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Anthropometry and Dietary Intake of Type 2 Diabetes Patients Attending an Outpatient Clinic

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ABSTRACT

A cross sectional study on Type 2 diabetes patients seeking treatment in the Primary Health Care outpatient clinic of the University Malaya Medical Centre, Kuala Lumpur was undertaken. Two hundred and thirty-three subjects participated. They were asked questions on biodata and dietary intake using face-to-face interview techniques. Dietary intake was assessed using the 24-hour dietary recall. Anthropometric measurements including weight and height were taken and Body Mass Index (BMI) was computed to establish the extent of obesity. Of the 196 subjects, 66.8% were overweight (BMI ≥25 kg/m^2) with 15.8% obese (BMI ≥30 kg/m^2). The mean BMI of males and females were 25.9±4.3 kg/m^2 and 27.2±4.7 kg/m^2 respectively. The findings from the dietary survey showed that the mean energy intake of the subjects only achieved about 72% of the Recommended Daily Allowance (RDA) for Malaysia while protein intake of all subjects was adequate. The macronutreint contribution to the total calorie was consistent with the recommendation of the Malaysian Diabetic Association for a healthy diet for diabetes patients. The male subjects were found to meet the RDA requirements for all nutrients while the female subjects did not have sufficient intake of calcium, vitamin A and niacin. No consistent pattern in energy and nutrient intake was observed among different age groups. On the other hand, the Malay subjects seemed to have lower energy and all nutrient intake (except vitamin A and vitamin C) compared to the Chinese and Indian subjects. The Indian subjects seemed to have the highest intake of calcium compared to the others. Advice needs to be given to those who did not have adequate nutrient intake as well as those who need to reduce their weight.

INTRODUCTION

Diabetes mellitus is a chronic disease which requires continuing medical care and education to prevent acute complications and to reduce the risk of long term complications. The treatment for diabetes requires a multiple approach that would include medical nutrition therapy, exercise, weight reduction and use of drugs when indicated (ADA, 2001c).

Medical nutrition therapy (MNT), formerly known as diet therapy, is the cornerstone of diabetes care and management. The primary MNT goals for type 2 diabetics are to achieve and maintain glucose, lipid and blood pressure goals. Hypocaloric diets and weight loss could improve short-term glycemic levels and have the potential to improve long term metabolic control. Following the recommendations of the Malaysian Diabetics Association (PDM 1993), the macronutrient

contribution to the total calorie should be in the ranges of 50-60%, 10-20% and 30% for carbohydrate, protein and fat respectively. However these guidelines need to be individualized, depending on blood glucose and lipid levels. Protein recommendations would be lower for individuals with evidence of nephropathy (ADA 2001a). The energy requirement of diabetics should be sufficient to attain and maintain a reasonable body weight for adults, increased needs during pregnancy and lactation or for recovery from catabolic illnesses.

While much of the focus of the relationship between diet and diabetes has been on macronutrient content, proper micronutrient intake should also be achieved for optimal health. Vitamin and mineral intake should meet the established requirements for health. Provided that the diet is adequate, patients with type 2 diabetes do not require or seem to benefit from dietary supplementation of vitamins or minerals (PDM 1993; ADA 2001b).

There are limited studies on the diet of our Malaysian diabetic patients. However, a few surveys have been conducted in different settings. Norimah & Abu Bakar (1993) found that the diets of those diabetic patients attending the UKM (Universiti Kebangsaan Malaysia) outpatient clinics were high in carbohydrate. (55-59% of total calorie), low in fat (23-28% of total calorie) and protein in the range of 17 to 18% of total calorie. A study on diabetics which was population based by Ruzita (1998) found the proportion of carbohydrate to be in the range of 38 to 55%, fat 28 to 30% and protein 16 to 34% of total calorie intake. Another study on diabetics among inmates of an old folks home by Zalifah (1999) found that their intake of carbohydrate, protein and fat was quite similar to the above two studies with the proportion being 57%, 14% and 28% of total calory intake respectively.

