

A Study on the Nutritional Status of Diabetics and Associated Risk Factors

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ABSTRACT Nutritional status of 115 subjects (56 male and 59 females) suffering with NIDDM and attending a diabetic clinic was determined using standard techniques. A questionnaire was designed to collect information regarding background of patients, family history and clinical history. Anthropometry included measurement of height, weight, mid upper arm circumference and tricep skin fold. Diet history was collected using 24 hr recall and food frequency. Data revealed that a majority of subjects were between 50-65 years of age, Hindu by religion, studied up to undergraduate level and were from lower and middle income group. The onset of disease was noticed between 40-45 years with higher incidences up to 60 years. The symptom of frequent thirst and urination was more common. Many reported family history of diabetes from parent's side. Fasting blood sugar level of >120 mg/dl was reported by majority of subjects. The incidence of anemia was more in women. Among associated risk factors, eye and heart problems were predominant. Anthropometry of patients revealed that 60 (M) and 49% (F) of patients were in normal range of BMI, 33.9 (M) and 35.6 % (F) were over weight and 5.4 (M) and 13% (F) were obese. 49 and 34 % of female subjects and 41 and 17 % of male subjects had higher than ideal tricep skin fold and waist-hip ratio respectively. Diet survey showed the intake of carotene, iron, vitamin C, niacin and riboflavin to be inadequate and that of calcium, fat and thiamine to be adequate.

INTRODUCTION

Diabetes mellitus is a clinical syndrome characterized by hyperglycemia and disturbances of carbohydrate, fat and protein metabolism that are associated with absolute or relative deficiencies in insulin action and/or insulin secretion. Although it is an endocrine disease in origin, its major manifestations are those of a metabolic disease (WHO, 1994). The metabolic derangement is frequently associated with permanent and irreversible functional and structural changes in the cells of the body, those of the vascular system being particularly susceptible. The changes lead in turn to the development of well-defined clinical entities, the complications of diabetes, which characteristically affect the eye, the kidney and the nervous system (Davidson, 1991).

Diabetes mellitus is on the increase world wide as many countries are achieving greater affluence and as their populations are growing grayer. If 25% of the adults coming to health centers meet the WHO criteria for diabetes

mellitus, there would be millions in the world who may suffer from eventual complications of the disease. The prevalence of diabetes in several parts of India has shown an increasing trend in the past 15 years. The increase in the prevalence is probably as a result of changing life styles. Prevalence of diabetes is high in the urban Indians and similar to the values reported in migrant Indians in different countries (Ramachandran, 2000).

Many factors contribute to the onset of diabetes and these are termed as predisposing or risk factors. Environmental factors such as diet, obesity and sedentary life style increase the risk of diabetes (Zimmet et al., 2001). Other important risk factors include high familial aggregation, insulin resistance, nutritional status, age, life style changes due to urbanization etc. (Ramachandran, 2000). Complications of diabetes are several. There is always the hazard of acute complication of ketoacidosis, which is dangerous but treatable medical emergency. Hypoglycemia and infections are other acute complications. Bacterial and fungal infections are the most commonly occurring infections. Chronic complications of diabetes include atherosclerosis, diabetic eye diseases and kidney diseases, retinopathy, nephropathy, neuropathy, foot ulceration and amputation. The magnitude of diabetes as a problem is enormous and the

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implications for health services are staggering and it is life long condition with the diabetic who are always at the risk of associated complications. However, these can be avoided by meticulous management through medication and diet. The objectives of this study were to assess the nutritional status of diabetics using standardized techniques, to determine the food and nutrient intake of diabetics and to investigate the presence of associated risk factors.

