Original Article

Evaluation of nutritional status among a group of young Chinese adults in Kuala Lumpur, Malaysia

Norimah Karim PhD and SW Leong BSc

Department of Nutrition and Dietetics, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

A nutritional status study was carried out among a group of young Chinese adults, aged between 19 and 25, in Kuala Lumpur, Malaysia. Subjects comprised 108 young adults (55 women, 53 men) who were students at two institutes of higher learning. Physical characteristics were evaluated by anthropometric measurements while food intake was determined with a 3-day food record. Blood cholesterol and triglyceride were assessed using the Reflotron analyser. Birthweight was obtained from birth certificates or by proxy. The results showed that the mean body mass index (BMI) for men and women was 21.4 ± 3.3 and 20.0 ± 2.0, respectively, indicating normal weight. Further analysis of BMI classification demonstrated that 28% of men and 39% of women were underweight, 11% of men and 2% of women were overweight while 2% of men were obese. Mean waist-to-hip ratio showed that the subjects had a low risk of developing cardiovascular disease (0.72 ± 0.03 women; 0.81 ± 0.05 men). Mean energy intake was 8841 ± 1756 kJ per day for men and 6426 ± 1567 kJ per day for women. Closer analysis of energy intake of the subjects showed that 86% of men and 91% of women were consuming below the Malaysian recommendation for energy. Nutrients found to be deficient in at least one third of women were calcium, vitamin A, niacin and iron. Mean cholesterol intake in the diet was 278.7 ± 108.7 mg in men and 207.0 ± 82.5 mg in women and there was a significant difference between genders. Blood cholesterol and triglyceride levels were 3.88 ± 0.76 mmol/L and 1.08 ± 0.33 mmol/L, respectively in men, while these levels were lower in women, 3.87 ± 0.80 mmol/L for cholesterol and 0.99 ± 0.29 mmol/L for triglyceride. A general trend of higher mean blood cholesterol and triglyceride levels was shown in adults who were born with lower birthweights.

Key words: body mass index, nutritional status, young Chinese adults in Malaysia.

Introduction

Malaysia is a country with a multi-ethnic population. The population comprises three main ethnic groups, namely Malay, Chinese and Indian. Research on the nutritional status of various age groups have been largely carried out among the Malay communities. Most nutritional status studies in the last 5 years have focused on various age groups in the rural communities, ranging from preschoolers, primary schoolers and the elderly.[1,2,3] Studies on the nutritional status of young adults, specifically university students, were carried out in the late 1980s through to the early 1990s, again focusing on the Malay ethnic group.[4–6]

Due to the scarcity of nutritional status studies among the Chinese community, the present study on young Chinese adults was carried with two objectives. The first objective of the study was to determine the nutritional status among these young Chinese adults. The second objective was to explore the relationship between birthweight of these adults and their biochemical parameters such as blood cholesterol and triglyceride during adulthood. In the United Kingdom, Barker *et al*.[7] demonstrated a relationship between foetal growth and adult disease. It was suggested that size at birth might have profound and long-term consequences for human health. Some studies have reported that low birthweight babies had a higher tendency to develop diabetes, hypertension and cardiovascular disease as adults.[8–10] Cardiovascular risk factors such as increased blood pressure, hypertriglyceridaemia, increased BMI and waist-to-hip ratio (WHR) as well as decreased high density lipoprotein were found to be associated with low birthweight.[11,12]

Materials and methods

Subjects

Subjects consisted of young adults, who were defined as adults between the ages of 18–30 years old.[13] A briefing regarding the objective of the research was carried out at two campuses, namely Systematic College and Universiti Kebangsaan Malaysia, both in Kuala Lumpur, before the project started. A group of young Chinese adults consisting of 55 men and 53 women volunteered to participate in this study. Subjects were students attending these two institutions of higher learning. The age of these subjects ranged between 19 and 25 years, with a mean age of 22 years.