The association of obesity with type 2 diabetics is well established and well known. A study by Thai *et al.* (1990) in Singapore found that 58% of diabetic patients were overweight (BMI> 25 kg/ms^2) with Malays having the highest BMI compared to the Chinese and Indians; Norimah & Abu Bakar (1993) found that 62% of diabetic patients were overweight. An increased risk of diabetes with increasing weight has been shown in prospective studies in Norway, Sweden, Israel and the USA (Maggio & Pi-Sunyer 1997).

There is limited data on the anthropometry and dietary intake of diabetics among the multi-ethnic groups of Malaysia whose social and cultural backgrounds are different. This contributes to different and unique dietary patterns among these ethnic groups which might eventually affect their nutritional status as reflected by anthropometry and dietary intake. Furthermore, compliance to the dietary prescription is viewed as important for optimal management of diabetes mellitus. Our objectives are therefore to study the anthropometry and dietary intake of Type 2 diabetics as well as to assess how far the nutritional recommendations and guidelines for macro- and micro-nutrients are being met in the outpatient clinic of the Department of Primary Health Care, University Malaya Medical Centre. This study makes comparisons between males and females and across the different ethnic groups.

MATERIALS AND METHODS

This study was carried out in the outpatient clinic of the Department of Primary Health Care, University Malaya Medical Centre. As there were a total of 900 diabetes patients registered with the clinic, a sampling frame was prepared. Three hundred patients were selected from the sampling frame using stratified sampling. The patients were stratified by ethnicity and gender. Simple random sampling was then conducted within each stratum. Two hundred and thirty three patients (77.7%) participated in the survey. Non-response was due to reasons such as patients' refusal to participate, patients who stopped seeking treatment from this clinic or death. The subjects were interviewed using pre-tested questionnaires by trained paramedical staff. Socio-demographic information was also obtained.

Anthropometric measurements which included weight and height were taken with a SECA beam balance and recorded to the nearest 0.1 cm and 0.1 kg respectively. There was no hunching in subjects above 60 years old and the technique used for taking height was the same for all subjects. Body Mass Index (BMI) was then computed using the ratio of weight (kg) / height^2 (m^2) following the classification of WHO (1997).

Dietary intake was assessed using the 24-hour dietary recall. Subjects were interviewed for their past 24-hour food intake using household measures such as cups, bowls, spoons etc. The nutrient content of foods consumed was recorded and calculated based on the Malaysian Food Composition Table (Tee *et al.,* 1988).

Statistical analysis

All the variables were coded and entered into SPSS for Windows version 9.0. Appropriate statistical analyses were performed using the same software. Statistical tests used included analysis of variance (ANOVA), post hoc Bonferroni test and χ^2 test. The significance level was preset at 0.05.

RESULTS

Socio-demography information

Of the total of 233 subjects, 104 (44.6%) were males and 129 (55.4%) were females. Of this, 76 (32.6%) were Malays, 77 (33.0%) Chinese and 80 (34.3%) Indians. Their mean age was 54.8± 8.2 years . The majority (82.8%) were married. About half of the subjects only had primary education or never acquired any formal education. More than 60% of the subjects were either housewives or had retired from work (Table 1). The mean duration of diagnosis among the subjects was 9.1 ± 6.5 years with the range of duration being from 1 to 34 years.

Anthropometric measurements

The mean height of the whole population was 157.3±9.7 cm with males being 163.3±8.3cm and females 151.8±7.3 cm respectively. The difference in height among the males and females was

statistically significant ($p < 0.05$). The Indian subjects (both males and females) were statistically taller than the other ethnic groups ($p < 0.05$) (Table 2). The mean weight of the population was 65.4 ±11.9 kg with males having a mean weight of 69.6±11.6 kg and females 61.9±11.1 kg.

