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Dietary patterns and risk factors of diabetes mellitus among urban indigenous women in Fiji

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The dietary patterns of indigenous Fijians are changing rapidly. Dietary relationships in regard to the prevalence of diabetes are poorly studied in Fiji. A survey was conducted to show the relationship of dietary patterns and other lifestyle factors for the development of diabetes among urban indigenous women in Fiji. A sample of 200 Fijian women aged 30–39 who agreed to participate were interviewed by the use of semiquantitative food frequency, 3 day-24 h recall study. Physical activity and ceremonial dietary customs were also taken into consideration. Anthropometry included measurements of height, weight, waist and hip. Total percentage bodyfat measurements and glycosuria tests were also conducted. The results showed high rates of obesity manifested in high percentage bodyfat, high body mass index (BMI) and high waist and hip ratio (WHR). The mean 24 h dietary intake exhibited a moderate intake of protein, high intake of fat and a low intake of carbohydrate. The carbohydrate reduction was a result from the decline in consumption of traditional staples. Consumption of cereals and related products favored the high intake of butter and margarine and also encouraged the use of cooking oil in frying varieties of flour products. The daily intake of anti-oxidant vitamins of β-carotene and vitamin E were low, however there was a high intake of vitamin C. The food frequency study revealed cassava, bread and sugar were consumed daily as the main carbohydrate foods. Fish and meat were the most frequently consumed protein foods. The main beverage was sweet tea with whole-cream milk. Butter, margarine, coconut cream, cheap lamb flaps and cooking oil provided the main sources of fat. Levels of physical activity included high sedentary lifestyles with a high rate of subjects being overweight and obese. Ceremonial dietary customs showed a high consumption of meat and fish. Fruits were rarely consumed. Glycosuria existed among the age group under study. The impact of dietary transition, coupled with dietary excesses and physical inactivity, seem to be potential risk factors of diabetes among the indigenous women in the urban area.

Key words: diabetes mellitus type 2, diabetes risk factors, dietary patterns, Fijian women, glycosuria.

Introduction

Fiji is a multiethnic nation, exposed to an abundance of exotic and imported foods to meet the demands of its citizens and to accommodate tourists who visit. A decrease in consumption of traditional foods and a over consumption of imported foods, coupled with poor nutritional knowledge and inactivity, have resulted in the dramatic increase in the incidence of nutrition-related disorders among the indigenous population.[1–3]

The prevalence of diabetes is almost reaching an epidemic level in Fiji, as 10–12% of the adult population suffer from the disease.[4] In the past centuries, the Fijian culture recognized 'being fat' as a sign of prosperity and it conferred certain prestige. However, as a result of the increase in the incidence of non-communicable or nutritional-related disorders, this attitude needs to be critically reviewed.

Communal gatherings, feasting and customary obligations are postulated to encourage people to overeat, when there is an abundance of food to choose from. Overeating during traditional practices, coupled with inactivity, favour a positive energy balance.

Diets and lifestyle of the indigenous Fijians have undergone great changes and the result of this is the escalation of nutritional disorders such as diabetes. Examining the relationship between dietary patterns and the diabetes incidence is quite complex and therefore few studies have been carried out in Fiji.[1–4]

This study examines and analyzes relationships between dietary patterns and the potential diabetes risk factors among urban indigenous Fijian women.

Methodology

The survey, which was conducted in 1996, targeted the population residing in the 'Suva–Nausori' corridor. This urban to peri-urban area is comprised of the largest congregation of population in Fiji. The study was randomly conducted using questionnaires administered to 200 Fijian women aged 30–39 who voluntarily agreed to participate. The interview included a triple 24 h recall, semiquantitative food frequency,