Anthropometric measurements

The anthropometric measurements carried out were weight, height, waist circumference and hip circumference. Subjects were weighed in light clothing without shoes using a Seca balance (Model 713, Seca; Hamburg, Germany) to nearest

Correspondence address: Norimah A Karim, Department of Nutrition and Dietetics, Faculty of Allied Health Sciences, Universiti Kebangsaan Malaysia, 50300 Kuala Lumpur, Malaysia.
Tel: 60 3 4405247; Fax: 60 3 2947621
Email: nak@medic.ukm.my
Accepted 20 December 1999

0.1 kg. Height was measured to the nearest 0.1 cm using the Seca balance with a height attachment. Body mass index (weight/height^2) was calculated for each subject. In this study, BMI cut-off points used to classify subjects as underweight, normal weight, overweight and obese were: < 18.5, 18.5–24.9, 25.0–29.9 and ≥ 30, respectively.[14] Waist and hip circumference was measured with a flexible tape. The waist circumference was measured between the costal margin and iliac crest, while the hip circumference was measured at the widest part of the hip. Waist-to-hip ratio was also calculated for each subject. Men with a WHR greater than 0.95 and women with a WHR greater than 0.85 indicates an increased risk of developing cardiovascular disease.[15]

Food intake evaluation

Subjects were given a food diary to record all foods and drinks consumed for 3 days (2 week days and 1 week-end day). Subjects were given a briefing on how to record their food intake. They were requested to estimate the foods they consumed based on household measurement such as cups, plates, tablespoons, etc. The energy and selected nutrient content of the food intake was calculated using a computer package based on the Malaysian Food Composition Table.[16] The cholesterol content was calculated based on the new edition of the Malaysian Food Composition Table.[17] The energy and nutrient intake were compared with the Malaysian recommended dietary allowance for adequacy.[18]

Cholesterol and triglyceride assessment

Blood cholesterol and triglyceride measurements were carried out after the food intake assessment. Subjects were requested to fast overnight before a blood sample from a finger prick was taken first thing in the morning before breakfast. Blood was drawn (32 μL) using a heparinized capillary tube. The blood samples were dropped onto test strips for cholesterol and triglyceride and analysed immediately with the Reflotron analyser (Boehringer; Mannheim, Germany).

Birthweight data

Birthweight data of the subjects were obtained from those birth certificates on which it was recorded. For subjects whose birthweight was not recorded on the birth certificate, the birthweight was provided from a proxy, usually their mothers.

Statistical analysis

Results were presented as mean ± standard deviation. The paired *t*-test was used to evaluate differences between gender for anthropometric, food intake, blood cholesterol and blood triglyceride measurements. Correlation analysis was carried out to determine the relationship between blood parameters and birthweight. A difference of $P < 0.05$ was accepted as significant.

Results and discussion

The anthropometric measurements of the subjects are described in Table 1. The mean age of men and women was 21.9 ± 1.7 years and 21.8 ± 1.5 years, respectively. The mean weight and mean height of the men was significantly higher than that of the women. The mean BMI measurements for men (21.4 ± 3.3) and women (20.0 ± 2.0) were within the desirable weight range. Mean WHR was 0.81 ± 0.05 for men and 0.72 ± 0.03 for women. There was a significant difference between gender for BMI and WHR. The distribution of subjects according to BMI classification is shown in Table 2.

Anthropometric parameters measured such as BMI and WHR index indicated that the majority of subjects had normal weight and a low risk of developing heart disease. Based on BMI classification, 28% of men and 39% of women were classified as underweight. However, 11% of men and 2% of women were categorized as overweight while 2% of men were obese. An earlier study carried out among young Chinese adults showed a higher prevalence of underweight (43% among men and 60% among women), however, there was zero prevalence of overweight and obesity.[19] An increasing prevalence of obesity was reported by Ismail *et al*.[20] who studied adults between the ages 18–60 years from the three main ethnic groups in Malaysia, that is Malay, Chinese and Indian. This could suggest that the Malaysian community is moving towards a nutritional trend whereby there is an increase in BMI. However in this study, subjects were students and in the younger age group (19–25 year olds). Underweight was more an apparent problem than overweight. Another study by Ismail[21] showed similar findings, whereby underweight subjects in his study also consisted mainly of university students between 20 and 24 years old.

Table 3 shows the energy and nutrient intakes of subjects according to gender. There is a significant difference in energy and all the nutrients between men and women. The mean cholesterol intake of both men (278 ± 109 mg) and women (207 ± mg) were within the acceptable level of intake of 300 mg per day.[22] Comparison of energy and selected nutrient intake with the Malaysian RDA are shown in Table 4 for men and Table 5 for women. 86% men and 91% women did not meet the recommended energy intake. Nutrients which were deficient in at least a third of women were calcium, iron, vitamin A and niacin. About 10% men and women were lacking in their intake of thiamin and riboflavin.