Table 1. Socio-demography data of the subjects by ethnicity

	Malay n=76		Chinese n=77		Indian n=80		Mean	
	n	(%)	n	(%)	n	(%)	n	(%)
Age (years)	54.9±7.7		55.6±7.6		54.0±8.9		54.8±8.2	
30-39	4	5.3	3	4.0	7	8.9	14	6.1
40-49	18	24.0	12	16.0	19	24.1	49	21.4
50-59	28	37.3	37	49.3	30	38.0	95	41.5
≥60	25	33.3	23	30.7	23	29.1	71	31.0
Marital status								
Single	2	2.6	6	7.8	2	2.5	10	4.3
Widow/widower	4	5.3	8	10.4	13	16.3	25	10.7
Divorced	2	2.6	1	1.3	2	2.5	5	2.1
Married	68	89.5	62	80.5	63	78.8	193	82.8
Occupation*								
Retired	21	27.6	24	31.2	20	25.0	65	27.9
Housewives	28	36.8	23	29.9	41	51.3	92	39.5
Semi skilled worker	13	17.1	11	14.3	7	8.8	31	13.3
Skilled worker	2	2.6	9	11.7	4	5.0	15	6.4
Semi professional	7	9.2	4	5.2	2	2.5	13	5.6
Others	2	6.5	6	7.8	6	7.6	15	6.5
Education level								
No formal education	9	11.8	8	10.4	8	10.0	25	10.7
Primary	31	40.8	36	46.8	24	30.0	91	39.1
Secondary	31	40.8	26	33.8	36	45.0	93	39.9
Diploma	3	3.9	4	5.2	10	12.5	17	7.3
University	2	2.6	3	3.9	2	2.5	7	3.0

* (Abramson & Abramson, 1990)

The Body Mass Index (BMI) of this population was 26.6±4.6 kg/m^2 with males being 25.9±4.3 kg/m^2 and females 27.2±4.7 kg/m^2. The mean BMI of females was significantly higher than that of the males ($p < 0.05$). The subjects of Malay origin had higher BMI than other ethnic groups but significant difference only occurred in the male subjects ($p < 0.05$) (Table 2). When the subjects were categorized into categories following WHO (1997) criteria, only 33.2% of subjects fell within the normal weight range. The others were in the overweight or obese groups and more than half of the subjects were overweight (Table 3).

Dietary intake

Energy and nutrient intake was tabulated according to age groups as found in the Malaysian RDA (Teoh, 1975). Tables 4a and 4b show the mean energy and nutrient intake as well as the %RDA by age and gender while Table 5 shows the %RDA by gender and ethnicity.

Table 2. Anthropometric measurement of subjects by gender and ethnicity

		Weight (kg) n = 230	Height (m) n =196	BMI (kg/m^2) n =196
Total population		65.4±11.9	157.3±9.7	26.6±4.6
Male	Malay	71.9±15.9^A	160.1±11.3^A	27.8±6.1^A
n = 103	Chinese	66.5±8.2^A	163.0±5.6^A	25.1±2.7^B
	Indian	70.8±8.7^A	167.3±5.6^B	24.9±2.6^B
	Mean	69.6±11.6*	163.3±8.3*	25.9±4.3*
Female	Malay	62.9±11.7^A	148.7±6.5^A	28.7±5.3^A
n = 127	Chinese	61.9±8.5^A	152.9±4.9^B	26.5±3.7^A
	Indian	61.3±12.5^A	153.9±9.2^B	26.5±4.9^A
	Mean	61.9±11.1	151.8±7.3	27.2±4.7

For each gender, values in the same column with different superscripts are significantly different ($p < 0.05$)
*Indicates significant difference in the mean weight, height and BMI between gender

Table 3. Body Mass Index (BMI) categories by ethnicity

BMI Categories* (kg/m^2)	Malay n(%)	Chinese n(%)	Indian n(%)	Mean n(%)
Normal (18.5-24.9)	10 (15.6)	29 (39.7)	26 (44.1)	65 (33.2)
Overweight (25-29.9)	35 (54.7)	37 (50.7)	28 (47.5)	100 (51.0)
Obese I (30-34.9)	18 (28.1)	7 (9.6)	5 (8.5)	30 (15.3)
Obese II (35-39.9)	0 (0)	0 (0)	0 (0)	0 (0)
Obese III (≥ 40)	1 (1.6)	0 (0)	0 (0)	1 (0.5)