METHODOLOGY

The subjects selected for the study were all NIDDM patients between the age group of 35 to 70 years attending the diabetic clinic. The study was conducted on a total number of 115 patients, of whom 56 were male (M) and 59 female (F). A questionnaire was developed for the collection of data from the subjects on various aspects like, background information, clinical history and diet history. Background information collected included age, sex, religion, education, occupation, income and family type. In clinical history, the age of onset of diabetes and family history were recorded by interviewing. Under biochemical analysis, data on fasting blood glucose (FBS) and haemoglobin collected with the help of laboratory technician were included. Blood glucose was estimated by glucose oxidase method (Raghuramulu et al., 2003) and haemoglobin by cyanmethemoglobin method (DeMaeyer et al., 1989). Presence of associated diseases of diabetes as diagnosed by the physician were recorded for all subjects. For information regarding the diet history of subjects, a food frequency table was formulated to study the frequency of consumption of various foodstuffs and the nutrient intake of subjects was determined making use of data from 24-hour recall method. Pre-standardized cups and ladles were used to elicit information regarding the food intake and food composition tables were used to arrive at the nutrient intake of individual subjects (Gopalan et al., 1996). The food frequency data was consolidated to represent number of families consuming a particular food item in a day using one months consumption pattern of foods.

Standardized techniques were used for measuring the nutritional status of the individuals. The measurements included height, weight, mid upper arm circumference, skin fold thickness and waist-hip measurements. Height and weight of the subjects were measured using

a vertical height scale and a spring balance respectively. Skin fold thickness was measured using Harpenden's calipers and non-stretch fiber tape was used for mid upper arm circumference and waist-hip measurement. From this information BMI and waist hip ratio (WHR) were calculated (James et al., 1988; WHO, 2000). The data collected was classified age and sex wise and the average values were reported.

RESULTS AND DISCUSSION

The results of the study are summarized in Tables 1-5. The background information of patients presented in Table 1 revealed that the number of subjects increased with increase in age since NIDDM is an age-related disease. The prevalence increased markedly above the age of 35 years and the maximum incidence was seen between the ages of 40-60 in the study. Highest numbers were seen between 60-70 years in male and female subjects. 88.7% of the total subjects were Hindus followed by Muslims (9.6%) and Christians (1.7%). Of the 115 subjects, 10.4% were illiterate, 23.5% had school education, 35.7% were undergraduates and 30.4% were graduates. Education is an important aspect in the management of diabetes. The overall management of diabetes includes management

Table 1: Background information of patients (Percent of subjects)

Particulars	Information			
	30-39	40-49	50-59	60-70
Age (in Years)				
Male	10.7	25.0	27.6	36.7
Female	10.2	25.6	28.5	35.7
<i>Religion wise distribution</i>				
Religion	Hindu	Muslim	Christian	-
	88.7	9.6	1.7	
<i>Literacy level of subjects</i>				
Education	Illiterate	School education	Under graduate	Post graduate
	10.4	23.5	35.7	30.4
<i>Occupational status</i>				
Category	Housewives /retired	Business	Official	Others
	48.7	19.1	16.5	15.7
<i>Income in Rs. Level</i>				
	>3000	3000-5000	5000-7000	>7000
	25.8	25.7	21.9	26.6
<i>Family Type</i>				
	Nuclear	Extended	Joint	
	53.9	20.9	25.2	
<i>Housing Pattern</i>				
	Own house	Rental		
	69.6	30.4		

through drugs, diet and physical exercise and educated subjects perceive the diabetes education in a better way. Implementation of knowledge regarding the management helps the subjects to live a better quality of life.

Of the total subjects, 48.7% were either housewives or retired from active occupation. They formed the largest group in the occupational status. 19.1% were of business class, 16.5% were officials and 15.7% came under the group of others and included agriculturists, coolies, hotel workers and beedi workers. Diabetes is seen mostly among people who lead a sedentary lifestyle, as such a life style leads to obesity and obesity in turn is one of the major predisposing factors for the onset of diabetes. Most of the housewives who visited the clinic were overweight. This may be due to sedentary life style or lack of physical activity. In the business community and officials, stress may be one of the factors for the onset of diabetes. Most of the subjects had monthly income ranging from Rs. 1000 -7000. A small percentage were in the higher income category. As the income of the subject increases, his food purchasing power also increases. High income also facilitates better management of the diabetes because the subject can afford medical facilities and medicines better.

Nuclear family type formed the major group for total number of subjects. More than half i.e., 53.9% of subjects lived as nuclear families, 20.9% were in extended families and 25.2% of subjects lived in joint families. These figures show the shift from traditional living style to urbanization. The number of vegetarians was more than the number of non-vegetarians. 4.4% of the subjects were smokers while 6.1% consumed alcohol.

