

Original Research Article

How different is the dietary pattern among individuals with metabolic syndrome?

ABSTRACT

Background: Metabolic syndrome has turned out to be a chief public health concern, but the role of diet in the etiology of metabolic syndrome is not well understood.

Aims: This study aimed at assessing whether individuals with metabolic syndrome had a specific dietary pattern and how it compared with the Recommended Nutrient Intakes for Malaysia and the Medical Nutrition Therapy Guidelines by the Malaysian Dietitians' Association.

Study design: Cross-sectional study

Place of study: Putrajaya, Malaysia

Duration of study: Eight weeks

Methodology: Waist circumference, systolic blood pressure, diastolic blood pressure, triglycerides, HDL cholesterol and fasting plasma glucose were collected in 659 randomly selected subjects. A total of 275 out of 322 subjects with metabolic syndrome completed the self-administered three-day food record. Data were analysed with NutritionistPro, and were compared with the Recommended Nutrient Intakes for Malaysia (2010), based on age and gender. Metabolic syndrome was defined according to the 'Harmonized' criteria.

Results: Subjects' mean age was 34.51 ± 8.30 years, 202 Females: 73 Males. Comparison of subjects' food records with the Recommended Nutrient Intakes for Malaysia revealed that protein consumption was significantly higher among study subjects compared to the Recommended Nutrient Intakes for Malaysia (62 g/day for

27 males; 55 g/day for females), $P < .001$. All subjects (100%) had low fibre (< 20 g/ day)
28 intake. Conversely, most subjects (72.0%) had high sodium intake (≥ 2400 mg/ day).

29 **Conclusion:** This study highlights the importance of assessing the dietary pattern of
30 each individual with metabolic syndrome. There is a discrepancy between the dietary
31 pattern among individuals with metabolic syndrome and the Recommended Nutrient
32 Intakes for Malaysia or Medical Nutrition Therapy Guidelines by the Malaysian
33 Dietitians' Association. Notwithstanding, our study cannot declare that diet induces the
34 disease, yet it definitely sheds more light on the need for appropriate and professional
35 dietary measures to be integrated in the management of individuals with metabolic
36 syndrome.

37 **Keywords:** metabolic syndrome, dietary pattern, medical nutrition therapy, Recommended
38 Nutrient Intakes

39 1 INTRODUCTION

40 Metabolic syndrome is a cluster of risk factors, including obesity, dyslipidemia, hypertension, glucose
41 intolerance and insulin resistance, that increases the risk for cardiovascular disease and type 2
42 diabetes mellitus [1-2]. A remarkable increase in the number of people with metabolic syndrome has
43 occurred worldwide [3]. A national survey conducted from January to December 2008 revealed that
44 the overall prevalence of metabolic syndrome was 32.1%, 34.3%, 37.1% and 42.5%, based on
45 definitions from the World Health Organisation, the National Cholesterol Education Program ATP III,
46 the International Diabetes Federation and 'Harmonized', respectively [4]. Identification of particular
47 foods and nutrients associated with metabolic syndrome is imperative for the formulation of dietary
48 recommendations [5]. Further, the combined effect of food and nutrients, which are consumed
49 together, may be synergistic. In this context, dietary pattern analysis, which concentrates on
50 macronutrients and their composition, may impart supplementary data to relate diet to disease risk.

51 Notwithstanding, previous studies have recognised dietary patterns and examined their association
52 with metabolic syndrome, but these studies were predominantly from Europe [6,7], Korea [8-11], the

53 Middle East [12-14], North America [15], Samoa [16], and the United States [17-18]. Dietary habits of
54 Asians, including Malaysians, are considerably different from those countries [19].

55 Despite the evident links to metabolic syndrome, little is known about the dietary patterns of
56 individuals with metabolic syndrome. Management for individuals with metabolic syndrome generally
57 includes diet modifications, albeit there is a lack of supporting evidence. Hence, the aim of this study,
58 conducted among government employees with metabolic syndrome, was to analyse their dietary
59 patterns and how they compared with the Recommended Nutrient Intakes for Malaysia [20] and the
60 Medical Nutrition Therapy Guidelines by the Malaysian Dietitians' Association [21].

