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Study on nutritional status in type-2 diabetic patients with chronic kidney disease

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Abstract

This study was undertaken to observe the dietary intake of diabetic kidney failure patients from dietary diary and evaluate the nutritional status of diabetic patients with chronic kidney disease by measuring different anthropometric parameters. For this purpose, a total of 125 diabetic patients were included from Chronic Renal Failure (CRF) follow-up program of which 80 belonged to pre dialysis (group-1) and 45 from those on hemodialysis (group-2). Both groups were matched for age, sex and Body Mass Index (BMI). Anthropometric comparisons of skin fold thicknesses showed that group-2 had significantly lower Mid Arm Circumference, TSF and SSF than group-1. Dietary protein intake was relatively higher in group-2, but lower than recommended level (1.2g/kg/d) during dialysis. The intake of high biological value (HBV) protein was also low in all the subjects. The dietary sodium intake was high and calcium intake was low in both the groups, but potassium and phosphate were adequate. It was found that the diabetic chronic kidney disease patients' diet is deficient in quality protein, vitamins and calcium intake. It was also found that the dialysis subjects were malnourished as is evidenced from reduced muscle mass and decreased subcutaneous fat distribution. Appropriate nutrition intervention can reduce risk for malnutrition and the morbidity and mortality associated with it. Appropriate supplementations, such as quality protein, calcium, vitamins may help improving their overall nutritional status.

Keywords: Anthropometry, Diabetes mellitus, Diet, Kidney disease, Malnutrition

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1. INTRODUCTION

Nutrition is the science of foods and the way that bodies utilize them. It is concerned with how food is produced, processed, handled, sold, prepared, shared and what happens to eaten food, or to food in the body (Kings and Burges, 1992). Nutritional status is defined as the study of the condition of the body as it relates to the consumption and utilization of food. A variety of methods are used to determine nutritional status; they can be used either alone or in combination. The methods are based on series of dietary, laboratory, anthropometry and clinical measurements designed to characterize each stage in the development of a nutritional deficiency state (Gibson, 1990). The appropriate diet at any stage of life is one that provides sufficient energy and all the essential nutrients (carbohydrate, protein, fat, vitamins, minerals and water) are in adequate (Stanfield and Hui, 2003). A poor nutritional status reduces the life expectancy of diabetic patients. Diabetic patients have many dietary restrictions, especially for those who have renal failure.

Malnutrition results, in part, from reduced dietary intake attributable to anorexia, nausea and vomiting, changes in taste and smell, and dietary restrictions (Stratton *et al.*, 2005). Diabetic patients with End Stage Renal Disease (ESRD) have significantly increased morbidity compared to adequately nourished ones (Seliger *et al.*, 2003; Herselman *et al.*, 2000). In Chronic Kidney Disease (CKD) patients, several indicators of nutrition status are independently associated with increased mortality (Kopple 1999; Pifer *et al.*, 2002; Shinaberger *et al.*, 2006), resulting in more and longer hospitalizations and higher health care costs (Ikizler *et al.*, 1999; Chertow *et al.*, 2005; Pupim *et al.*, 2003; Burrowes *et al.*, 2005; Braunschweig, 2000). Malnutrition in CKD patients negatively affects functioning and quality of life (Stratton *et al.*, 2005; Utaka *et al.*, 2005). There are not many studies assessing nutritional status of Bangladeshi diabetic subjects with or without kidney disease. The objective of the study is to evaluate the nutritional status of diabetic patients with CKD to suggest better dietary supplementations for them.

2. MATERIALS AND METHODS

2.1 Type of the study

The study was observational in nature.

2.2. Study subjects

Patients with diabetic nephropathy attending the out-patient departments and dialysis unit of the Bangladesh Institute of Research and Rehabilitation in Diabetes Endocrine and Metabolic disorders (BIRDEM) and the Bangladesh Sheikh Mujib Medical University (BSMMU) were enrolled for this study. They were in two groups: Group-I included patients suffering from chronic diabetic kidney disease (Diabetic Nephropathy-DN), but not getting any dialysis (i.e. pre dialysis group) and Group II was comprised of patients on hemodialysis. In total, there were 80 and 45 subjects in Group I and Group II, respectively.

