nutrients such as amino acids, glucose, proteins, water soluble nutrients and other trace elements from their body. Chazot et al 2001 evaluated the nutritional status of patients treated with HD for more than 20 years and concluded that despite of adequate dialysis dose and protein intake, patients treated by HD for a long period of time became malnourished. Thus long term support on dialysis may also responsible for malnourishment in patients.

The figure 3.3 given below, illustrates the details on the commencement of dialysis of the subjects. The current study revealed that majority (60%) of patients have been undergoing dialysis from more than past 24 months , whereas remaining 32% and 8% are on dialysis from past 12-24 months and 6-12 months respectively. The dialysis session of all the

subjects lasts for about six hours weekly i.e. two days/ week. Thus, all of them had undergone total 24 dialysis sessions in last three months and majority of them may be are at high risk of malnourishment.

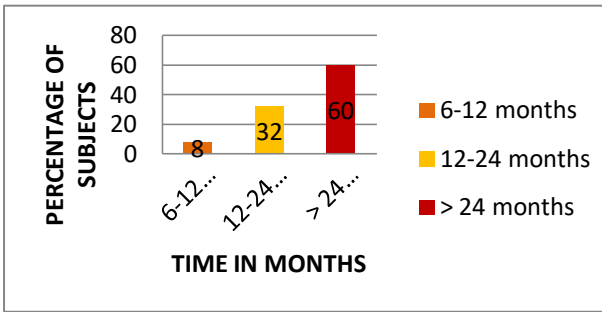

Figure 3.3 Commencement of Dialysis

3.2 Anthropometric Assessment

Anthropometric assessment is very crucial for adults for assessing their nutritional status. After analysing the data regarding anthropometric measurements the figures below shows the mean anthropometric data of subjects which includes height, weight, mid upper arm circumference and body mass index.

Table 3.4 Anthropometric Assessment of Patients

Subject (n=60)	Ht. (cm) Mean ± SD	Wt. Mean ± SD	MUAC (cm) Mean ± SD	BMI (kg/m^2) U. Wt (< 18.5)	Nor-mal (18.5-24.9)	Overwt. (≥25.00)
Male n=38	168.4 ± 6.70	57.13± 8.87	18.5 ± 1.32	22 (58)	11 (29)	5 (13)
Fe-male n=22	160.7 ± 5.69	48.14± 8.78	17.7 ± 1.39	17 (77)	3 (14)	2 (9)

Note: Figures in parenthesis indicate percentage.

The data on anthropometric assessment of patients revealed that mean height of male and female is found to be 168.4 cm and 160.7 cm respectively. The mean weight of male is 57.13 kg whereas in case of females it is 48.14 kg. Beside height and weight, MUAC was measured for all the patients, to assess their nutritional status and found mean MUAC to be 18.5 and 17.7 of male and female respectively. Therefore, it is seen that neither males nor females are able to meet the standards for MUAC and indicates the poor nutritional status of both. After computing the BMI, the data suggests that 58% of males, 77% of females are found to be underweight and only 5 % males, 2% females are overweight. Remaining 29% males and 14% females are normal.

The study suggests that majority of patients on HD are underweight indicating malnutrition. Malnutrition may arise due to multifactorial causes which include constant restriction of food due to monotony of diets, loss of nutrients in dialysate, recurrent illness, uremic toxins, endocrine abnormalities such as insulin resistance, hyperglucanemia and hyperthyroidism . The reasons for lower anthropometric values compared to standards may also include prolonged use of various medications, long term support of HD and their critical condition which makes them prone to stress and depression. Due to so many challenges, it becomes difficult for CKD patient to meet the standards and remain physically fit. Saran et al 2011, also performed a study to assess the nutritional status of HD patients and concluded that 4% of the patients were underweight, 49% had average weight, 27.5% were overweight, 14% were obese, and 5.5% had morbid obesity, which indicates that half of them were malnourished.

Another study conducted by Suman et al 2007 to assess nutritional status of HD patients suggests that on the basis of BMI, majority of males and females were classified as normal and equal percentage of males were underweight and overweight. 50% of females were underweight showing malnutrition. The mean MUAC was lower than the standards which reflect their poor nutritional status.