61

62 **2 METHODOLOGY**

63 **2.1 Study procedure**

64 Subjects were requested to fill in a three-day food record, which was checked for completeness and,
65 where necessary, was clarified by asking the subjects questions. We also collected data that were
66 routinely obtained in a health examination, including anthropometric measures (waist circumference),
67 blood pressure measurement and biochemical data. This study conformed to the principles of the
68 Helsinki Declaration and was approved by the Ethics Committee of the Faculty of Medicine and
69 Health Sciences, Universiti Putra Malaysia (Reference No UPM/FPSK/100-9/2-MJKEtikaPen
70 (JPD_Jan (12) 04). Written informed consent was obtained from each subject. The flow chart of data
71 collection was demonstrated in Figure 1.

72

A total of 675 employees were randomly selected from 5 government agencies in Putrajaya, Malaysia



73
74
75
76
77
78
79

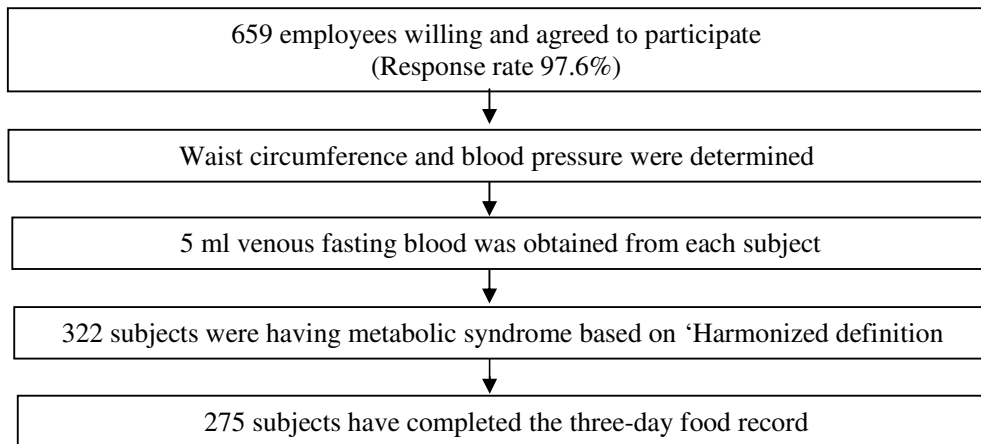


Figure 1 Flow chart of data collection

80
81

2.2 Study subjects

82 A total of 675 government employees were randomly selected from a list of 3173 government
83 employees at the five government agencies, using a Table of Random Numbers.

84 Of the 322 government employees with metabolic syndrome, 275 subjects (73 males and 202
85 females) aged 18 to 59 years completed the self-administered three-day food record.

86

2.3 Dietary assessment

87 Dietary intake data was obtained through use of a food record for three days (two consecutive
88 weekdays and one weekend day). Each subject was familiarised with portion sizes and the relevant
89 procedures for successfully completing a food record. The records were checked for any mis-
90 recorded or missing information when subjects returned the records.

91 To estimate compliance with respect to recording everything, a ratio between total daily energy intake
92 (EI) and basal metabolic rate (BMR) was calculated [22]. The basal metabolic rate was obtained from
93 the Lifecorder e-Step activity monitor (Suzuken Company Limited, Nagoya, Japan). A ratio of EI/BMR
94 below 1.2 was used as the cut-off point to identify non-compliance in recording [23].

95 **2.4 Anthropometric measurement**

96 Waist circumference was measured at the end of normal expiration between the lowest rib and the
97 iliac crest using a non-elastic measuring tape to the nearest 0.1 cm. Waist circumference was
98 categorised as 'normal' (< 90 cm for men and < 80 cm for women) and 'high risk' ($\geq$ 90 cm for men
99 and $\geq$ 80 cm for women) according to the cut-off points proposed by the 'Harmonized' definition [24].

100 **2.5 Blood pressure measurement**

101 Duplicate measurements of blood pressure (in mmHg) were measured two minutes apart with a
102 digital automated blood pressure monitor, Omron HEM-907 (Omron, Japan), after the subjects had
103 rested in a seated position for five minutes [25]. An average of the two readings was taken. The right
104 arm was placed on a table and a cuff was placed on the right upper arm. The mean value of the two
105 measurements was computed. Elevated blood pressure was defined as either elevated systolic blood
106 pressure ($\geq$ 130 mmHg) or elevated diastolic blood pressure ($\geq$ 85 mmHg) alone, or a combination of
107 both [24].