2.3. Data collection

A standard pretested questionnaire was administered to obtain information on demographic and socio-economic status of the enrolled subjects, such as age, sex, location, occupation, family size, income status etc. A three days dietary history was obtained from patient through the use of food diaries. From the dietary history, the patient's intake of calories, protein, fat, carbohydrate, calcium, phosphorus, sodium, potassium, vitamin-A and vitamin-B was calculated by using a standard food table developed by applying previously published information in the literature, for the conversion of calorie from different foods (Ali, 1992; Gopalan *et al.*., 1993; Joshi, 2002; Bowers and Churchs, 2005).

2.4. Measurements used to assess the intake foods

Purchased weight of food was the weight of a food during buying or harvesting. Edible weight of a food was the weight that was eaten. The percent Edible Portion (EP) was the edible weight of food in 100g of its purchased state. The raw food was the food before being cooked. The weight of raw and cooked food means the food before and after cooking. The calculation was done according to Blumenkrantz *et al.*, 1980.

2.5. Calculating the nutrient content of foods

Nutrient content was calculated by finding the food in the food composition tables that shows the different nutrients in 100gm of the edible food. The amount of the

nutrient in 1gm of the food was calculated by using the conversion factor. Finally, the amount of the nutrient was calculated in the edible portion of food.

2.6. Calculations of energy and nutrients

The food energy was calculated from the content of the proximate principles assuming that proteins, carbohydrates and fats yield 4, 4 and 9 Kcal, respectively per gm. For trace element analyses of foods, data published from atomic absorption spectrophotometry were used (Gopalan *et. al.*, 1993).

In this study cooked foods were decimated to their basic uncooked version by dividing them with factors of those foods. Then this raw food data were arranged in a 'food composition table" for calculating their calorie values. If rice was considered plate-cooked, it was measured as two and half' cup cooked rice. One cup-cooked rice weighs about 100gm. So, two and half cup was considered as 250gm. When this weight of cooked rice (250gm) was divided by the constant factor of rice (2.8), then it was converted to its basic uncooked form. Then this was compared to calorie value given for uncooked rice in the food composition table. Following this procedure food caloric values of other items were also calculated

2.7. Anthropometries Measurements

The anthropometric measurements to assess protein energy nutritional status was done by measuring skin fold thickness at biceps, triceps, sub-scapular, supra iliac, mid-arm muscle areas, or circumference and body mass index (BMI). Skin calipers were used to measure the skin folds. The mean value of repeated measurements of an area was taken. The measures at triceps and biceps were taken vertically on the center of the back of the arm and on the center of the front of the upper arm, respectively. To measure mid upper arm circumference (MUAC) each subject's right arm was bent at the elbow at a 90 degree angle with the upper arm held in parallel to the side of the body, measured the distance between the acromion and olecranon process at the elbow. The mid-point between these two landmarks was marked with indelible ink. The subject's right arm was flexible and hanged loosely at his or her side. A measuring tape was positioned around the upper arm at the previously marked midpoint. The circumference was recorded to the nearest 0.1 cm. The normal value of MUAC is 17.6- 29.3 cm for man, and 17.4- 28.5 cm for woman (Salmond, 1980). A subject's sub scapular skin fold was measured just below and laterally to the inferior angle of the left scapula while the shoulder and arm were relaxed. The waist measurement was

done by using a measuring tape and the reading was taken in the middle to the abdomen in the Transpyloric plane at the level of umbilicus. The hip measurement was done from a subject having normal outfit while the measuring tape was placed just below the buttock (Donoghue, 1985). Waist-Hip Ratio (W/H) was used to describe the distribution of both subcutaneous and intra—abdominal adipose tissue. W/H ratios > 1 .0 for man and 0.8 for woman were considered as indication for obesity (www.topendsports.com/testing/tests/Whr.htm. Accessed 6 March 2007).

