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Dietary Intake and Somatic Status of Selected Diabetics as Compared to Normal Subjects

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KEY WORDS Dietary Intake. Somatic Status. Diabetic and Normal Subjects.

ABSTRACT The dietary status of diabetics as compared to normal subjects was assessed by body size measures, dietary history and some biochemical measures. The study revealed that the food behaviour and dietary intake pattern of the diabetics was similar to that of normal. The diets were essentially that of vegetarian, high in carbohydrate. Though the body mass index (BMI) was within the normal range, energy intake was found to be lower than the recommended dietary intake (RDI). However, the energy intake met the basal energy requirement of the subjects. Nutritional quality of diet was found to be low in micronutrients particularly retinol, iron and β-complex vitamins. Though the total cholesterol and fasting blood glucose was significantly higher ($P < 0.01$) in the diabetic group the haemoglobin levels did not differ between normal and diabetics

INTRODUCTION

The study of life-style of populations in India, where large majority subsist on high-carbohydrate diet, revealed a low prevalence rate of chronic diseases that affect the western world. Current evidence suggests that diets high in carbohydrate, fiber and low in fat can favourably influence the insulin response and reverse the diabetic state to normal (Anderson, 1986). Such diets have also been found to retard the development of complications that are associated with uncontrolled and progressive diabetes (Fajans et al., 1978; Ganda, 1980). The conventional treatment of diabetes includes insulin and oral hypoglycemic drugs (Mayer, 1991). Hence patients tend to ignore the need for dietary compliance. As diet appears to have a far-reaching effect on health, it is important to assess the dietary intake pattern of communities. Earlier studies indicate a high carbohydrate and low fat intake by diabetics which was similar to the prevailing dietary pattern of the normal population in Mysore (Khanna and Puttaraj, 1985; Asha and Puttaraj, 1996). It was also reported that there was no difference in dietary pattern of the diabetic before and after the onset of disease. Hence, it was thought essential to compare the dietary intakes of diabetics with that of normal individuals.

METHODOLOGY

A total of 57 non-insulin dependent diabetic patients (NIDDM) (34 men, 23 women) aged 29-59 years attending the outpatient diabetic clinic at the railway Hospital and Vikram Clinic, Mysore were selected for the study. They had been diagnosed as having diabetes for more than a year. All the subjects were in good general health except for having diabetes. Thirteen subjects were being treated by diet alone 44 by oral drugs.

A total of 59 volunteers (30 men, 29 women) aged 21-45 years with normal glucose tolerance (as tested by oral glucose tolerance test) and within desirable range of body mass index (BMI) participated in the study. They were selected from among the persons accompanying the diabetic subjects.

Body Size Measurements : (Height and weight) as described by Jelliffe (1966) were recorded twice for each subject. The BMI was calculated (wt/ht^2 in kg/m^2) as an index of obesity. Biochemical indices *viz.*, fasting blood sugar (FBS), total cholesterol and haemoglobin were also measured by standard techniques in all subjects. In addition, blood pressure measurements were also recorded.

The subjects were interviewed with the help of a questionnaire using 24 hr recall method of dietary survey. Repeat data were collected which included information on food frequency, dietary pattern and food habits of the family. Household

measures relevant to Indian cuisine (serving bowls of various sizes, spoons or laddles) were used to assess the portion size. The data from the 24 hour recall were analyzed and nutrient intakes were calculated using the Indian food composition tables (Gopalan et al., 1989).

The constituents of fat (calculated as part of the total fat) and dietary fibre content of the foods consumed were calculated using reported values (CAST, 1986). Recommended dietary intake (RDI) energy and protein was derived for each subject using ICMR recommended dietary allowance (ICMR, 1987). Resting WHO/FAO equations (WHO/FAO, 1985). Desirable dietary pattern (DDP) was computed based on Recommended dietary intake (RDI) (ICMR, 1987) for adults with IBW (ideal body weight) to give 1800-2100 calories and 50-60 protein per day. The nutrient intakes in both groups were analyzed and differences was tested by Student' 't' test.