108 **2.6 Biochemical measurements**

109 Blood samples were collected in the morning after subjects had undergone an overnight fast. A total
110 of 5 ml of venous blood was collected with a syringe and needle. All vials were delivered in a cool box
111 packed with dry ice to an accredited pathology laboratory (Gribbles Pathology (M) Sdn Bhd, Bangi,
112 Malaysia) after collection of all blood samples.

113 **2.7 Definition of metabolic syndrome**

114 Metabolic syndrome and metabolic risk factors were defined according to the 'Harmonized' criteria
115 [24]. There are five metabolic risk factors according to the 'Harmonized' definition, including waist
116 circumference, HDL cholesterol, triglycerides, fasting glucose, systolic blood pressure and diastolic
117 blood pressure (Table 1).

118 Table 1: Five metabolic risk factors according to 'Harmonized' definition

Clinical measure	Insulin	Body weight	Lipid	Blood pressure	Glucose
------------------	---------	-------------	-------	----------------	---------

resistance					
Harmonized	None, but any	Increased waist	TG ≥ 1.7	$\geq 130/85$	FPG ≥ 5.6
(Alberti <i>et al.</i> , 2009)	three of the five risk factors	circumference (Gender- and ethnicity- specific)	mmol/L or on TG treatment HDL cholesterol <1.0 mmol/L in men or <1.3 mmol/L in women or on HDL cholesterol treatment	mmHg or on hypertensive treatment	mmol/L or diabetes

119

120 2.8 Statistical analysis

121 NutritionistPro (First Data Bank) was used to analyse dietary data. Data was analysed using SPSS
122 version 20. Nominal or ordinal variable values were depicted as frequency and percentage, while
123 interval or ratio variable values were presented as mean $\pm$ standard deviation. One sample *t*-test was
124 used to test whether there was a significant difference between the sample means and the
125 Recommended Nutrient Intakes for Malaysia [20] and the Medical Nutrition Therapy Guidelines by the
126 Malaysian Dietitians' Association [21].

127 3 RESULTS

128 Of the 322 government employees with metabolic syndrome, 275 subjects (73 males and 202
129 females) aged 34.51 ± 8.30 years completed the self-administered three-day food record (response
130 rate 85.4%). Table 2 shows the distribution of subjects based on individual metabolic risks.

131 **Table 2** Distribution of subjects based on individual metabolic risks

Metabolic Risk Factors	Number of subjects	
	Yes	No
Abdominal obesity	265 (96.4)	10 (3.6)
Elevated systolic blood pressure	198 (72.0)	77 (28.0)
Elevated diastolic blood pressure	102 (37.1)	173 (62.9)
Elevated blood pressure	221 (80.4)	54 (19.6)
Low HLD cholesterol	219 (79.6)	56 (20.4)
Elevated triglycerides	135 (49.1)	140 (50.9)
Elevated plasma glucose	49 (17.8)	226 (82.2)

Based on Table 3, a comparison of the subjects' food records with the Recommended Nutrient Intakes for Malaysia revealed that protein consumption was significantly higher among study subjects compared to the Recommended Nutrient Intakes for Malaysia (62 g/day for males; 55 g/day for females), ($P < .001$). All subjects (100%) had low fibre (< 20 g/day) intake. Conversely, most subjects (72.0%) had high sodium intake (≥ 2400 mg/day), as portrayed in Table 4.

4 DISCUSSION

Dietary intake data was obtained using a food record for three days, which were composed of two consecutive weekdays and one weekend day [26-33]. Keeping a food record for three days has proven to be the best approach for assessing actual nutrient intake [34-36]. The choice of the number of days is typically dependent upon pragmatic considerations such as the willingness of the subject to be compliant [37]. Recording all food consumed for more than one or two consecutive days is a

145 **Table 3** Comparison between the sample means with Recommended Nutrient Intakes for Malaysia (Ministry of Health, 2005) and Medical Nutrition Therapy
 146 (MNT) Guidelines by Malaysian Dietitians' Association (2005) using One sample *t*-test