Under clinical history (Table 2) the age of

onset of diabetes, symptoms noticed when diabetes was diagnosed, family history, values of biochemical analysis and presence of associated diseases of diabetes were included. Of the total number 10.4% became diabetics between the age group 30-35 years and the incidence of onset of diabetes between 50-60 years was between 18-19%. After 60 it had come down to 3.4 decreasing further after 65 years to 0.9%. The various symptoms reported were frequent thirst (58.2%), excess weakness (53%) frequent urination (51.3%), frequent perspiration (42.6%) frequent hunger (32.1) and loss of weight (23.5%). Family history of diabetes indicated a highest incidence in mothers (35.6%) followed by father, brother and sisters. Smaller percent also reported presence of diabetes in uncles, aunts and grandparents. A familial tendency to diabetes undoubtedly exists. It is generally seen that NIDDM runs into families. Many studies have shown that heredity is one of the major predisposing factors for the onset of diabetes (Gopalan, 1995). Of the subjects, 50.8% had associated complications of diabetes like eye problems (10.4%), neurological problems like peripheral neuropathy (2.2%), dental problems (7.8%), skin problems (7.8%), heart problems (20.9%) and kidney problems (1.7%). Chronic uncontrolled diabetes gives rise to many complications which can be life threatening.

The blood sugar levels and haemoglobin status of the subjects were analyzed and classified as per WHO standards (Table 3). 17.8% of males had their FBS levels between 79-99 mg/dl and another 17.8% had levels between 100-119mg/dl. 64.2% of men, the largest group, had FBS levels above 120. This indicates that in such cases diabetes was poorly controlled. 10.2% of the females had their FBS levels between 79-99mg/dl

Table 2: Clinical history of diabetics (Percent of subjects)

Age of onset		Symptoms reported at the time of diagnosis		Family history		Subjects with associated risk factors	
Years	%	Symptoms	%	Relation	%	Associated risk factors	%
31-35	10.4	Frequent thirst	58.2	Father	23.5	Eye problems	10.4
36-40	10.4	Frequent hunger	32.1	Mother	35.6	Neurological problems	2.2
41-45	20.0	Frequent urination	45.3	Brother	17.4	Dental problems	7.8
46-50	17.3	Frequent perspiration	42.6	Sister	10.4	Skin problems	7.8
51-55	18.3	Excess weakness	53.0	Paternal grandparents	0.1	Foot problems	-
56-60	19.2	Loss of weight	23.5	Maternal uncle	4.3	Heart problems	20.9
61-65	3.5	-	-	Paternal uncle	6.9	Kidney problems	1.7
66-70	0.9	-	-	Maternal aunt	4.3	-	-
		-	-	Paternal aunt	2.6	-	-

and 11.9% had levels between 100-119mg/dl. In this group, diabetes was under control as the normal range is 80-120mg/dl. 76.2% of the female subjects had FBS levels of more than 120 which indicates that diabetes was poorly controlled. It could be due to improper diet, negligence about medication etc. 98.2% of men had normal hemoglobin status while only 1.8% were classified as mildly anemic. Among women, 78% of them enjoyed normal haemoglobin status and 22% were mildly anemic.

Table 3 also gives the nutritional anthropometry of subjects. Of the total 56 male subjects, 60.7% had normal BMI, 33.9% had grade I obesity and 5.4% had grade II obesity. In this group obesity may have functioned as a predisposing factor for NIDDM. Of the total 59 female subjects, it was seen that 49.2% had normal BMI, 35.6% had grade I obesity and 15.3% had grade II obesity. It was observed that higher number of female subjects were obese compared to males. The risk of NIDDM increases continuously with BMI and decreases with weight loss (WHO, 1994). MUAC indicates the protein status of a person. Of the 56 male subjects, 14 men came under the classification of more >100 and rest were below it indicating normal protein status. Among females, 49 out of 56 came under the

classification of >100, and the rest were below it. Skinfold thickness indicates subcutaneous fat status. 41 men and 49 women had higher skinfold thickness than the standard indicating obesity.