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24 h activity and ceremonial eating habits. Anthropometric and impedance measurements of height, weight and percentage bodyfat were taken by the use of a portable Tanita TBF-511, Body Fat Analyser (Tanita, Tokyo, Japan). Waist and hip ratios were measured by the use of a rotary measure (Butterfly, Shanghai, China). The body mass index (BMI) was calculated and compared with the World Health Organization (WHO) and the University of the South Pacific (USP) standards.[4] The waist and hip ratio (WHR) was also calculated and compared with the WHO standard. Glucose urine Testape (Yeongdong Pharmaceutical, Seoul, Korea) was used to identify the presence of glucose in the urine. The 24 h recall was calculated using the Diet 1 database prior to statistical analysis by SPSS Windows version 7.0 statistical package.[5]

Results

Anthropometry, impedance and glycosuria

Anthropometric and impedance measurements are shown in Table 1.

Detailed categorization showed that 63% of the respondents had ≥ 30 BMI. A total of 79% overweight and obese cases were identified. The mean BMI in this study was 31 compared to 28 for the years 1980[4,6] and 1993[4], respectively. The BMI proportions of combined overweight and obese cases in the urban female population of 1993 and this study showed 47.4%[4] and 79%, respectively.

Central obesity and fat distribution showed that 77% of the respondents had a WHR ≥ 0.80 and 93.5% had ≥ 30% bodyfat. A total of 96.5% of the respondents were either overweight or obese by this measurement. Anthropometric and impedance results revealed a high prevalence of obesity among Fijian urban women. The glycosuria test resulted in 8% of positive cases.

Respondents with positive glycosuria subjects had an average BMI of 34 ± 4, % bodyfat of 50 ± 8 and WHR of 0.89 ± 0.05 (data not shown).

24 h recall

Energy. Table 2 shows the mean nutritional intake of the 3 day-24 h dietary recall. The percentage of energy from the protein, fat and carbohydrate (PFC) showed that 59.5% of

Table 1. Glycosuria, percentage bodyfat and anthropometry (n = 200)

Variables	Mean ± SD	Cut-off points	Percentage
Glycosuria		–	92
		+	8
Percentage bodyfat	44.74 ± 0.7	≤ 27	3.5
		28–29	3
		≥ 30	93.5
BMI	31.34 ± 5.8	20–26*	21
		27–29*	16
		≥ 30*	63
		20–26†	21
		27–32†	32
		≥ 32†	47
WHR	0.85 ± 0.1	< 0.80	23
		≥ 0.80	77

BMI, body mass index; WHR, waist-to-hip ratio; *WHO, World Health Organization Standards (FNFNC, 1995); †USP, The University of the South Pacific Standards (Fiji) (FNFNC, 1995).

Table 2. Mean 3 day–24 h dietary recall and percentage people with nutrient cut-off points (n = 200)

Nutrient	Mean ± SD intake	South Pacific RDA	Cut-off points	Subject (%)
Total energy (kcal)	2256 ± 574	2200	< 2200	47.5
	≥ 2200	52.5		
Protein (%)	15.7 ± 4.0	15	< 15	40.5
	≥ 15	59.5		
Fat (%)	32.7 ± 7.0	25	< 25	12.5
	≥ 25	87.5		
Carbohydrate (%)	51.5 ± 8.7	60	< 60	83
	≥ 60	17		
Dietary fibre (g)	23.3 ± 69	40*	< 40	97.5
	≥ 40	2.5		
Cholesterol (mg)	293 ± 193	300*	< 300	61.5
	≥ 300	38.5		
β-Carotene (mg)	5434 ± 3593	25000	< 25000	100
	≥ 25000	0		
T/A Eq (mg)	1320 ± 1805	750	< 750	22
	≥ 750	78		
Vitamin C (mg)	160 ± 86	30	< 30	2
	≥ 30	98		
Vitamin E (mg)	8.7 ± 5.4	10	< 10	72
	≥ 10	28		
Fe (mg)	15.2 ± 6.2	12	< 12	30.5
	≥ 12	69.5		
Zn (mg)	11.3 ± 41	12	< 12	82.5
	≥ 12	17.5		

T/A Eq, Total Vitamin A Equivalent; RDA, recommended daily allowance; *World Health Organization RDA.
Fe, iron; Zn, zinc.

the respondents had ≥ 15% protein, 87.5% had ≥ 25% fat and 17% had ≥ 60% carbohydrate.