Nutrients	Age	Male (n=73)					Female (n=202)				
		Mean±SD	RNI	P-value	MNT	P-value	Mean±SD	RNI	P-value	MNT	P-value
Energy (kcal)											
	19-<30	2110.19±194.15	2440	< .001			2249.46±254.44	2000	< .001		
	30-<51	2350.13±372.55	2460	.049			2270.57±72.39	2180	< .001		
	51-<60	2296.67±515.35	2460	.518			2289.81±258.91	2180	.090		
Carbohydrate (g)											
		327.77±55.34	200	< .001			327.40±3.01	180	< .001		
			330	.732				230	< .001		
Carbohydrate (%)											
		57.70±5.97	55	< .001	50	< .001	57.92±5.01	55	< .001	50	< .001
			70	< .001	60	.002		70	< .001	60	< .001
Sugars (%)											
		6.88±3.25	<15				6.64±3.25	<15			
Protein (g)											
		82.70±18.76	62	< .001			80.64±14.42	55	< .001		
Protein (%)											
		14.54±2.53			15	.124	14.23±1.93			15	< .001
					20	< .001				20	< .001
Fat (g)											
		73.67±17.54	54	< .001			71.91±16.08	46	< .001		
			82	< .001				70	.092		
Fat (%)											
		29.01±4.56	20	< .001	25	< .001	28.49±5.10	20	< .001	25	< .001

		30	.067	30	.067		30	< .001	30	< .001
PUFA (%)	5.10±2.41	6	.002			5.16±2.13	6	< .001		
		10	< .001				10	< .001		
MUFA (%)	5.58±2.34	12	< .001			5.53±2.01	12	< .001		
		15	< .001				15	< .001		
SFA (%)	6.38±2.55	<10				5.72±2.29	<10			
Fiber (g)	6.60±2.97	20	< .001			6.83±3.20	20	< .001		
		30	< .001				30	< .001		
Sodium (mg)	3099.65±1117.57			<2400		2962.03±925.62			<2400	

Table 4 Distribution of subjects based on Recommended Nutrient Intakes for Malaysia (Ministry of Health, 2005) and Medical Nutrition Therapy (MNT) Guidelines by Malaysian Dietitians' Association (2005)

	Recommended Nutrient Intakes for Malaysia				Medical Nutrition Therapy (MNT) Guidelines			
		Male (n=73)	Female (n=202)	Total (n=275)		Male (n=73)	Female (n=202)	Total (n=275)
Carbohydrate (%)	<55	21 (28.8)	53 (26.2)	74 (26.9)	<50	5 (6.8)	13 (6.4)	18 (6.5)
	55-70	51 (69.9)	149 (73.8)	200 (72.7)	50-60	44 (60.3)	117 (57.9)	161 (58.5)
	>70	1 (1.4)	0 (0.0)	1 (0.4)	>60	24 (32.9)	72 (35.6)	96 (34.9)
Sugars (%)	<15	70 (95.9)	200 (99.0)	270 (98.2)				
	≥15	3 (4.1)	2 (1.0)	5 (1.8)				
Protein (%)					<15	46 (63.0)	137 (67.8)	183 (66.5)
					15-20	26 (35.6)	65 (32.2)	91 (33.1)
					>20	1 (1.4)	0 (0.0)	1 (0.4)
Fat (%)	<20	2 (2.7)	8 (4.0)	10 (3.6)	<25	15 (20.5)	50 (24.8)	65 (23.6)
	20-30	46 (63.0)	118 (58.4)	164 (59.6)	25-30	33 (45.2)	76 (37.6)	109 (39.6)
	>30	25 (34.2)	76 (37.6)	101 (36.7)	>30	25 (34.2)	76 (37.6)	101 (36.7)
PUFA (%)	<6	50 (68.5)	132 (65.3)	182 (66.2)				
	6-10	21 (28.8)	67 (33.2)	88 (32.0)				
	>10	2 (2.7)	3 (1.5)	5 (1.8)				
MUFA (%)	<12	72 (98.6)	201 (99.5)	273 (99.3)				

	12-15	1 (1.4)	1 (0.5)	2 (0.7)				
	>15	-	-	-				
SFA (%)	<10	68 (93.2)	193 (95.5)	261 (94.9)				
	≥10	5 (6.8)	9 (4.5)	14 (5.1)				
Fiber (g)	<20	73 (100.0)	202 (100.0)	275 (100.0)				
	20-30	-	-	-				
	>30	-	-	-				
Sodium (mg)					<2400	18 (24.7)	59 (29.2)	77 (28.0)
					≥2400	55 (75.3)	143 (70.8)	198 (72.0)

158

159 notorious behaviour modification method for reducing food intake. In spite of this, a food record is
160 often employed as the gold standard for validating other dietary assessment methods when
161 observation is not possible [38].