The results from the food intake assessment showed that generally food consumption in men was better than in women, whereby the intake of most nutrients in men met the recommended daily allowance compared with the women. Mean intake of energy for men and women were 8841 ± 1756 kJ and 6426 ± 1567 kJ, respectively, which were lower than the recommended energy intake for Malaysia. These energy intakes were comparable with other studies among young adults.[5,6,23] The inadequate energy intake among Malaysian young adults should be of concern as low energy intake in the diet could cause poor intake of other essential nutrients in the diet.

This study was not the first study to show inadequate intake of energy in both men and women and insufficient iron and calcium, especially in women. Inadequate iron and calcium intake were also demonstrated by studies among university students and adults,[5,23,24] adolescents[25] and the elderly.[3] A possible reason for the inadequate intake of these nutrients was due to the poor consumption of foods which were rich sources of these nutrients. Furthermore, the energy intake of most subjects did not meet the suggested requirement, indicating poor intake of foods in general. The low energy intake of subjects in the study could be contributed to by the habit of not consuming three main meals per day. A

Table 1. Age and physical characteristics of subjects according to gender (mean ± SD)

Physical attributes	Men (n = 55)		Women (n = 53)	
Age (years)	21.9 ± 1.7	(19–25)	21.8 ± 1.5	(19–25)
Weight (kg)	62.4 ± 10.5	(44.0–91.1)	49.8 ± 5.74*	(38.4–65.0)
Height (m)	1.71 ± 0.06	(1.5 3 –1.86)	1.58 ± 0.04*	(1.4 + 1.7)
BMI (kg/m2)†	21.4 ± 3.3	(15.2–30.5)	20.0 ± 2.00‡	(16.3–25.8)
WHR	0.81 ± 0.05	(0.67–0.80)	0.72 ± 0.03*	(0.68–0.940)

BMI, body mass index; WHR, waist-to-hip ratio; *P < 0.01; †WHO, 1997[14]; ‡P < 0.05.

Table 2. Distribution of BMI classification according to gender[14]

Gender	Underweight*	Normal weight†	Overweight‡	Obese§
Men (n = 55)	15 (28%)	33 (59%)	6 (11%)	1 (2%)
Women (n = 53)	21 (39%)	31 (60%)	1 (2%)	0 (0%)

BMI, body mass index; *****underweight, BMI less than 18.5; †normal weight, BMI 18.5–24.9; ‡overweight, BMI 25–29.9; §Obese, BMI 30 and above.

Table 3. Energy and nutrient intake according to gender (mean ± SD)

Nutrient	Men (n = 55)	Women (n = 53)
Energy (kJ)	8841 ± 1756	6426 ± 1567 *
Protein (g)	88 ± 26	62 ± 17*
Fat (g)	64 ± 20	47 ± 18*
Carbohydrate (g)	296 ± 50	215 ± 48*
Calcium (mg)	440 ± 163	361 ± 115*
Iron (mg)	18.0 ± 6.9	14.1 ± 5.9*
Sodium (mg)	2670 ± 1051	1807 ± 900*
Potassium (mg)	1581 ± 584	1301 ± 458*
Vitamin A (μg)	913 ± 527	634 ± 263*
Thiamin (mg)	1.1 ± 0.4	0.88 ± 0.3*
Riboflavin (mg)	1.7 ± 0.6	1.2 ± 0.4*
Niacin (mg)	16.9 ± 6.2	11.9 ± 4.3*
Vitamin C (mg)	71 ± 42	100 ± 69*
Phosphorus (mg)	1026 ± 313	774 ± 230*
Cholesterol (mg)	278 ± 109	207 ± 83*

*Significant difference at P < 0.01.

Table 4. Percentage of subjects consuming below 2/3 RDA for nutrients in men (n = 55)

Nutrient	Mean intake	% RDA	% subject < 2/3 RDA
Energy (kJ)	8841 ± 1756	85	86 < RDA
Protein (g)	88 ± 26	165	0
Calcium (mg)	440 ± 163	98	11
Iron (mg)	18.0 ± 6.9	200	0
Vitamin A (μg)	913 ± 527	122	9
Thiamin (mg)	1.1 ± 0.4	110	16
Riboflavin (mg)	1.7 ± 0.6	113	11
Niacin (mg)	16.9 ± 6.2	101	16
Vitamin C (mg)	71 ± 42	236	5

RDA, recommended daily allowance.

fraction of the subjects did not take breakfast, citing lack of time as the main reason for skipping breakfast.