3. RESULTS AND DISCUSSION

Distribution of the studied subjects is shown in Table 1 and in Figure1. The mean ages of the subjects of the pre dialysis and dialysis groups were 56±9 and 53±11 years, respectively, ranging from 14 to 77 years. The pre dialysis patients (Group I) belonged to mild to moderate diabetic nephropathy. Dialysis patients (Group II) were severe kidney failure patients requiring hemodialysis for survival. The educational statuses of the subjects were almost similar between the two groups (Figure 2). Twenty-three and 41% subjects belonging to Group I and II, respectively, had education below the secondary school level while 2% subjects were illiterate. The monthly incomes of the subjects although varied from >5 to >30 thousand taka, majority had a monthly income of > 20 thousand taka. Patients with different income strata between the groups were however similar.

Table-1: Base line characteristics of the subjects belonging to the groups enrolled in the study

Characteristic	Pre dialysis (Gr-CRF)	Dialysis (Gr -HD)	*P-value*
Age (years)	56±9	53±11	0.171
Weight (kg)	61±9	61±14	0.842
BMI(kg/m^2)	25±6	24±5	0.263

BMI-Body Mass Index; Gr: CRP: Group of chronic renal failure subjects; Gr-HD: Group of subjects undergoing haemo-dialysis; Data are expressed by Mean ±Sd