162 However, all methods for assessing dietary patterns are subject to a large error sample, especially in
163 overweight or obese populations, in whom a tendency to underestimate food consumption has been
164 demonstrated [39]. The rate of under-reporting of total calorie intake was 3.3% (n = 9) of the total
165 subjects: 7 of the under-reporters were male, while another 2 were female.

166 According to the Medical Nutrition Therapy Guidelines (MNT) by the Malaysian Dietitians' Association
167 [21], 50 to 60% of total energy intake from carbohydrate [40], is recommended. Lower intake of 50%
168 should be considered for individuals with metabolic syndrome who have elevated triglycerides or low
169 HDL cholesterol [41]. Nevertheless, fat consumption should not be less than 25% of total energy
170 intake in order to avoid replacement with excess carbohydrate, which might result in higher
171 triglycerides and lower HDL cholesterol.

172 In this study, we demonstrated that individuals with metabolic syndrome record a diet richer in protein
173 (%) and poorer in fibre (g) when compared to the recommendations. Fibre consumption was lower
174 than recommended (20 to 30 g/day) in all the subjects, which may have contributed to fat
175 accumulation and insulin resistance.

176 **5 CONCLUSION**

177 This cross-sectional study among government employees further highlights the importance of
178 assessing the dietary pattern of each individual with metabolic syndrome. There is a discrepancy
179 between the dietary patterns among individuals with metabolic syndrome and the Recommended
180 Nutrient Intakes for Malaysia or the Medical Nutrition Therapy Guidelines from the Malaysian
181 Dietitians' Association. Notwithstanding, our study cannot declare that diet induces the disease, yet it
182 definitely sheds more light on the need for appropriate and professional dietary measures to be
183 integrated in the management of individuals with metabolic syndrome.

REFERENCES

- [1] Mortillo, S., Filion, K.B., Genest, J., Joseph, L., Pilote, L., Poirier, P. et al. The metabolic syndrome and cardiovascular risk a systematic review and meta-analysis. *Journal of the American College of Cardiology*. 2010; 56(14): 1113-1132.
- [2] Ford, E.S., Li, C., Sattar, N. Metabolic syndrome and incident diabetes: Current state of evidence. *Diabetes Care*. 2008; 31(9): 1898-1904.
- [3] Cameron, A.J., Shaw, J.E., Zimmet, P.Z. The metabolic syndrome: Prevalence in worldwide populations. *Endocrinology Metabolism Clinics of North America*. 2004; 33(2): 351-375.
- [4] Wan Nazaimoon, W.M., Aziz, A.I., Amir, S., Ikram, S.I., Kamarul, I.M., Khalid, A.K. et al. Prevalence of metabolic syndrome and its risk factors in adult Malaysians: Results of a nationwide survey. *Diabetes Research and Clinical Practice*. 2011; 91(2): 239-245.
- [5] Kimokoti, R.W., Brown, L.S. Dietary management of the metabolic syndrome. *Clinical Pharmacology & Therapeutics*. 2011; 90(1): 184-187.
- [6] Heidemann, C., Scheidt-Nave, C., Richter, A., Mensink, G.B. Dietary patterns are associated with cardiometabolic risk factors in a representative study population of German adults. *British Journal of Nutrition*. 2011; 106(8): 1253-1262.
- [7] Paganiotakos, D.B., Pitsavos, C., Skoumas, Y., Stefanadis, C. The association between food patterns and the metabolic syndrome using principal components analysis: The ATTICA study. *Journal of American Dietetic Association*. 2007; 107(6): 979-987.
- [8] Cho, Y.A., Kim, J., Cho, E.R., Shin, A. Dietary patterns and the prevalence of metabolic syndrome in Korean women. *Nutrition, Metabolism & Cardiovascular Disease*. 2011; 21(11): 893-900.