The percentage contribution of energy from PFC were 16, 33 and 51%, respectively, compared to the South Pacific recommended daily allowance (RDA) of 15, 25 and 60%, respectively.[5]

Dietary anti-oxidants. The dietary anti-oxidant intake (Table 2) of vitamin C, vitamin E and β-carotene levels show that β-carotene (5434 mg) and vitamin E (8.7 mg) were below their RDA and there was a high intake of vitamin C (160 mg).

Micronutrients and other important nutrients. About 30.5 and 82.5% of respondents had not been meeting the iron and zinc daily requirements, respectively, although, their mean intake was moderate.

Other important food components are cholesterol and fibre. The consumption pattern showed that 38.5% had ≥ 300 mg (RDA) of cholesterol, while dietary fibre consumption showed 97.5% had < 40 mg (RDA).

White bread, sugar and cassava were the two most frequently consumed sources of carbohydrate, the latter being the most dominantly consumed staple root crop. These data were consistent with the result reported by the NFNC and Lutubula.[4,7]

Food frequency (data not shown). The most frequently consumed carbohydrate foods were cassava (94%) and bread (81%) of the respondents consumed them. The daily intake was about 400 g of cassava and 90 g of bread per meal. Bread was the most frequently consumed cereal, which was mostly eaten for breakfast with butter and jam accompanied by hot sweet tea with full-cream milk. Additional carbohydrate foods consumed for breakfast were rice, biscuits and flour-based products such as pancakes, *topoi* (steam flour-based product mixed in coconut cream) and *roti* (also known as chappati).

The proportion of people who consumed rice, biscuits and flour-based products twice a week were 70.5, 47.5 and 64%, respectively. When rice is eaten for breakfast, it is usually cooked in coconut cream. This tends to increase the calorie level of rice and hence the total breakfast calories. Additionally, the frequent use of flour-based products had favored the frequent use of cooking oil in frying varieties of breakfast foods such as pancakes, *roti* and *babakau* (a type of deep-fried pancake made of flour with yeast).

Sweet tea was the most frequent beverage and drunk three times a day, which contained about 18 g of sucrose per cup of tea (200 mL/cup). Likewise, daily consumption of jam spread on bread accounted for the modal sugar intake of 20 g per meal. An additional source of sugar that was eaten frequently in large quantities was sweet pie.

The most frequently consumed protein foods were fish and meat, whereby 93.5% of respondents had fish and 79.5% consumed meat at least twice a week. The most frequently consumed meat was cheap lamb cuts imported from New Zealand. Additional protein sources were canned fish and eggs.

The main sources of fat intake were observed to be butter, cooking oil, coconut cream, lamb chops and whole-cream milk. Milk was commonly taken with tea. Whole-cream milk was more frequently taken compared to low-fat and skim milk, and about 75% of respondents had milk in their tea. Butter was more popular than margarine. Coconut cream was consumed at least twice a week by 80% of the respondents. The use of cooking oil to fry food twice a week increased the calorie intake.

Table 3. Lifestyle activity (24 h activity) (n = 200)

Activity	Hour categories	Subject percentage	Mean ± SD No. of hours
Standing	< 5	49	
	5–8	44	5.0 ± 2
	≥ 9	7	
Sitting	< 7	42	
	7–10	46	7.2 ± 3
	≥ 11	12	
Walking	≤ 3	61.5	
	4–6	32	3.3 ± 2
	≥ 7	6.5	
Sleeping/lying	< 8	34	
	8–10	54.5	8.3 ± 2
	≥ 11	11.5	
Brisk walk	No	91.5	0.1 ± 0.3
	Yes	8.5	
Sports/aerobics	No	93.5	0.1 ± 0.2
	Yes	6.5	

The main sources of dietary anti-oxidants were vitamin C and β-carotene and are found in fruits and vegetables. However, fruits were consumed only once a week by 56.5% of the respondents, with the modal intake of 110 g per meal. Although vegetables were consumed only 2–3 times per week with the modal intake of 150 g in a meal, cooking in coconut cream raised the calorie value and boiling simultaneously destroyed most of these important anti-oxidants.