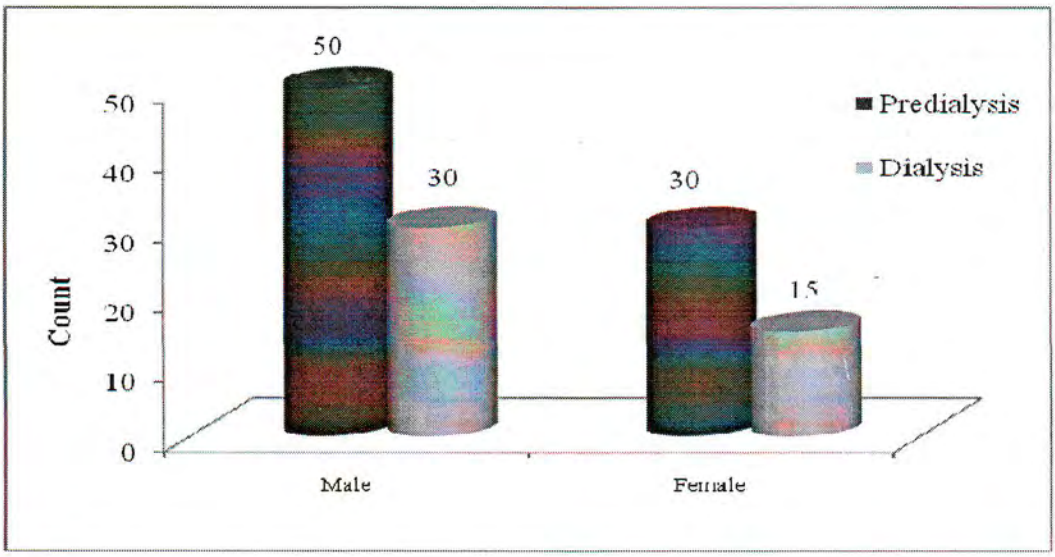

Figure-1: Distribution of the study subjects by sex

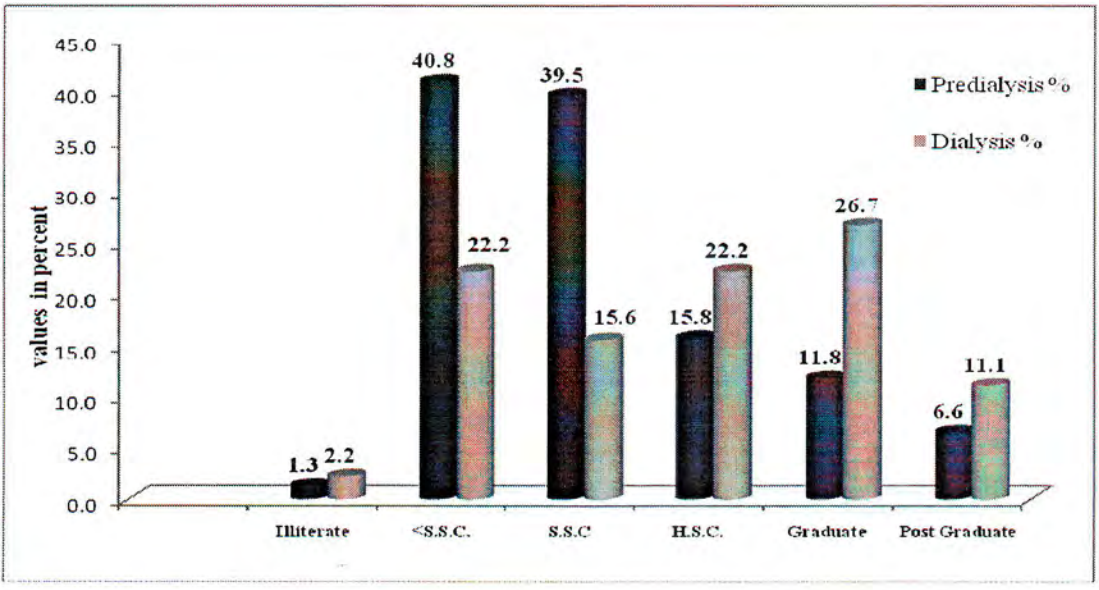

Figure-2: Distribution of study subjects by education

The body weights of the subjects of Group I and Group II were 61±9 and 61±14 kg, respectively (P=0.842) and their BMI was 25±6 and 24±5 kg/m^2, respectively

(P=0.263) (Table 2). The values of BSF was 8.6±3.4 mm in group I and 7.6±3.3 mm in Group II (P=0.128) while their corresponding TSF values were 16.3±5.8 and 14±5.5mm, respectively (P<0.033). Like TSF when SSF was compared (25±7 *vs* 20±9) its value was also significantly lower in the subjects of Group II, the dialysis patients (P <0.001). The MAC measurements between Group I and Group II were 28.2±3 and 25.8±5 cm, again significantly lower in the second group (P<0.05). However, WAIST/HIP ratios between the groups were similar - 0.93±.05 vs 0.95±.07, respectively (P<.096).

The dietary intakes of different nutrient of two groups are shown in Table 3. The total calorie intake/day of pre-dialysis and dialysis subjects were 1266±302 and 1429±419 kcal/day, respectively (P<0.025) and the calorie intake per kg body weight was 20±5 versus 24±8 kcal (P<0.001). Therefore, pre-dialysis group had a lower calorie intake. The percentages of carbohydrate intake was 63±15 versus 55±15 (P<0.004), showing a higher percentage in pre dialysis subjects. The protein intake in the two groups were 0.79±0.24 versus 97±0.59 g/kg/d (P<0.004). The HBV percentage was 37±14% in Group I, 45±23 % in Group II (P<0.038), indicating a relatively high intake of protein by dialysis subjects. Dietary fat (%) between pre-dialysis and dialysis patients were 23±7 and 22±7(P=0 .922), a similar intake between the two groups.

Table-2: Anthropometrics of the enrolled subjects

Anthropometries (mm)	Pre dialysis (Gr-CRF)	Dialysis (Gr-HD)	*P-value*
BSF	8.6±3.4	7.6±3.3	0.128
TSF	16.3±5.8	14±5.5	0.033*
SSF	25±7	20±9	0.006*
MAC(cm)	28.2±3	25.8±5	0.005*
Waist(cm)	88±8	84±14	0.172
Hip(cm)	95±7	89±10	0.003*
W/H ratio	0.93±.05	0.95±.07	0.096

BSF-Biceps skin fold thickness; TSF- Triceps skin fold; SSF- Sub scapular skin fold thickness; MAC- Mid arm circumference; W/H ratio- Waist Hip ratio; Results were expressed by Mean ±Sd.
* indicates significance.

Of the vitamins folic acid and niacin intakes were significantly different between the groups (87±49.72 vs 122.55±84.59 mg/day and 15±9 vs 11±9.15 mg/day). These comparisons showed that niacin intake was generally higher in the CRF

subjects, where as folic acid intake was more in HD group. Vitamin A, thiamin and riboflavin intakes were almost similar between the groups.