Waist circumference is a convenient and simple measurement and is an approximate index of intra abdominal fat mass and total body fat. Changes in waist circumference reflect changes in risk factors for CVD and other forms of chronic diseases. WHR is a useful tool for identifying individuals at risk for chronic diseases. Ideal values of WHR are 1.0 in men and 0.85 in women. Of the total number of 56 male subjects, 39 men came under the classification of <1 indicating good health whereas 17 men came under the classification of >1 indicating abdominal fat accumulation. Out of 59 female subjects, most patients were obese. Their WHR was more than the accepted ratio. Only 16 subjects had normal WHR.

Food frequency of the subjects given in Table 4 represents number of subjects using a food item per day which in turn is consolidated from a month's record. Rice and ragi formed the staple cereal of most patients while wheat was used by lesser number of subjects. Among pulses, red gram dhal was used by majority and all the other pulses and grams were used either weekly or

Table 3: Biochemical parameters and Nutritional anthropometry of subjects (Percent of subjects)

Subjects		Parameters			
<i>Fasting Blood Sugar Levels (mg/dl)</i>					
	<79	79-99	100-119	>120	
Male	-	17.8(10)	17.8(10)	64.4(36)	
Female	1.7(1)	10.2(6)	11.9(7)	76.2(45)	
<i>Hemoglobin Status (g/dl)</i>					
	>12	10-12	7-10	<7	
	<i>Normal</i>	<i>Mild</i>	<i>Moderate</i>	<i>Severe</i>	
Male	98.2(55)	1.8(1)	-	-	
Female	78.0(46)	22.0(13)	-	-	
<i>Body Mass Index (grades)</i>					
	15.0-18.5	18.5-25.0	25.0-30.0	>30.0	
Male	-	60.7(34)	33.9(19)	5.4(3)	
Female	-	49.2(29)	35.6(21)	15.2(9)	
<i>Mid Upper Arm Circumference (% of standard)</i>					
	>100	90-100	80-89	70-79	<70
Male	25.0(14)	39.3(22)	25.0(14)	8.9(5)	1.8(1)
Female	83.1(49)	10.1(6)	1.7(1)	5.1(3)	-
<i>Tricep Skinfold (% of standard)</i>					
	>100	90-100	80-89	70-79	<70
Male	73.2(41)	3.6(2)	16.1(9)	5.3(3)	1.8(1)
Female	83.0(49)	10.2(6)	1.7(1)	5.1(30)	-
<i>Waist Hip Ratio</i>					
	<i>Ideal ratio</i>	<1	>1	<0.85	>0.85
Male	1.0	66.1(39)	28.8(17)	-	-
Female	0.85	-	-	27.1(16)	72.9(43)

Numbers in parentheses refers to number of subjects.

Table 4: Frequency of consumption of foods (number of subjects using a food item per day consolidated from a month's record)

Food items	Number of subjects	Food items	Number of subjects
<i>Cereals</i>		<i>Vegetables</i>	
Rice	112.6	Tomato	89.4
Ragi	80.8	Onion	64.9
Wheat	67.7	Cucumber	37.4
<i>Pulses</i>		<i>Green leafy</i>	
Red gram dhal	102.0	Beans	17.1
Black gram dhal	20.8	Knolkhol	10.6
Bengal gram dhal	18.9	Ladies finger	10.6
Green gram dhal	12.3	Radish	10.6
Green gram	14.3	Ridge gourd	8.9
Bengal gram	13.6	Brinjal	8.6
Cow pea	8.3	Carrot	8.3
Peas	7.7	Drumstick	8.0
Horse gram	6.6	Potato	5.7
<i>Fruits</i>		<i>Beet root</i>	
Banana	49.1	Bottle gourd	5.3
Papaya	10.8	Cauliflower	4.3
Apple	3.1	Ash gourd	4.0
Water melon	3.7	Capsicum	3.7
Musk melon	2.0	Snake gourd	3.7
Pomegranate	2.0	<i>Other foods</i>	
Guava	1.6	Coconut	103
Grapes	1.0	Sugar	27
Mango	1.1	Jaggery	6
Pineapple	0.7	Mutton	8.6
<i>Milk group</i>		<i>Fish</i>	
Milk	111	Fish	3.7
Curds	82.4	Chicken	5.3
Ghee	8.6	Egg	5.4

fortnightly. The intake of green leafy vegetables was less with 42 subjects consuming it once a week, 29 of them twice a week, 11 of them thrice a week and 23 subjects once in a fortnight. Consumption of green leafy vegetables is