The results of blood cholesterol and triglyceride levels are described in Table 6. The mean blood cholesterol levels in men and women were 3.88 ± 0.76 mmol/L and 3.87 ± 0.95 mmol/L, respectively. The mean blood triglyceride level was higher in men (1.08 ± 0.33 mmol/L) than women (0.99 ± 0.29 mmol/L), although this difference is not significant. Comparison of these two blood parameters with the reference levels indicates that the mean blood triglyceride and mean blood cholesterol levels in both genders were within the normal range.

The mean cholesterol intake of the subjects was below 300 mg, thus meeting the recommended intake as suggested by the National Cholesterol Education in Program (NCEP).[22] However, 38% of men and 15% of women consumed more than 300 mg cholesterol per day. This higher intake of cholesterol in some of the subjects was due to the intake of moon cake, of which some varieties had duck eggs as one of the ingredients. Duck eggs, especially the yolk, have a high cholesterol content.[17] The food record collection data coincided with the moon cake festival, which is a festival celebrated by the Chinese community. Main sources of cholesterol in the diet of the subjects included eggs, pork, chicken, anchovies, fried noodles and *chao kway teow.* However the cholesterol level in the blood was found to be within the acceptable level recommended by NCEP.[22]

The cholesterol intake and blood cholesterol agreed well with those of Zawiah and Sitti.[19] However comparison of blood cholesterol between different community groups indicated that generally young adults exhibited a lower cholesterol level in the blood.[26–28] Only the Malaysian Aborigine demonstrated a lower blood cholesterol level than these young adults. This could be attributed to the different physical activity level, lifestyle and food habits of the Aborigine.

Table 5. Percentage of subjects consuming below 2/3 RDA for nutrients in women (n = 53)

Nutrient	Mean intake	% RDA	% subject < 2/3 RDA
Energy (kJ)	6426 ± 1567	76.6	91 < RDA
Protein (g)	62 ± 17	150	2
Calcium (mg)	316 ± 114	80	32
Iron (mg)	14.1 ± 5.9	50	83
Vitamin A (μg)	634 ± 263	85	38
Thiamin (mg)	0.88 ± 0.30	110	11
Riboflavin (mg)	1.2 ± 0.4	100	11
Niacin (mg)	11.9 ± 4.3	92	47
Vitamin C (mg)	100 ± 69	334	4

RDA, recommended daily allowance.

Table 6. Blood cholesterol and triglyceride levels according to gender (mean ± SD)

Parameter	Normal levels*	Men (n = 55)	Women (n = 53)
Cholesterol (mmol/L)	< 5.2	3.88 ± 0.76[a] (2.60–5.42)	3.87 ± 0.95[a] (2.59–5.73)
Triglyceride (mmol/L)	< 1.7	1.08 ± 0.33[b] (0.80–2.32)	± 0.29[b] (0.80–2.28)

a,b, Same letter on the same row signifies no significant difference at $P < 0.05$; *as recommended by the National Cholesterol Education Program (1988).[22]

Table 7. Blood cholesterol, triglyceride, BMI and WHR according to birthweight

Parameter	Birthweight (n = 79)		
	< 2.5 kg (n = 14)	2.5–3.5 kg (n = 55)	> 3.5 kg (n = 10)
Blood cholesterol (mmol/L)	3.90 ± 0.60	3.89 ± 0.80	3.61 ± 0.80
Blood triglyceride (mmol/L)	1.17 ± 0.30	1.09 ± 0.30	1.09 ± 0.30
BMI (kg/m^2)	20.7 ± 2.7	20.9 ± 3.3	20.1 ± 2.0
WHR	0.76 ± 0.05	0.77 ± 0.07	0.75 ± 0.04

BMI, body mass index; WHR, waist-to-hip ratio.

Table 8. Correlation between blood cholesterol, triglyceride, BMI and WHR with birthweight (n = 79)

Parameter	Variable	Correlation coefficient
Birthweight	Blood cholesterol	– 0.1142
	Blood triglyceride	– 0.0090
	BMI	– 0.1300
	WHR	0.0845

BMI, body mass index; WHR, waist-to-hip ratio.

Relationship between birthweight and blood cholesterol and triglyceride levels

Table 7 tabulates the mean cholesterol and triglyceride levels in blood according to birthweights. The general trend shows that adults who have a lower birthweight have higher blood cholesterol and triglyceride levels than those adults who have a heavier birthweight. This general trend is not observed with BMI and WHR. The correlation between birthweight and blood cholesterol, triglyceride, BMI and WHR are weak, that is, between –0.13–0.08 (Table 8).