*WHO (1997)

The energy intakes of both male and female subjects in this study only achieved about 77% and 67% of the Malaysian RDA respectively (Tables 4a & 4b) with the Malays having the lowest energy intake (males 63.2% and females 57.9%) compared with the other ethnic groups. The mean intake of the subjects was found to exceed 70% of the Malaysian RDA (Tables 4a, 4b and 5) for all cohort age groups and ethnic groups except for calcium, vitamin A and niacin among the female subjects. An arbitrary cutoff point of 70% RDA is used because RDA includes a margin of safety to allow for individual variation. The level below 70% would be considered a significant risk of nutrient inadequacy (Thomas, 1996). The distribution of calories by carbohydrate, protein and fat are as shown in Table 6. The mean carbohydrate, protein and fat intake of this population contributed 56.9%, 14.0 to 14.7% and 28.4% of the total calory intake respectively. However, the Chinese subjects had a significantly higher intake of fat whereas the Indians had the highest intake of carbohydrate ($p < 0.05$).

Table 4a. Mean and %RDA energy and nutrient intake of male subjects by age groups (mean ± s.d.)

Nutrients		Age (years)			
		≤49 n=28	50-59 n=40	≥60 n=35	Mean n=103
Energy	(kcal)	1704.6±610.1	1666.6±633.7	1396.6±440.8	1588.9±581.2
	(%RDA)	70.9	73.1	87.3	77.0
Protein	(g)	57.1±23.6	60.8±24.0	47.6±15.3	55.5±21.9
	(%RDA)	107.7	114.7	89.8	104.3
Ferum	(mg)	12.7±6.9	11.4±5.7	10.8±7.8	11.5±6.8
	(%RDA)	70.6	126.7	120	128.3
Calcium	(mg)	306.2±177.1	397.7±188.5	256.9±115.1	326.5±174.1
	(%RDA)	68.0	88.4	57.1	72.2
Vitamin A	(mg)	529.3±344.4	570.6±285.9	561.2±388.6	556.1±335.2
	(%RDA)	70.6	76.1	74.8	74.2
Thiamin	(mg)	0.86±0.56	0.88±0.43	0.78±0.43	0.84±0.47
	(%RDA)	88.5	97.8	97.5	94.4
Riboflavin	(mg)	1.14±0.58	1.22±0.58	0.95±0.36	1.11±0.52
	(%RDA)	80.6	87.1	79.2	82.5
Niacin	(mg)	10.9±6.4	11.2±5.4	8.6±5.1	10.3±5.7
	(%RDA)	68.8	74.7	66.2	69.9
Vitamin C	(mg)	56.1±57.6	94.9±77.4	57.2±63.8	71.9±69.9
	(%RDA)	187.1	316.3	190.7	238.7

Table 4b. Mean and %RDA energy and nutrient intake of female subjects by age groups (mean ± s.d.)