Physical activity. The level of lifestyle activities in this study (Table 3) shows that a majority of the respondents had low levels of activity, that is, more sitting and sleeping/lying than standing. More than 46% of the respondents had a 7–10 h sitting period and 54.5% had 8–10 h sleeping/lying within a 24-h period. About 61.5% walked ≤ 3 h. Organized exercise or sports was rarely practiced.

Ceremonial dietary customs. This study shows that 63% (data not shown) of the respondents attended communal functions which involved food consumption, of which 43% (data not shown) attended ceremonies four times a month and 26.5% attended twice a month.

Table 4 reveals that the most frequently consumed protein foods during ceremonies were meat and fish. About 61% of the respondents consumed more than 200 g of meat and 39.5% had more than 200 g of fish in a ceremonial meal. The most common cooking method used for meat and fish was frying and then re-cooking in coconut cream.

The main carbohydrate foods eaten were traditional root crops, about 79.5% of the respondents ate more than 300 g in a ceremonial meal. The main method of preparation was traditional steaming in hot stones (*lovo*). It seems that only during ceremonial feasting are prestigious staples, such as taro, are consumed. Fresh fruits were rarely included in a ceremonial feast. About 48.5% of the respondents ate more than 100 g of vegetables, which was usually cooked in

Table 4. Ceremonial dietary customs (n = 200)

Food item	Intake (mL or g)	Subject percentage	Median (g)	Mode (g)	Mean ± SD (g)	Cooking method	Subject percentage
Meat			300	300	300.4 ± 381.4	*Lovo*	30.3
	< 75	17.5				Boil/soup	25.2
	75–200	21.5				Roast	6.5
	201–300	34.5				Fry	38
Fish			200	200	207.0 ± 139.9	Others	0.6
	< 75	15				Raw	4.5
	75–200	45.5				*Lovo*	2.6
	201–300	30.5				Boil	9.7
	> 300	9				Roast	0.6
						Coconut cream	64.3
						Fry	7.7
						Fry and coconut cream	10
Shellfish			0	0	10.6 ± 41.0	Others	22.7
	0	91.5				Raw	50
	20–60	2.5				Boil	9.1
	100–200	6				Coconut cream	13.6
						Fry	4.5
Root crops			400	400	382.0 ± 171.2	Others	0.5
	< 300	20.5				*Lovo*	57.9
	301–400	54				Boil	41.6
	> 400	25.5					
Rice			0	0	31.8 ± 5.1	Boil	71.4
	0	96.5				Coconut cream	28.6
	150	2					
	> 160	1.5					
Fruit			0	0	49.7 ± 95.1	Raw	100
	0	67.5					
	≤ 100	8					
	101–200	19.5					
	≥ 200	5					
Vegetables			100	100	108.0 ± 104	Raw	10.8
	0	33				Boil	0.8
	≤100	18.5				Coconut cream	86.9
	101–200	41				Fry	1.5
	≥ 200	7.5					
Dessert			0	0	62.0 ± 106	Ice cream	48.3
	0	65.7				Vakalolo*	5.2
	≤ 100	2.5				Vakasoso†	5.2
	101–200	23.2				Custard	1.7
	≥ 200	8.6				Pie	1.7
						Pudding	1.7
						Trifle	1.7
						Fruit salad	34.5

*Traditional dessert made of pounded staple crops and sweet caramelized coconut cream. †Traditional dessert of ripe plantain cooked with coconut flesh.

coconut cream. The most frequently consumed desserts during ceremonies were ice cream (48.3%) and canned fruit salad (34.5%).