RESULTS

Socio-economic data of the subjects revealed that all the subjects were from middle socio-economic group having a moderate educational status. The onset of diabetes was around 40 plus years for majority (64%) of the diabetic subjects and below 40 years for the rest. Both normal and diabetic subjects were leading a sedentary life-style.

Mean anthropometric measurements of the subjects are presented in table 1. The somatic measures - height and weight, were found to be within the normal range for majority of subjects, though diabetic women showed an upward trend.

Table 1: Body size and Biological data of the subjects ($\bar{x}$ ± SD)

Parameter	*Diabetics Men*	*Diabetics Women*	*Normals Men*	*Normals women*
Weight (kg)	60.6±8.75	58.5±8.54	56.0±10.3	52.1±10.0
Height (cm)	166.3 ±7.54	154.1±7.95	166.6±7.4	157.5 ± 8.8
Body Mass Index (BMI)	21.9±3.2	24.6±3.3	20.3±3.4	21.0±4.5
Fasting blood sugar (mg %)	160.0±26.2	143.3±12.2	76.4±12.2	69.3±9.5
Total cholesterol (mg %)	200.0±18.6	173.0±10.5	180.5±22.7	177.1±20.1
Haemoglobin (g %)	13.0±0.6	11.9±1.0	12.7±1.3	11.4±2.5

Biological data of the subjects is also given in table 1. Most subjects in both groups had the haemoglobin level and total cholesterol levels within the normal range. However, the fasting blood sugars were significantly high ($P<0.01$) in the diabetic group.

The meal pattern of the subject in both groups was similar to that prevalent in Mysore area consisting of two meals and one breakfast. The diabetic subjects had been advised by the attending physician, at the onset of disease, to decrease the consumption of certain foods, *viz.*, rice, sugar, fatty foods, fruits and tubers and to include foods like ragi (*Elucine coracana*), wheat, green leafy vegetables and pulses. Most of the subjects showed an inclination towards following dietary counselling imparted to them.

Table 2: Mean food intake of the subjects ($\bar{x}$ ± SD)

Foods (g/day)	*Diabetics*		*Normal*		*DDP**
	Men	*Women*	*Men*	*Women*	
Cereals	260 ±35	230± 32.8	245±50	190±32	240
Pulses	40±15	30±12	30±10	30±8	60
Green leafy vegetables	14±21	30±24	26±22	25±17	100
Other vegetables	30±30	40±25	32±32	30±27	50
Roots and Tubers	20±13	25±13	20±17	30±13	50
Milk and milk products	75±45	80±35	110±40	105±60	150
Sugar and Jaggery	4±5	5±4	20±9	18±6	30
Fats and Oils	17±7.2	20±6.8	20±4	18.4	30
Fruits	7±17	7±16	25±28	20±25	100
Flesh foods	8±2	4±3	15±5	10±4	-

*DDP – Desirable dietary pattern- computed based on the RDA for adults with IBW to give 1800-2000 calories and 60 g protein/day

The mean food intake of the subjects is presented in table 2. Cereals were the major item of the foods consumed, followed by pulses and milk and its products. Their diets consisted of low amounts of green leafy vegetables and other vegetables. Though the cereal intake of the subjects was within the range, it was found to be low in normal women when compared to the desirable dietary pattern (DDP). With respect to other protective foods like pulses, milk, vegetables especially green leafy, fell short of the desirable pattern in both the groups.

The daily nutrient intake of the subjects is given in table 3. The pattern of mean per cent energy contributed from carbohydrate, protein

and fat was 70, 10 and 20, respectively in both the subject groups. The mean carbohydrate intake ranged from 185-230 g per day. The energy and protein intake, when compared to RDA of Indian (ICMR, 1987) was inadequate in both groups. However, the low consumption of diet did not reflect in their body weight as BMI was within normal range for majority of subjects.

The pattern of lower energy and protein intake as compared to the recommended intake (Table 4) was similar, in both the groups. It was interesting to note that energy consumed per kg body weight decreased as the BMI increased in both the groups (Table 5). The energy intake met the basal energy in most of the subjects with BMI less than 24 in both groups, however, it did not meet the minimum required for sedentary life style.