- 207 [9] Hong, S., Song, Y.J., Lee, K.H., Lee, H.S., Lee, M., Jee, S.H. et al. A fruit and dairy
208 dietary patterns and glucose tolerance abnormalities in Japanese men. *Journal of*
209 *Nutrition*. 2012; 136(5): 1352-1358.
- 210 [10] Kim, J., Jo, I. Grains, vegetables and fish dietary pattern is inversely associated with the
211 risk of metabolic syndrome in South Korean adults. *Journal of the American Dietetic*
212 *Association*. 2011; 111(8): 1141-1149.
- 213 [11] Song, Y., Joung, H. A traditional Korean dietary pattern and metabolic syndrome
214 abnormalities. *Nutrition, Metabolism & Cardiovascular Diseases*. 2012; 22(5): 456-462.
- 215 [12] Amini, M., Esmailzadeh, A., Shafaezadeh, S., Behrooz, J., Zare, M. Relationship
216 between major dietary patterns and metabolic syndrome among individuals with
217 impaired glucose tolerance. *Nutrition*. 2010; 26(10): 986-992.
- 218 [13] Esmailzadeh, A., Kimiagar, M., Mehrabi, Y., Azadbakht, L., Hu, F.B., Willett, W.C.
219 Dietary patterns, insulin resistance and prevalence of the metabolic syndrome in women.
220 *American Journal of Clinical Nutrition*. 2007; 85(3): 910-918, 2007.
- 221 [14] Naja, F., Nasreddine, L., Itani, L., Adra, N., Sibai, A., Hwalla, N. Association between
222 dietary patterns and the risk of metabolic syndrome among Lebanese adults. *European*
223 *Journal of Nutrition*. 2013; 52(1): 97-105.
- 224 [15] Denova-Gutierrez, E., Castanon, S., Talavera, J.O., Gallegos-Carrillo, K., Flores, M.,
225 Dosamantes-Carrasco, D. et al. Dietary patterns are associated with metabolic syndrome
226 in an urban Mexican population. *Journal of Nutrition*. 2010; 140(10): 1855-1863.
- 227 [16] DiBello, J.R., McGravey, S.T., Kraft, P., Goldberg, R., Campos, H., Qusted, C. et al.
228 Dietary patterns are associated with metabolic syndrome in adult Samoans. *Journal of*
229 *Nutrition*. 2009; 139(10): 1933-1943.
- 230 [17] Deshmukh-Taskar, P.R., O'Neil, C.E., Nicklas, T.A., Yang, S.J., Liu, Y., Gustat, J. et al.
231 Dietary patterns associated with metabolic syndrome, sociodemographic and lifestyle

- 232 factors in young adults: the Bogalusa Heart study. *Public Health Nutrition*. 2009; 12(12):
233 2493-2503.
- 234 [18] Lutsey, P.L., Steffen, L.M., Stevens, J. Dietary intake and the development of the
235 metabolic syndrome: the Atherosclerosis Risk in Communities study. *Circulation*. 2008;
236 117(6): 754-761.
- 237 [19] FAO Statistics Division. Food and Agriculture Organization of the United Nations.
238 Accessed 1 May 2011. Available: <http://faostat.fao.org>.
- 239 [20] Ministry of Health, National Coordinating Committee on Food and Nutrition.
240 Recommended Nutrient Intakes for Malaysia. A report of the Technical Working Group
241 on Nutritional Guidelines. Malaysia: Ministry of Health; 2005.
- 242 [21] Malaysian Dietitians' Association. Guidelines for Dietary Management of
243 Hyperlipidemia. Malaysia: Malaysian Dietitians' Association; 2005.
- 244 [22] Macdiarmid, J., Blundell, J. Assessing dietary intake: Who, what and why of under-
245 reporting, *Nutrition Research Reviews*. 1998; 11(2): 231-254.
- 246 [23] Goldberg, G., Black, A., Jebb, S., Cole, T., Murgatroyd, P., Coward, W. et al. Critical
247 evaluation of energy intake data using fundamental principles of energy physiology: 1.
248 Derivation of cut-off limits to identify under-recording, *European Journal of Clinical*
249 *Nutrition*. 1991; 45(12): 569-581.
- 250 [24] Alberti, K., Eckel, R.H., Grundy, S.M., Zimmet, P.Z., Cleeman, J.I., Donato, K.A. et al.
251 Harmonizing the metabolic syndrome. *Circulation*. 2009; 120(16): 1640-1645.
- 252 [25] Murphy, M.H., Murtagh, E.M., Boreham, C.A.G., Hare, L.G., Nevill, A.M. The effect of
253 a worksite based walking programme on cardiovascular risk in previously sedentary civil
254 servants. *BMC Public Health*. 2006; 6(1): 136-143.