Nutrients		Age (years)			
		≤49 n=34	50-59 n=55	≥60 n=35	Mean n=124
Energy	(kcal)	1242.6±427.9	1108.7±355.5	1260.9±392.7	1190.2±390.6
	(%RDA)	64.9	61.6	78.8	67.3
Protein	(g)	45.3±19.6	40.5±16.2	46.4±14.2	43.6±16.7
	(%RDA)	110.5	98.8	113.2	106.3
Ferum	(mg)	8.9±3.7	8.0±3.3	8.9±4.1	8.5±3.7
	(%RDA)	33.7	88.9	98.9	76.1
Calcium	(mg)	272.6±147.9	255.1±135.8	337.9±144.9	284.2±145.1
	(%RDA)	60.6	56.7	75.1	63.1
Vitamin A	(mg)	446.0±269.7	432.0±290.2	614.±886.4	489.3±539.2
	(%RDA)	59.5	57.6	81.9	65.1
Thiamin	(mg)	0.63±0.33	0.65±0.31	0.69±0.31	0.66±0.31
	(%RDA)	78.8	81.2	86.2	82.1
Riboflavin	(mg)	0.91±0.41	0.87±0.36	1.10±0.39	0.95±0.39
	(%RDA)	75.8	72.5	91.7	78.9
Niacin	(mg)	8.2±4.1	7.1±3.4	8.3±3.6	7.8±3.7
	(%RDA)	63.0	54.6	63.8	59.7
Vitamin C	(mg)	50.3±60.5	62.5±53.7	86.7±85.7	66.2±67.3
	(%RDA)	167.6	208.3	289	221.0

Table 5. Percent Malaysian RDA (%RDA) of energy and nutrient intake of subjects by gender and ethnicity

Nutrients	Male				Female			
	Malay n=34	Chinese n=38	Indian n=31	Mean n=103	Malay n=41	Chinese n=37	Indian n=46	Mean n=124
Energy	63.2	77.9	74.6	72.1	57.9	78.9	67.8	67.9
Protein(g)	96.8	114.1	101.7	104.7	91.4	116.2	112.2	106.5
Ferum(mg)	114.1	130.8	136.2	126.9	62.1	90.9	73.2	74.8
Calcium(mg)	61.5	72.9	83.9	72.5	52.3	65.7	70.6	63.1
Vitamin A(mg)	73.8	83.9	60.8	73.6	76.2	65.7	52.3	64.2
Thiamin(mg)	80.1	109.9	104.5	98.7	63.7	87.6	96.1	82.9
Riboflavin(mg)	73.3	78.9	101.2	83.8	65.1	77.9	92.7	79.2
Niacin(mg)	60.0	71.9	76.0	69.2	48.2	65.9	67.4	60.6
Vitamin C(mg)	224.8	330.2	177.5	249.5	196.2	300.9	178.6	220.9

Table 6. Macronutrient contribution to the total calorie by gender and ethnicity

	n	Carbohydrate (%)	Protein (%)	Fat (%)
Male				
Malay	35	57.7±8.1^{A}	14.7±2.9^{A}	27.7±7.4^{A}
Chinese	38	54.8±79^{A}	14.2±32^{A}	30.8±8.7^{B}
Indian	31	58.9±8.5^{A}	13.1±2.2^{A}	26.1±5.6^{A}
Mean	104	56.9±8.4	14.0±2.9	28.4±7.6
Female				
Malay	41	57.5±95^{A}	14.7±3.7^{A}	27.8±8.6^{A}
Chinese	39	53.0±9.5^{A}	14.4±3.0^{A}	32.9±7.5^{B}
Indian	47	59.8±8.7^{B}	14.9±3.2^{A}	25.3±73^{A}
Mean	127	56.9±9.2	14.7±3.3	28.4±8.4

For each gender, values in the same column with different superscripts are significantly different ($p < 0.05$)

DISCUSSION

The anthropometric data shows that more than 60% of our subjects who are Type 2 diabetics are either overweight or obese. Subjects of Malay origin were found to be having the highest mean BMI compared to the Chinese and Indian subjects. This result is similar to study conducted in Singapore (Thai *et al.*, 1990). Obesity is known to be a cause of insulin resistance (Bonadonna, Groop & Kraemer, 1990; DeFronzo, Bonadonna & Ferrannini, 1992). Insulin resistance will cause hyperinsulinemia and impaired glucose tolerance, eventually causing Type 2 diabetes (DeFronzo *et al.*, 1992). Weight reduction of 5 to 9 kg without achieving the optimum weight will be able to control one's diabetic condition (ADA, 2001b). The United Kingdom Prospective Diabetes Study (UKPDS, 1998) on Type 2 diabetes patients found that the level of blood glucose was greatly improved in those who achieved weight reduction. Therefore, it is crucial for this

group of subjects to have their weight reduced by methods such as dietary control and physical exercise. Health education should be targeted on these aspects.