Koefoed , 2016 did a study on assessment of current prevalence of protein-energy wasting, low lean body mass index and obesity in maintenance dialysis patients, and compared different methods of nutritional assessment. A cross-sectional study was conducted in 2014 at Roskilde Hospital, Denmark, Anthropometry (body weight, skinfolds, mid-arm, waist, and hip circumferences) was performed on Seventy-nine eligible maintenance dialysis patients participated. The prevalence of protein-energy wasted patients was 4% as assessed by the coexistence of low lean body mass index and low fat mass index. Low lean body mass index was observed as 32%.The study concluded on how to increase and preserve lean body mass in dialysis patients is suggested in the future.

3.3 Dietary Recall

The dietary recall is another method of nutritional assessment to evaluate the individual's nutritional status, so that patient must be provided with required level of nutritional support to accelerate their recovery. After analysing the data regarding, nutrient intake of patients the table 3.5 given below shows

the mean intake of calories, protein and electrolytes respectively.

Table 3.5 DIETARY PROFILE OF PATIENTS

AGE (N=60)	ENERGY (kcal)	PROT-EIN (g)	SOD-IUM (g)	POTA-SSIUM (g)	PHOS-PHOR-OUS (g)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
<60 years (n=37)	988± 142	32.3± 6.5	0.2± 0.11	0.9± 0.21	0.74± 0.13
>60 years (n=23)	919± 146	29.6± 3.9	0.2± 0.04	1.0±0.2	0.80± 0.09

The present study reveals that mean intake of calories and protein in the patients aged less than 60years was 988kcal i.e. 17kcal/kg and 32.3g i.e. 0.56g/kg respectively which is approximately half of the calories (35kcal/kg/d) and protein(1.2g/kg/d) recommended (Beto et al 2004). The patients aged more than 60 years found with mean intake of calories to be 919kcal i.e. 16kcal/kg which is below the range (30-35kcal/kg/d) recommended whereas, mean intake of protein is found to be 29.6g i.e. 0.51g/kg which is approximately half of the recommended i.e. 1.2g/kg/d (Mahan et al 2008). Therefore, the data reflects the poor intake of macro-nutrients which may be due to anorexia, starvation, monotonous diet and certain complications which may further brings the certain dietary restrictions. . Earlier, Nunes et al, 2008 conducted a study to assess the nutritional status of 44 HD patients of mean age 51+15years using dietary recall and concluded with inadequate calories and protein intake by patients which indicated their poor nutritional status. Another study was conducted by Alshatwi et al in 2007, who examined the nutritional parameters of 32 male HD patients from Riyadh Central Hospital and then compared them to 39 aged matched healthy male subjects and showed that mean energy and protein intake was significantly higher in healthy male subjects than HD patients ($p<0.001$ and $p<0.05$, respectively). In 2005, a study conducted by Thurnberg et al, in which 58 non-diabetic patients on HD participated, the results reflects that half of the patients ate less protein and calories than prescribed to them which showed high prevalence of protein-energy malnutriton in HD patients. Besides the calories and proteins, it is necessary to monitor the intake of other nutrients too namely sodium, potassium and phosphorous because its accumulation in the body can make the patients' condition worsen due to kidney insufficiency to filter out blood and to give normal urine output. The mean intake of sodium, potassium and phosphorous is 0.2g, 0.9g and 0.74g respectively in patients less than 60years of age and 0.2g, 1g, 0.8g respectively in the patients aged more than 60years which reflects the less intake of all micro-nutrients than recommendations, except phosphorous which is within the acceptable range, indicating a good control over the intake of these nutrients which may help to prevent further progression of their condition.

The Pearson's correlation analysis was performed to see any association between mean values of energy and BMI, protein and MUAC which is shown in table 4.5. Besides this, student t- test was performed to assess the difference between BMI and MUAC between two different groups (one going under HD from past less than 24 months and another going under HD from more than 24 months), which is shown in Table 3.6

TABLE 3.6: CORRELATION BETWEEN MEAN VALUES OF ENERGY AND BMI, PROTEIN AND MUAC

VARIABLES		PEARSON'S COFFICIENT (r)
ENERGY	BMI	0.44^{*}
PROTEIN	MUAC	0.13^{NS}

(* Significant at level 1% and 5% level, NS – Not Significant at any level)

The positive co-relation was found to exist between mean values of energy and BMI which is found to be significant at both the levels i.e. 1% and 5%. But, the positive co-relation between protein and MUAC is not found to be significant in any of the levels.

Table 3.7: SIGNIFICANCE DIFFERENCE of BMI and MUAC

VARIABLES	t- value
BMI	2.35^{*}
MUAC	0.68^{NS}

(* significant at 5% level, NS – Not Significant at any level)

There is significant difference found between variable namely energy of two different groups (one undergone dialysis from less than 24 months and another for more than 24 months) at 5% level. No significant difference is found in between another variable i.e. MUAC between two different groups.

