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Original article

Socio demographic and lifestyle factors of metabolic syndrome among adult rural indigenous Malaysian population from Perak State, Malaysia

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ABSTRACT

Metabolic syndrome (MetS) is defined as a cluster of known disorders that increase the risk for morbidity and mortality from cardiovascular diseases (CVD) and type 2 diabetes mellitus. This cross sectional study was carried out to estimate the prevalence of MetS using Adult Treatment Panel 3 (ATP 3) classification and socio-demographic and lifestyle factors contributing to metabolic syndrome among rural indigenous Malaysian population from Perak state, Malaysia which included 148 rural Malay and 145 Orang Asli(OA) individuals. This community based cross-sectional study revealed that the prevalence of MetS was significantly higher among Malays (27.7%) as compared to Orang Aslis (13.8%). Overall Prevalence of Metabolic syndrome in the rural indigenous Malaysian population was 20.8%. Prevalence of abdominal obesity and high blood pressure were significantly higher among Malays as compared to OA population. Metabolic syndrome was significantly higher among those above 45 years of age group in overall rural indigenous Malaysian population and among OA. The prevalence of MetS was significantly higher among those who were obese and overweight and among Malays who were regularly taking snacks between meals. There was no significant association between other dietary risk factors, smoking, alcohol use or physical activity with metabolic syndrome.

1. Introduction

Metabolic syndrome (MetS) is defined as a cluster of known disorders that increase the risk for morbidity and mortality from cardiovascular diseases (CVD) and type 2 diabetes mellitus (Lakka et al., 2002; Laaksonen et al., 2002). Risk for type 2 diabetes mellitus increases from 5 to 9 times with metabolic syndrome (Lakka et al., 2002). Metabolic syndrome is defined as the occurrence of 3 or more of any of the 5 following factors: abdominal obesity, elevated triglyceride (TG), low HDL-C, elevated blood pressure (BP), and elevated fasting glucose (FG) (Grundy et al., 2005).

Not many studies are done to know the prevalence of MetS in rural indigenous Malaysian population. Previous studies which included a hospital based study and a nationwide study showed a high prevalence of MetS from various parts of Malaysia (Tan et al., 2008; Mohamud et al., 2012).

Lifestyle factors such as alcohol, cigarette smoking, dietary habits and physical activity have been reported to affect an individual's metabolic profile (Freiberg et al., 2004; Klatsky, 2004). Studies have also reported an inverse relationship between physical activity and certain components of metabolic syndrome such as increased waist circumference (Rennie et al., 2003; Waller et al., 2008;Termizy and Mafauzy (2009)) low HDL cholesterol (Fung et al., 2000) and increased blood pressure values (Paffenbarger et al., 1983; Paffenbarger et al., 1991).

The Orang Aslis (OA) are the indigenous people of Peninsular Malaysia. Majority of the OA still lives in remote and rural areas but over the past three decades, many had to undergo relocation programs when their inhabited land and the land where they grow their crops were acquired by the state authority for development. They were given new homes with basic amenities, special schools for the children, free health care services and various programs implemented to ensure employment and improvement in their

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quality of life. Malays form another ethnic group which forms a part of rural indigenous Malaysian population, whose ancestry originates wholly or partly in the Malay world. Indigenous Malays or local Malays form an integral proportion of rural indigenous Malaysian population (Mohd and Rahmat, 2014). Very few research were carried out on metabolic syndrome and its risk factors among rural indigenous Malay and Orang Asli population in Malaysia. A research which was carried out to know the prevalence of MetS among 119 OA female revealed that the prevalence of MetS among Orang Aslis was 22.7%.

So the researchers aimed to do a research on Metabolic syndrome and its risk factors among rural Malay and Orang Asli population from Perak state, Malaysia. Conducting a cross sectional research on metabolic syndrome among rural indigenous Malaysian population can help to identify the trend in cardiovascular risk factors, so that preventive measures can be implemented.

This research was aimed to study the prevalence of metabolic syndrome in rural indigenous Malaysian population from Perak state, Malaysia which included rural indigenous Malay and Orang Asli(OA) individuals, various socio demographic and lifestyle factors among the study population and to investigate the role of various demographic and lifestyle factors on Metabolic syndrome among the study participants.