Discussion

This study reveals a high prevalence of overweight and obesity among the indigenous women in the urban area. This indicates a lack of nutritional status awareness and understanding among the indigenous community. It also implies that the majority of people still accept the notion 'big is beautiful', which still emphasizes hierarchy and status in Fijian society.

The WHR circumference is an important predictor of potential health hazards.[8] A ratio of ≥ 0.80 for women reflects central obesity or android.[9] The high rate of central obesity (77%) with 93.5% of respondents carrying excess bodyfat with mean percentage bodyfat of 45% and 8% positive glycosuria cases pose a higher risk towards diabetes. It is likely that in the next 10 years, a significant number of these respondents will start to develop complications of obesity if they do not improve their eating patterns and lifestyle activities. Excess fat in the abdominal area with apple-shaped obesity carry a greater risk of chronic diseases,

especially diabetes mellitus type 2. Too much bodyfat also may promote insulin resistance.[10]

The 24 h dietary recall reveals a low contribution of total energy from carbohydrates with a high contribution of fat. High energy intake of fat in diet, especially saturated fat, has been widely documented to be associated with the risk of non-communicable diseases.[11–13] It seems that the low energy intake from carbohydrate (51%) had been supplanted by a high-energy intake from fat (33%) compared to 1980 calorie value of 1910kcal with the PFC ratios of 12, 20 and 68%, respectively, of the urban Fijian women.[6] This shows a marked increase in energy intake of fat by 13% and marked decrease in carbohydrate energy intake by 17%. This concurrent radical change may be because of the decline in consumption of nutritious traditional staple crops and the increase in consumption of refined cereal products. Consumption of refined cereals and cereal products require the frequent use of butter and cooking oil, hence exacerbating the intake of fat.

A high consumption of dietary anti-oxidants has been documented to be protective against free radical formation which results in less tissue and cell damage.[14–17] Vitamin C, vitamin E and β-carotene are considered to be important in maintaining health and disease prevention and acting as radical-scavenging defense system.[18,19] Eating varieties of different kinds of food in a meal to obtain optimum levels of nutrients and anti-oxidants would be an advantage in protecting our body from tissue damage. In this study, β-carotene and vitamin E intake was much lower than their RDA, which leads to concern of the higher risk of tissue damage from free radicals and thus a higher risk of developing diseases.

Micronutrients are important for the normal body functions but are only required in a certain quantity. Too much or too little may be deleterious to health. Proportions of iron and zinc are important because excess amount promote autoxidation and Fenton reaction.[20] A deficiency contributes to the development of anaemia and other related disorders, respectively.

The low intake of fibre indicates that few people were consuming complex carbohydrates such as root crops, which are high in fibre. However, more people were consuming refined carbohydrates. This could be evidence of a dietary transition and deviation from the traditional eating pattern to a more western style. To achieve the same satiety associated with traditional foods, one has to consume large quantities of low-fibre processed foods. In this respect, it is likely that the rapid radical change in the dietary pattern has not been accompanied by an adjustment in the 'change in human biology'.[12]

The food frequency shows that the major sources of fat were butter, margarine, whole-cream milk, cooking oil, coconut cream and cheap cuts of lamb. Lamb flaps sold in Fiji is one of the lowest meat grade, and its frequent consumption may be because of its affordability, especially with the low-income earners.