4. Conclusion:

On the basis of tools used (Anthropometry and dietary recall) it can be concluded that overall nutritional status of majority of patients is poor. The

patients irrespective of age and gender were not able to meet their macro-nutrient requirement on daily basis. But they are able to keep a control over micro-nutrients intake i.e. sodium, potassium and phosphorous, which are restricted among CKD patients. Beside the dietary restrictions and complications, loss of nutrients in dialysate during the removal of fluid from body may also be responsible for poor nutritional status of patients. Thus, it is suggested that patients must be kept on HD on the basis or required removal of excess fluid from body which is based upon urine output in last 24 hours, fluid loss through diarrhoea/ vomiting and sweating/ perspiration. Besides this, it is necessary to monitor the dietary intake of patients on HD and timely advice and counselling must be done to improve their nutrient intake, in order to make them to live better livelihood. The hospitals and other concerned organisations/institutions must come forward to organize various melas, seminars to spread awareness among the CKD patients and as well as their care takers who play the significant role in recovering patients from their disease condition. Apart from this, they must promote the development of new products for such patients, which besides providing appealing taste must be sufficient to meet their daily macro and as well as micro-nutrient requirements.

References

[1] Alshatwi AA, Alshmary A and AL Khalifa A. Nutritional assessment of hemodialysis patients. Journal of Medical Science.; 7(2):294-298,(2007)

[2] Beto JA, Bansal VK. Medical NutritionTherapy in chronic kidney failure Integrating clinical practice guidelines. Journal of American Association; 104:404, (2004)

[3] Gopalan C, Sastri BVR and Balasubramanian SC, Revised and updated by Rao BSN, Deosthala YG and Pant KC.(2007)

[4] Gunes, F. Esra Medical Nutrition Therapy for Hemodialysis. Marmara University, Health Science Faculty, Department of Nutrition and Dietetic, Turkey, 21-43, (2017).

[5] Jones, JM: The methodology of nutrition screening and assessment tools. Journal Hum Nutrition Diet;15:59-71.(2002)

[6] Khanna Kumud, Sharda Gupta, Santosh Jain, Rama Sethi, Ranjana Mahna and Seema Puri. Nutrition and Dietitics. (2005)

[7] Koefoed M, Kromann CB, Ryberg S, Danni J, Ekelund,, HB, Frandsen NE, Marckmann P. Nutritional Status of Maintenance Dialysis Patients: Low Lean Body Mass Index and Obesity Are Common, Protein-Energy Wasting Is Uncommon. PLOS https://doi.org/10.1371/journal.pone.0150012 (2016).

[8] Kondrup J, Rasmussen HH and Hamber O: Nutritional risk screening: a new method based on an analysis of controlled clinical trials. Clinical Nutrition; 22(3):321-336 (2003)

[9] Mahan K, Escott-Stump S. Krause's Food and the Nutrition Therapy. 12th Edition, Elsevier,(2008)

[10] Malekmakan L, Haghpanah S, Pakfetrat M, Malekmakan A and Khajehdehi P. Causes of chronic renal failure among Iranian hemodialysis patients. Saudi Journal of Kidney Dialysis Transplant. 20(3):501-4 May (2009)

[11] Nunes,NT, CamposG, Paula SMX, Merhi VAL,Portero-Mclellan KC, Motta DG, Dialysis adequacy and nutritional status of hemodialysis patients Hemodial Int, 12 , pp. 45-51, (2008)

[12] Salahudeen AK. Obesity and survival on dialysis. *Am J Kidney Dis*; 41: 925–932 *(*2003)

[13] Shirodkar M, and Mohandas KM. Subjective Global Assessment: Screening Tool for Malnutrition. Indian Journal of Gastroenterology Nov-Dec;24(6):246-50 (2005)

[14] Suman S, Malagi U, Rama K and Kasturiba B. The Nutritional Status of Predialytic and Hemodialytic patients, The Indian Nutrition of Dietetics. 44,447(2007)

[15] Thunberg BJ, Swamy AP and Cestero RV. Cross-sectional and longitudinal nutritional measurements in maintenance hemodialysis patients. American Jounal of Clinical Nutrition 1981;34(10) (2005).

[16] Vijayraghvan K; Assessment of nutritional status in community settings-1. Public nutrition, June : 137-138. (2009)