2. Materials and methods

2.1. Study design and study period

This community based cross-sectional study was carried out from 2014 to 2016.

2.2. Study location and study population

Malay and orang Asli population from selected villages in Perak State, Malaysia were studied. All the Malay villages and all the Orang Asli villages from the state were listed out. A total of four villages, two remote rural villages from Gerik and Batang Padang districts were selected for each ethnic group. All those who attended the health check-up visit and satisfied the inclusion criteria were included in this research. Both males and females $\geq$ 18 years who had never been diagnosed as diabetes previously, were included. Very sick, debilitated subjects, diabetics and those who were uncooperative or unable to communicate were excluded from the study.

2.3. Sample size determination

Minimum sample size for Malay population was calculated assuming that prevalence of metabolic syndrome based on Adult Treatment Panel 3 (ATP 3) criteria was 35% with an allowable error of 8 as 137 for a confidence level of 95%. Minimum sample size for Orang Asli population was calculated assuming that prevalence of metabolic syndrome was 23% with an allowable error of 7 as 139 for a confidence level of 95%. Total sample size in this research was 293 with 148 Malays and 145 Orang Aslis.

2.4. Study variables and methods of collection of data

Data were collected using a structured questionnaire and through medical examination. Following parameters related to Metabolic Syndrome were measured: a. **Anthropometric measurements:** These included height, weight and waist circumference. Height was measured in centimetres using portable wall mounted Stadiometer (Seca bodymeter 206) to the nearest of one tenth of centimetre accuracy. Standard method and precautions were observed. Weight was measured in kilograms by using weight machine "Seca 762 personal scale" observing standard method and precautions. Body mass index (BMI) was calculated by dividing the weight in Kilograms by square of height in meters.

Waist circumference was measured in centimetres according to the World Health Organization guidelines at the approximate midpoint between the lower margin of the last palpable rib and the top of the iliac crest using a measuring tape, which was snug around the body, but not pulled so tight that it is constricting. Measuring tape was applied directly to the skin after removing the shirts and inner garments. The tape is correctly positioned parallel to the floor at the level at which the measurement is made.

ATP III metabolic syndrome criteria (as in Table 1) was taken for the classification of abdominal obesity and other components of Metabolic syndrome.

National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) devised a definition for the metabolic syndrome (Table 1) according to which, metabolic syndrome is present if three or more of the following five criteria are met: waist circumference over 40 in. (men) or 35 in. (women), blood pressure over 130/85 mmHg, fasting triglyceride (TG) level over 150 mg/dl, fasting high-density lipoprotein (HDL) cholesterol level less than 40 mg/dl (men) or 50 mg/dl (women) and fasting blood sugar over 100 mg/dl (National Cholesterol Education Program (NCEP), 2002).

b. **Blood pressure:** It was measured by a trained nurse using electronic digital Blood pressure monitor (OMRON automatic blood pressure monitor, model MX3) which was standardized with the mercury sphygmomanometer at the start of each data collection session. Doubtful readings were double checked with both the apparatuses. Three Blood pressure readings were measured in the left arm of study participants, at an interval of five minutes in a comfortable sitting position and lowest reading was taken as the representative blood pressure measurement.

c. **Fasting blood glucose** estimation was measured using ROCHE Accucheck glucometer.

d. **HDL cholesterol and triglycerides** were measured in fasting state.

e. Data about the **socio demographic characteristics** and **life style factors** such as age, gender, ethnicity, education, occupation, dietary habits, level of physical activity, smoking and alcohol intake were collected using a structured questionnaire. Jogging/Aerobic exercise/Brisk walk/cycling/swimming (either alone or combined for a duration of 2 h or more a week was considered as physically active.

2.5. Data analysis

Data were analysed by using Statistical Package for Social Sciences software (SPSS) version 17. Data were analysed using descriptive statistics, chi square test and independent samples T test. Level of significance was fixed at 0.05.