advisable for diabetes as it contains a good amount of fiber and fiber is believed to be helpful in controlling blood sugar levels. These are also potential sources of calcium, iron, folic acid and carotene. In root and tubers, most patient did not consume beetroot and carrot on dietitian's advice. Potato was believed to be gas forming, hence it was avoided. Most other vegetables were consumed on a weekly basis or fortnightly basis. In fruits, more than 50% of the subjects did not consume most fruits except for bananas. Milk and curds were used by majority of subjects everyday. Among other foods, coconut consumption was very high. Of the total population surveyed, 64 subjects were vegetarians and did not consume mutton, fish or chicken. Others mostly consumed these foods weekly, fortnightly and some of them occasionally. 27 subjects used sugar daily. 79 and 101 subjects did not use sugar and jaggery respectively.

Using pre-standardized cups and ladles, food intake of the patients was determined and the nutrient intake was computed using food composition tables. Data formulated thus was classified age and sex wise (Table 5). In the age group of 30-40 years, fat intake was very high compared to RDA (ICMR, 1996). The intake of protein, calcium, thiamine and niacin was adequate. The adequacy of carotene and iron was only 24 and 58% respectively. In the age group of 40-50 years, protein, iron and carotene were inadequate. In the age group of 50-60 years, in addition to these, B-Complex were inadequate. In the last group, i.e., above 60 years, fat intake

Table 5: Average nutrient consumption of subjects

Nutrients	Age in years							
	Males				Females			
	30-40	40-50	50-60	>60	30-40	40-50	50-60	>60
Protein (g)	64.3	54.4	46.2	44.3	46.6	45.1	39.1	39.5
Fat (g)	50.0	42.7	30.0	29.7	42.2	47.2	28.5	26.0
Carbohydrate (g)	332	325	295	239	266	250	212	218
Energy (Kcal)	2096	1968	1727	1456	1640	1496	1310	1264
Calcium (mg)	890	988	562	923	804	710	529	499
Iron (mg)	16.3	27.4	24.9	29.6	17.2	16.0	19.9	10.9
Carotene (µg)	1008	1104	746	1071	3584	2389	680	349
Thiamine (mg)	1.75	1.65	1.07	2.80	0.96	1.51	0.83	1.24
Riboflavin (mg)	0.97	1.48	0.79	2.50	0.79	2.15	0.86	0.66
Niacin (mg)	15.4	18.7	10.2	9.2	8.9	10.7	8.6	7.1
Vitamin C (mg)	29.3	87.1	55.2	33.4	92.0	83.6	46.5	27.6
Dietary fiber (g)	26.7	30.4	19.0	15.2	21.7	23.7	16.4	22.6

was higher than the RDA. Calcium, iron, thiamine and riboflavin were consumed in adequate amounts while protein, carotene, niacin and vitamin C were found to be lesser than the requirement. Among female subjects, in the age group of 30-40 years, consumption of fat, calcium, carotene and vitamin C was found to be higher than the recommendations. Only 57.3% of iron was consumed compared to the RDA. Adequacy of B-vitamins, riboflavin and niacin was 80.6% and 89.7% compared to the RDA.

In the next age group, i.e., 40-50 years of age, intake of fat, calcium, thiamine, riboflavin and vitamin C were found to be much higher than the RDA. Iron in the diet was only half of the recommendations i.e., 53%. In the next age group of 50-60 years, intakes of protein, fat, calcium and vitamin C were adequate. Adequacy of iron was 66.3% while that of carotene was only 28.3%. This could be due to low consumption of green leafy vegetables, milk and its products and other rich sources. In the last age group i.e., above 60 years, the intake of fat, calcium, thiamine were found to be adequate. Proteins, riboflavin and niacin, and vitamin C were slightly lesser than the requirements. Diets of this group were low in iron and carotene. Adequacy of iron was 36.1% while that of carotene was only 14.5%. This could be due to non-consumption of rich sources or low intakes of the food itself due to the age factor.

It can be summarized from the results that among the associated risk factors of diabetes, heart disease and eye problems were the most prominent. Different grades of obesity was observed in study population although weight management is very important for diabetics. The diets were inadequate mainly in carotene and iron

in all age groups hence qualitative improvement of diets is very important.

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