The intake of total fat in terms of its constituents is presented in Table 6. Mean intake of both total fat and cholesterol was low in both groups. The diet consisted of polyunsaturated to saturated in the ratio of 1.0. Mean intake of cholesterol was low both in diabetics (22 mg) and

Table 3 : Mean nutrient intake of the subjects ($\bar{x}$± SD)

Mean Nutrients	*Diabetics*		*Normal*	
	Men	*Women*	*Men*	*Women*
Energy (Kcals)	1273 ±186	1185 ±168	1300 ± 195	1100 ± 120
Carhydrate (g)	225 ± 29 (70)	206 ± 28 (70)	203 ± 38 (70)	185 ± 25 (70)
Protein (g)	35 ± 75 (11)	32 ± 6 (11)	32 ± 6 (11)	27 ± 4 (11)
Fat (g)	24.5 ± 8 (18)	25.1 ± 9 (19)	22.7 ± 6 (18)	20.4 ± 6 (20)
Dietary fibre (g)	34.6 ± 5	33.1 ± 5	31.3 ± 6	24.7 ± 4
Calcium (mg)	413 ±194	395 ±1-3	326 ± 94	291 ± 81
Iron (mg)	11.6 ± 1.7	10.7 ± 1.6	11 ± 2.1	9.2 ± 1.4
Retinol (mg)	310 ± 29.0	412 ±27.0	420 ± 43.8	390 ± 25.6
Thiamine(mg)	1.17 ± 0.15	1.07 ± 0.14	1.7 ± 0.2	0.9 ± 0.1
Riboflavin(mg)	0.61 ± 0.12	0.57 ± 0.09	0.7 ± 0.1	0.9 ± 0.4
Niacin (mg)	7.77 ± 1.25	7.10 ± 0.95	7.3 ± 1.3	5.9 ± 1.3
Vitamin C (mg)	28.21 ± 20.6	36.3 ±20.1	8.0 ± 15.1	35.1 ± 14.7

Values in parenthesis indicate % calories from carbohydrate protein and fat.

Table 4: Energy and Protein intake of the subjects by age-wise classification ($\bar{x}$ ±SD)

Age group	*No.*	*Energy (Kcals)*		*Protein (g)*	
		[1]	*[2]*	*[1]*	*[2]*
I. Diabetics					
30-39 M	2	1364 ± 36	2020 ± 40	36 ±2.0	55 ± 0
W	-	-	-	-	
40-49M	10	1478 ± 1-5	1964 ± 95	38 ± 9	58 ± 6
W					
30-39 M	2	1364 ± 36	2020 ± 40	36 ±2.0	55 ± 0
W	-	-	-	-	-
40-49 M	10	1478 ± 105	1964 ± 95	38 ± 9	58 ± 6
W	8	1270 ± 212	1946 ± 109	32 ± 8	52 ± 6
50-59 M	21	1360 ± 88	1930 ± 968	34 ± 7	60 ± 6
W	15	1380 ± 146	1742 ± 93	32 ± 5	55 ± 4
II Normals					
20-29 M	20	1280 ± 190	2102 ± 118	31 ± 4	54 ± 8
W	-	1200 ± 130	1900 ± 120	28 ± 5	50 ± 8
40-49 M	2	1350 ± 127	1980 ± 103	34 ± 7	60 ± 3
W	5	1065 ± 90	1800 ± 85	27 ± 5	54 ± 6
50-59 M	7	1355 ± 85	1910 ± 130	33 ± 8	60 ± 4
W	-	-	-	-	-

1 = Actual Intake/ M = Men
2. = Recommended /W = Women

Table 5: Energy Intake and Body Mass Index of the subjects ($\bar{x}$ ±SD)

BMI	*No*	*Basal Energy (Kcals)*		*Energy intake (Kcals)*		*Energ recommended (Kcals)*	
		[1]	[2]	[1]	[2]	[1]	[2]
I. Diabetics							
19-24 M	11	26	1350±26	25	1370±60	36	2000±86
W	3	28	1210±21	28	1235±36	33	1580±50
> 124-30 M	22	25	1620±20	20	1300±46	36	2080±64
W	21	22	1375±36	20	1300±40	34	1810±40
II. Normals							
19-24 M	19	28	1491±36	26	1380±66	38	2020±80
W	15	26	1225±33	25	1262±26	38	1765±64
>24-30 M	9	25	1720±72	22	1550±91	38	2200±142
W	14	22	1268±43	20	1310±68	38	2000±110