The intake of sodium (Na) was 1895±791 in the CRP group, and 2364±1081 mg/d in the HD group (P<0.014). The potassium (K) intake was however similar, 923±396 vs 904±604 mg/d (P=0.86) between the groups. The levels of dietary calcium (Ca) and phosphorus (PO_4) between the groups were 398±243 vs 402±259 mg/d (P=0.937) and 839±245 vs 973±467 mg/d (P=0.079), respectively.

Table-3: Nutrients intakes by the subjects

Nutrient	Pre-dialysis (Gr-CRF)	Dialysis (Gr-HD)	P-value
Macronutrient			
Calorie (cal/kg/d)	20±3	24±8	0.001
CHO (%)	63±15	55±15	0.004
PROT/kg	0.79±0.24	0.97±0.59	0.015
HBV (%)	37±14	45±23	0.038
FAT (%)	23±7	23±7	0.922
Vitamins			
Vitamin A	1038±959	1161±1339	0.59
Thiamine(B_1)	0.4±0.3	0.38±0.26	0.804
Riboflavin(B_2)	0.99±2	1.24±0.84	0.37
Folic acid (mg/day)	87±49	122±84	0.012
Niacin (mg/day)	15±9	11±9.15	0.016
Electrolytes			
Na^+(mg/dl)	1895±791	2364±1081	0.01
K^+(mg/d)	923±396	904±604	0.86
Ca^+ (mg/d)	398±243	402±259	0.937
$PO4^-$(mg/d)	839±245	973±467	0.079

CHO: Percent of carbohydrate in diet; PROT/kg: Protein intake/kg body wt; HBV: Percent of high biological value protein in diet; Fat: percent of fat in diet: Data are expressed by Mean ±Sd.

Body fat distribution is frequently assessed, and is a sensitive tool for evaluating nutritional status. Comparisons of BSF, TSF and SSF between the groups showed that they were low in the dialysis group, an agreement with Joshi (2002). The dialysis patients are generally anorexic due to uremia and take less food. Also the dialysis process itself initiates catabolism which is partly responsible for poor

nutritional status leading to lower subcutaneous fat as well as decreased muscle mass (Joshi, 2002). In this study, the mid arm circumference (MAC) is lower in HD group than that of the pre dialysis subjects, indicating ill health and wasting. In these circumstances, it is expected that the BMI would be less in the under nourished group. But in our study, in both groups, BMI was similar, might be due to relatively higher weight in the HD group because of oedema in advanced renal failure stage. Therefore, BMI might not be a sensitive tool for nutrition status estimation. The dietary assessment from 3 day dietary diary showed that calorie intake, in general, was low in the chronic kidney disease patients (about 20-25 kcal/kg/day) than recommended (30-35kcal/kg/day). The protein intake in dialysis group was sub optimum (0.9g/kg/day) than the required amount (1.2g/kg/day) and their low muscle mass (MAC) was likely to be for this low protein intake (Zeman, 1991). The different electrolyte balance assessed from dietary sodium (Na), potassium (K), calcium (Ca) and phosphate (PO_4) intakes revealed that all the study subjects were taking salts much higher than the recommended amount, indicating a poor compliance to salt restriction required for kidney disease patients. The potassium and phosphate intake was within recommended range, but the calcium intake was lower in both groups. This again may be due to dietary restrictions on protein containing foods.

We also assessed micronutrients, such as vitamin A, B_1, B_2, niacin and folic acid intakes from dietary diary. Intakes of vitamin B_1, B_2 and folic acid were lower than the recommended levels. The major source for vitamin B_1 is unmilled cereals which were not being taken by most of the patients. Vitamin B_2 and folic acid are available in meat, fish, milk and some leafy vegetables. In chronic kidney disease, the restriction on amount of protein and vegetables again is likely to be responsible for these less vitamin intakes.

4. CONCLUSION

From this study, it may be concluded that, in diabetic chronic kidney disease patients (pre-dialysis and dialysis groups) calorie intake is generally lower than recommended. Their diet is deficient in quality protein, vitamins and calcium. It is also found that the dialysis subjects are malnourished, as is evidenced from reduced muscle mass and decreased subcutaneous fat distribution. Increased dietary macro and micro nutrients supplementations and their intakes might help to improve their overall nutritional status.

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