This study also explored the relationship between birthweight and blood parameters, namely cholesterol and triglyceride, in these young adults. The results showed that blood cholesterol level, blood triglyceride level, BMI and WHR was negatively correlated with birthweight. The increase in birthweight was correlated with a decrease in blood cholesterol level, blood triglyceride level, BMR and WHR when the individual reached adulthood. The birthweight of the subjects were categorized into three weight categories; < 2.5 kg (low birthweight), 2.5–3.5 kg (normal birthweight), and > 3.5 kg (high birthweight). The mean blood cholesterol and triglyceride levels, BMR, and WHR decreased, though not significantly, as the birthweight category increased. Preliminary data from a similar study among young Malay adults showed similar results.[23] This relationship has been shown by a cohort study in United Kingdom.[9] Many other studies have indicated the relationship between lower birthweight and increased prevalence of diabetes and impaired glucose tolerance as the individuals reached adulthood.[29–31] For the present study no relationship was observed between birthweight and biochemical indicators such as blood cholesterol and triglyceride, probably due to the small sample size.

Studies investigating the relationship between birthweight and adult diseases such as hypertension, diabetes and cardiovascular diseases were a new area of research in Malaysia. This study attempted to collect birthweight data and relate this data to biochemical indicators such as blood cholesterol and triglyceride in adulthood. In Malaysia, birthweights were first recorded on birth certificate from the late 1970s. There was difficulty in determining the birthweight for most of our subjects. Only some of the birthweight data were obtained from birth certificates. For those subjects without reported birthweights on their birth certificates, a proxy (usually the subject's mother) was used to give the birthweight. This might question the reliability of the birth data. However, the birthweight from 73% of the subjects was obtained. The 73% represents all the birthweights collected, including by proxy.

Conclusion

In conclusion, this study reported that a majority of young adults were deficient in their energy intake, also shown by the high prevalence of underweight among men (28%) and women (39%). These adults were also lacking in calcium, iron, niacin and vitamin A, especially among women. Cholesterol intake was within the recommendation. Although this was a preliminary study attempting to explore the relationship between birthweight and adult diseases, the results demonstrated a trend whereby adults who were born with a lower birthweight had a tendency to show higher blood cholesterol and triglyceride levels. More studies are required to gather the birthweight data of adults and further investigate the relationship between birthweight and adult diseases.

References

1. Soon SD, Khor GL. Nutritional status of children 1–6 years at FELDA Sg. Koyan, Pahang, Malaysia. Mal J Nutr 1995; 1: 115–128.
2. Khor GL, Tee ES. Nutritional assessment of rural villages and estates in Peninsular Malaysia. II Nutritional status of children aged 18 years and below. Mal J Nutr 1997; 3: 21–48.
3. Suriah AH, Zainorni MJ, Shafawi S, Mimie Suraya S, Zarina N, Wan Zainudin WA, Zalifah MK. Nutritional intake among elderly in Southern Peninsular Malaysia. Mal J Nutr 1996; 2: 11–20.
4. Norimah AK, Rogayah MY. Nutritional knowledge and food intake of first year students. Proc Nutr Soc Malaysia 1990; 5: 79–84.