Modernization of society is believed to contribute to the prevalence of obesity mainly as a result of mechanization. As societies become wealthier, machinery at home and at work, as well as modern transport have taken over most of the energy-demanding activities. This results in sedentary lifestyles and inactivity. Physical activity has profound effects on insulin sensitivity.[21] Leading an inactive, sedentary lifestyle, accompanied by consumption of a high-calorie diet contributes to obesity and greater susceptibility to diabetes. This study reveals that a lot of women spend more time resting and sleeping (8–10 h) without participating in any kind of sporting activities. High sedentary lifestyle among urban women was also reported by the FNFNC.[4]

There is apparently a genetic predisposition to obesity, however, it may be difficult to demonstrate this heredity nature.[22] Sharing a similar cultural and genetic background and common family food habits tend to complicate the issue, as families usually eat at the same table with common food habits. This study reveals the poor nutritional status awareness in the community, which was supported by the diagnosis of 63% obese cases, while only 7% identified themselves as obese. Perhaps an urgent action in educating the public on nutritional status awareness is warranted, especially when people are misled by the preconceived value of obesity as a symbol of 'high social status and prosperity'.

Overeating has been shown to occur when people are given free access to high variability of palatable foods.[23] This may be very true to the Fijian society. When low income families especially look for opportunities to eat 'good food', the best functions to attend are communal feasts where individuals consume in excess. Dietary excess in times of plenty promotes fat storage, which may also provide survival advantage in times of hardship.

Communal gathering, feasting, merry-making and customary obligations tend to exacerbate the prevalence of obesity by exposing people to over-indulge with food. It has been a norm and a practice to prepare an abundance of food or more than what is required. This way, hosts do not lose face and gain status in society. Guests who attend such ceremonies are expected to overeat to show appreciation of how much the host has prepared. The success of such communal gatherings is usually measured by the amount of 'left over' foods. Sunday is usually regarded as 'the feasting day'. Meals prepared on the day are usually extravagant and people tend to consume them excessively. It is usually a practice to have a complete rest and sleep throughout the afternoon after a big lunch on Sunday.

Conclusion

Dietary transition coupled with inactivity, traditional dietary practices on Sundays, communal feasting and dietary excess appear to have contributed to the high prevalence rate of obesity of the urban indigenous female population.

A typical diet based on white bread with butter and tea with sugar, as common breakfast and lunch foods may be adequate in providing basic energy needs. Unfortunately, it does not make a nutritionally well-balanced diet with respect to other nutrients such as proteins, vitamins and minerals which are essential to the body.

In Fiji, the availability of various essential foods is in abundance. However, failure to select a wider variety and to use them moderately seems to be the major nutritional problem. Food practices may be expected to change depending on income level and preferences of individuals or families. However, ignorance of nutritional concepts and food combinations seem prominent. Perhaps, effective nutrition

educational programs would help in the rapid widespread improvement of the nutritional status of the Fijian population.

If Fiji is to avoid or to at least reduce nutritional disorders, it should first conquer the battle of calorific excess and obesity. Three public-health strategies are suggested. These include that the Government should formulate a standard food composition table or database, based on the Fiji's food analysis to enable individuals, families, public, restaurant owners and food industries to refer to as a guide for nutritional adequacy. Once this is established, all food outlets; restaurants, schools or companies that are involved in the feeding or selling of food should prepare total energy values per serving, otherwise licenses should not be issued. If this is successfully put into practice, it would be one of the most effective ways the public could be made aware of their total calorie intake. This would at the same time boost the nutritional knowledge and nutritional status awareness to everyone in the society. For a concrete action to be implemented, training of appropriate personnel is necessary.

'Food and Nutrition' should be taught as one of the compulsory subjects in schools at all levels to both sexes. It should begin at the primary school level and more emphasis at the junior and high school levels. In this particular case, formulation of curriculum that would be relevant to the local situation is very important. Perhaps, publication of local resource materials and in the vernacular is warranted.

Workable intervention strategies or programs aimed at reducing obesity and increasing physical activity to the target and vulnerable groups should be promoted. This would practically avoid or at least reduce the possibility of obese subjects to suffer from the complications of obesity in the future.

If the problem of calorific excess and obesity cannot be rectified at this stage, it will be a major burden to the government in terms of increase in health expenses, a reduction in work capacity of the population and thus lowering the country's productivity.

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