- 255 [26] Kimm, S.Y., Glynn, N.W., Kriska, A.M., Fitzgerald, S.L., Aaron, D.J., Similo, S.L. et al.
256 Longitudinal changes in physical activity in a biracial cohort during adolescence.
257 Medicine & Science in Sports & Exercise 2000, 32(8): 1445-1454.
- 258 [27] Manios, Y. Design and descriptive results of the “Growth, exercise and nutrition
259 epidemiological study in preSchoolers”: The Genesis study. BMC Public Health 2006; 6:
260 32-40.
- 261 [28] Manios, Y., Kourlaba, G., Kondaki, K., Grammatikaki, E., Birbilis, M., Oikonomou, E.,
262 et al. Diet quality of preschoolers in Greece based on the Healthy Eating Index. The
263 Genesis study. Journal of the American Dietetic Association. 2009; 109(4): 616-623.
- 264 [29] Myszkowska-Rygiak J, Szymanska J, Harton A, Gajewska D. Evidence of high fat and
265 sugar intake, and low fiber and selected minerals intake in adult female coeliac patients.
266 Journal of Pre-Clinical and Clinical Research. 2010; 4(2): 112-115.
- 267 [30] Roy, M.S., Stables, G., Collier, B., Roy, A., Bou, E. Nutritional factors in diabetics with
268 and without retinopathy. American Journal of Clinical Nutrition. 1989; 50(4): 728-730.
- 269 [31] Samuel-Hodge, C.D., Fernandez, L.M., Hernandez-Roldan, C.F., Johnston, L.F.,
270 Keyserling, T.C. A comparison of self-reported energy intake with total energy
271 expenditure estimated by accelerometer and basal metabolic rate in African-American
272 women with type 2 diabetes. Diabetes Care. 2004; 27(3): 663-669.
- 273 [32] Soo, K.L., Wan Abdul Manan, W.M., Abdul Manaf, H., Lee, Y.Y. Dietary practices
274 among overweight and obese Chinese children in Kota Bahru, Kelantan. Malaysian
275 Journal of Nutrition. 2011; 17(1): 87-95.
- 276 [33] Wada, K., Nakamura, K., Tamai, Y., Tsuji, M., Sahashi, Y., Watanabe, K. et al.
277 Seaweed intake and blood pressure levels in healthy pre-school Japanese children.
278 Nutrition Journal. 2011; 10: 83-89.

- 279 [34] Bazzarre, T., Yuhas, J. Comparative evaluation of methods of collecting food intake data
280 for cancer epidemiology studies. *Nutrition and Cancer*. 1983; 5(3-4): 201-214.
- 281 [35] Gersovitz, M., Madden, J., Smiciklas-Wright, H. Validity of the 24 hour dietary recall
282 and seven day record for group comparisons. *Journal of the American Dietetic*
283 *Association*. 1978; 73(1): 48-55.
- 284 [36] White, J., Jago, R., Thompson, J.L. Dietary risk factors for the development of insulin
285 resistance in adolescent girls: A 3-year prospective study. *Public Health Nutrition*. 2012;
286 [Epub ahead of print].
- 287 [37] Rennie, K.L., Wareham, N.J. The validation of physical activity instruments for
288 measuring energy expenditure: Problems and pitfalls. *Public Health Nutrition*. 1998;
289 1(4): 265-271.
- 290 [38] Barrett-Connor, E. Nutrition epidemiology: How do we know what they ate? *American*
291 *Journal of Clinical Nutrition*. 1991; 54(1): 182S-187S.
- 292 [39] Willett, W. *Nutritional Epidemiology*. USA: Oxford University Press, 1998.
- 293 [40] American Diabetes Association. Report of the Expert Committee on the Diagnosis and
294 Classification of Diabetes Mellitus. *Diabetes Care*. 2003; 26: S3.
- 295 [41] NCEP ATP III. Final Report of the Third Report of the National Cholesterol Education
296 Program (NCEP) Expert Panel on detection, evaluation and treatment of High Blood
297 Cholesterol in *Adults (Adult Treatment Panel III, 2001)*. NIH; 2001.