1. = Calories/kg body weight M = Men
2. = Calories/day W = Women

Table 6 : Mean daily intake of total and different fats ($\bar{x} \pm SD$)

Fats	*Diabetics*		*Normals*	
	Men	*Women*	*Men*	*Women*
Fat (g)	24.5±8	25.1 ±9	20.7±6	20.4±6
Saturated fat (g)	6.6±2.8	6.2±2.3	6.6±2.2	6.8±1.0
Manoun saturated fat (g)	9.7±4.0	10.5±4.3	9.2±2.5	10.6±2.4
PUFA (g)	5.2±2	5.8±2.3	4.8±1.5	5.7±1.3
Cholesterol (mg)	21.4±18.5	22.4±9.2	38.8±8.8	25.3±10.2

normal (32 mg).

With regard to other nutrients (Table 3) intake of calcium, thiamine and vitamin C were satisfactory but on the lower range in women (normals).

DISCUSSION

In communities with low prevalence of diseases like diabetes, chronic heart disease, the diets contains 10-11 per cent of total proteins and 2.25 per cent of total fats and when consumed in reasonable volume should satisfy the energy needs. In addition to be nutritionally sound, it should contain foods like green leafy vegetables to satisfy the micronutrient needs (Goor and Riflkin, 1982).

The appropriate amount of carbohydrate universally accepted in a diabetic diet is around 60-65 per cent of the total calories. Studies by various groups have demonstrated better glucose control, lowered insulin requirements and increased sensitivity of peripheral tissues to insulin in patients treated with such diets (Anderson and Ward, 1979 and Anderson and Chen, 1979; Jenkins et al., 1980; Miranda and Horwitz 1978, Simpson et al., 1981). In South India, 70-80 per cent of the total calories are derived mainly from carbohydrates.

As it is seen, the dietary pattern of the subjects in the present study was that of high carbohydrate, moderate fiber and low in fat with a P : S ratio of 1.0. However, it fell short in micronutrients specially retinol, iron and B group of vitamins. Actual energy intake were lower than Recommended Dietary Allowance (RDA) (ICMR, 1987). Though their energy intake met the basal energy (BMR), it did not meet the minimum required for sedentary life-style.

High intakes of protein have been reported to improve metabolic control and lower the insulin requirement in diabetics (Spiller et al., 1987, Seino et al., 1983; Welch, 1991). In the present study, as the protein intake of both the normal and diabetics was lower than RDA, it is suggested that the intake of protein may be increased through the inclusion of more pulse. Since pulses as a class have been shown to produce favourable effect on carbohydrate and lipid metabolism (Jenkins et al., 1980, 1982, 1984; Thorne et al., 1983)

It is stated that the deficiency of micronutrients such as calcium, iron, vitamin A are associated with atherosclerotic cardiovascular diseases or with derangement in lipid and carbohydrate metabolism (Kurup, 1989; Turner, 1982). It appears that vitamin and mineral deficiencies which are present in young adulthood if carried over with aging will result in the early onset of age related diseases. Thus, the aging process along with deficiency of micronutrients may bring about impairment in energy utilization *per se*. In the present study as most of the diabetic subjects belonged to a older age group, it is possible that low intake of protective foods coupled with sedentary life-style over an extended period of time might have contributed to diabetes.

While no modification need to be introduced in the prevailing dietary pattern, it is important to specify the actual quantity of the foods to be consumed. Much more important is the type of carbohydrate, that would favourably influence the glycemic responses. Though the habitual Indian diet is high in fiber, it may not be effective in reducing the post-prandial glycemia as the major source of fiber is derived from cereals. Hence, it is suggested that addition of legumes in the diet as accompaniments would certainly increase both the protein and soluble fiber content of the diet, which would in turn have a favourable effect on the carbohydrate metabolism. It may also be worthwhile to correct the micronutrient deficiencies in order to check the progress of disease in diabetic and to prevent the early onset of age-related diseases in normal population.

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