5. Wan NI, Norimah AK. Anthropometric and food intake of third year students at the Faculty of Life Sciences, Universiti Kebangsaan Malaysia. 6th Asian Congress of Nutrition Book of Abstracts. Kuala Lumpur, Malaysia, 1991; 331.
6. Mohd Riza AR. Nutritional status among Universiti Kebangsaan Malaysia students. (BSc Nutrition Thesis). Universiti Kebangsaan Malaysia, 1992.
7. Barker DJP, Osmond C, Golding J, Kuhl D, Wadsworth MEJ. Growth in utero, blood pressure in childhood and adult life and mortality from cardiovascular disease. Br Med J 1989; 298: 564–567.
8. Law CM, Gordon GS, Shiell AW, Barker DJP, Hales CN. Thinness at birth and glucose tolerance in seven year old children. Diab Med 1995; 12: 24–29.
9. Barker DJP, Hales CN, Fall CHD, Osmond C, Phipps K, Clark PMS. Type II (non-insulin dependent) diabetes mellitus, hypertension and hyperlipidemia (syndrome X): relation to reduced foetal growth. Diabetologia 1993; 36: 62–67.
10. Phillips DIW, Barker DJP, Hales CN, Hirst S, Osmond C. Thinness at birth and insulin resistance in adult life. Diabetologia 1994; 37: 150–154.
11. Law CM, Shiell AW. Is blood pressure inversely related to birth weight? The strength of evidence from a synthesis review of literative. J Hypertensive 1996; 14: 935–941.
12. Claunsen JO, Borch-Jonsen K, Pedersen OWF. Relationship between birth weight and insulin sensitivity index in a population sample of 331 young Caucasians. Am J Epid 1997; 146: 23–31.
13. Eschleman MM. Meeting nutritional needs during childhood through adolescence. In: Hilton DL, ed. Introductory nutrition and nutrition therapy. New York: Lippincott, 1996; 359–380.
14. WHO. Obesity: preventing and managing the global epidemic. Report of a WHO consultation on obesity. Geneva: WHO, 1997.
15. Jones PRM, Hunt MJ, Brown TP, Norgan NG. Waist-hip circumference ratio and its relation to age and overweight in British men. Human Nutr Clin Nutr 1986; 40C: 239–247.
16. Tee ES, Ismail MN, Mohd Nasir A, Khatijah I. Nutrient Composition of Malaysian Foods. ASEAN Food Habits Project. National Subcommittee on protein, food habits research and development in Malaysia. Kuala Lumpur: Institute for Medical research, 1988.
17. Tee ES, Ismail MN, Mohd Nasir A, Khatijah I. Nutrient composition of Malaysian foods, 4th edn. Kuala Lumpur: Malaysian Food Group Database Programme IMR, 1997.
18. Teoh ST. Recommended daily dietary intakes in Peninsular Malaysia. Med J Mal 1975; 30: 38–42.
19. Zawiah H, Sitti A. Cholesterol and triglyceride value in relation to body mass index and dietary intake. Kumpulan Kertas Kerja UKM (Group Working Paper) 1994; 27: 294–298.
20. Ismail MN, Zawiah H, Chee SS, Ng KK. Prevalence of obesity and chronic energy deficiency (CED) in adult Malaysians. Mal J Nutr 1995; 1: 1–10.
21. Ismail MN. Malnutrition and food consumption pattern in Malaysia. Internat J Fd Sc Nutr 1992; 43: 69–78.
22. NCEP. Expert Panel. Report of the National Cholesterol Education in Program Panel on detection, evaluation and treatment of high blood cholesterol in adults. Arch Intern Med 1988; 148: 36–69.
23. Mimi MB. A study on the relationship between nutritional status and glucose status among young Malay adults. (BSc Nutrition Thesis). Universiti Kebangsaan Malaysia, Malaysia, 1998.
24. Chee SS, Zawiah H, Ismail MN, Ng KK. Anthropometry, dietary patterns and nutrient intakes of Malaysian estate workers. Mal J Nutr 1995; 2: 112–128.
25. Poh BK, Zawiah H, Ismail MN, Henry CJK. Changes in body weight, dietary intake and activity pattern of adolescent during Ramadhan. Mal J Nutr 1996; 2: 1–10.
26. Chong YH, Tee ES, Ng TKW, Kandiah M, Hussein RH, Teo PH, Shahid SM. Status of community nutrition in poverty kampungs. IMR Buletin 22. Kuala Lumpur: Institute for Medical Research, 1986.
27. Ng TKW, Tee ES, Rosman A. Rural communities in nutrition transition: emergence of obesity, hypertension and hypercholesterolemia as a public health problems in three kampungs in Bagan Datok, Perak. Malaysia Mal J Nutr 1995; 1: 129–139.
28. Teo PH, Chong YH, Mohd Zaini AR. Coronary risk factors among Malaysian male executives in two urban areas. Proc Nutr Soc Mal 1988; 3: 24–31.
29. Hales CN, Barker DJP, Clark PMS, Cox LJ, Osmond C, Winter D. Fetal and infant growth and impaired glucose tolerance at age 64 years. Br Med J 1991; 303: 1019–1022.
30. Phipps K, Barker DJP, Hales CN, Fall CHD, Osmond C, Clark PMS. Fetal growth and impaired glucose tolerance in men and women. Diabetologia 1993; 36: 225–228.
31. Robinson S, Walton RJ, Clark PMS, Barker DJP, Hales CN, Osmond C. The relationship of fetal growth to plasma glucose in young men. Diabetologia 1992; 35: 444–446.