The dietary survey from the 24-hour dietary recall shows that the distribution of calories for the macronutrients (carbohydrate, protein and fat) was consistent with the recommendations of the Malaysian Diabetes Association for a healthy diet for diabetics as well as a healthy population. Similar findings were observed in local studies on diabetics in various settings (Norimah & Abu Bakar, 1993; Ruzita, 1998 and Zalifah, 1999). A comparison among ethnic groups, revealed that the Chinese subjects had a higher fat intake. This could be due to their lower intake of carbohydrate foods which indirectly increased foods with higher fat content although this difference was only significant among the female patients.

Although the mean energy intake of the study population only achieved about 72% RDA, the majority of them were either overweight or obese. This discrepancy between the mean energy intake and their nutritional status (BMI) could be due to the limitations of the 24 hour dietary recall method of dietary intake assessment, such as (a) underestimation from either the subjects or the interviewer; (b) the subjects did not give a true picture of their daily intake or social desirability response bias; and (c) daily variation of subjects' diet. Other possible reasons could be (a) subjects are on diet control or (b) RDA Malaysia (Teoh, 1975) for energy intake was too high for this study population. A more accurate and thorough investigation needs to be carried out among the diabetic population since low energy intake in the long term will give rise to inadequate intake of vitamins and minerals.

When nutrient intake was compared among ethnic groups, the Indian subjects seemed to have a higher calcium intake compared with their counterparts. This could be associated with their dietary habit of taking milk and dairy products regularly. Adequate calcium intake is important especially for post menopausal women who were without hormonal protection (estrogen) which is crucial for bone health and bone density (Kolsky, 1999). Recent studies have shown that regular intake of milk and milk products could improve the bone density of middle aged and elderly women (Hu *et al.*, 1993; Lau, 2000). Therefore, Malay and Chinese subjects who did not consume adequate calcium in their diet should start taking milk regularly or take other foods that are high in calcium.

The low iron intake (33.7%) among the menstruating women (aged less than 49 years old) is a cause for concern since this will pose higher risks for those pregnant or lactating women who need more iron for their fetus or nursing babies. Iron deficiency anemia is a risk factor for maternal morbidity and mortality, fetal morbidity and mortality and intrauterine growth retardation (WHO, 2000). For the non-pregnant or non-lactating women, their work capacity will reduce and resistance to fatigue will also decrease. Therefore, they should be educated on the importance of having sufficient iron in their diet, the sources of iron- rich foods as well as the reasons for higher iron intake.

Vitamin C intake of both male and female subjects was found to be more than 200% RDA. Subjects of all ethnic groups also had adequate vitamin C intake. This high intake of vitamin C in their diet might be overestimated since some of the vitamin C in fruits and vegetables might be oxidized during the process of cutting and cooking. According to the American Dietetics

Association (1999), high vitamin C intake from food alone will not cause toxicity. Toxicity only occurs if the daily vitamin C intake exceeds RDA by 25 to 50 times.

CONCLUSIONS

More than half of the subjects were in the overweight/obese categories. The dietary results showed that the male subjects had sufficient intake of all nutrients while the female subjects did not have sufficient intake of calcium, vitamin A and niacin. Energy and nutrient intake among age groups did not show a consistent pattern while comparison among ethnic groups presented some patterns. Malay subjects were found to have lower energy and lower nutrient intake (except vitamin A and vitamin C) compared to the Chinese and Indians.

Given the importance of dietary management and the scarcity of dietary intake data on patients with type 2 diabetes, this paper contributes to the knowledge on anthropometric status of these patients' and how well current dietary recommendations are being followed. Future studies should be designed to determine some of the behavioral and food selection factors that may contribute to the overweight and obesity status of the diabetic patients.

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