Table 1
Clinical Identification of the Metabolic Syndrome – Any 3 of the Following according to ATP 3 criteria:

Risk factor	Defining level
Abdominal obesity	Waist circumference
Men	> 102 cm (>40 in)
Women	> 88 cm (>35 in)
Fasting Triglycerides	$\geq$1.7 mmol/L (over 150 mg/dl)
Fasting HDL cholesterol	
Men	less than1.04 mmol/L (less than40 mg/dl)
Women	less than 1.30 mmol/L (less than50 mg/dl)
Blood pressure	$\geq$130/$\geq$85 mm Hg
Fasting glucose	$\geq$5.5 mmol/L (>100 mg/ dl)

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Ethical consideration

Ethical approval was obtained from the institutional ethical committee. Participants were given information about the research and an informed consent was obtained from each of them.

5. Results

This study was carried out among 293 individuals from 4 different villages – two were Malay predominated villages and two were Orang Asli villages. Almost equal no. of participants were from Malay (148; 50.5%) and Orang Asli (145; 49.5%)ethnic groups. Majority were females (194; 66.2%) and were less than 45 years of age group (183; 62.5%).

Table 2 shows the prevalence of Metabolic Syndrome and its various components. Prevalence of abdominal Obesity and elevated blood pressure were significantly higher among Malays as compared to Orang Aslis. Prevalence of Metabolic syndrome was significantly higher among Malays (27.7%, 95% CI 20.49, 34.91) as compared to Orang Aslis (13.8%, 95% CI 8.19, 19.41). Overall Prevalence of Metabolic syndrome was 20.8% with 95% CI 16.15, 25.45%.

Table 3: shows the association between various socio-demographic factors with metabolic syndrome in different ethnic groups. Overall and among OA, Metabolic syndrome was significantly higher among those above 45 years of age group. Prevalence of MetS among males and females were 18.2% and 22.2% respectively. Among Malays prevalence among males and females were 24.1% and 30% respectively and among OA, prevalence among males and females were 9.8% and 15.4% respectively.

As in Table 4, prevalence of MetS was significantly higher among those who were obese and overweight. In our research, there was no association between cigarette smoking, alcohol use or physical activity with Metabolic syndrome.

Association between various dietary risk factors with Metabolic syndrome were studied. A total of 13 different questions were included for assessing the dietary risk. Mean dietary risk score among those with Metabolic syndrome was 4.03 (95% CI 3.6, 4.46) and among those without Metabolic syndrome was 3.65 (95% CI 3.41, 3.89). The difference in mean scores was not statistically significant.

Table 6 shows the association between dietary risk factors and metabolic syndrome among OA community. There was no significant difference in prevalence of Metabolic syndrome in any of those with the mentioned dietary risk factors.

6. Discussion

Prevalence of Metabolic syndrome among rural Malaysian population in this study was 20.8%. A survey done previously involving 109 adults (age 30 years or above), reported a prevalence of 22.9% and 16.5% by IDF and ATP III definitions (13), respectively, while a hospital-based study recorded a 40.4% prevalence among patients attending an obesity clinic (14). A nationwide study done among 4341 adults, showed that the prevalence of metabolic syndrome was 34.3% based on ATP 3 criteria (15). Irrespective of the definition used, Malaysia seemed to record a much higher prevalence of MetS compared with other Asian countries, such as India (Deepa et al., 2007), Hong Kong (Ko et al., 2006) and China (Gu et al., 2005), where prevalence ranged from 6.1 to 18.3%, when based on ATP III definition.

Many studies have shown that the prevalence of MetS varies among different ethnic populations living in the same country and is postulated to be associated with environmental and genetic factors (Poulsen et al., 2001; Reilly and Rader, 2003). Similarly, our

Table 2
Prevalence of Metabolic Syndrome and various components of Metabolic Syndrome in the study population according to ethnicity.

Components of metabolic syndrome	Malay N = 148	OA N = 145	No. (% of total) N = 293	P value
Abdominal obesity (ATP 3 criteria)				
Present	42	23	65	
Absent	(28.4%)106	(15.9%)122	(22.2%)228	0.01
Total	(71.6%)148	(84.1%)145	(77.8%)293	
	(100%)	(100%)	(100%)	
Triglycerides	97	109	206	
	(65.5%)51	(75.2%)36	(70.3%)87	>0.05
Low	(34.5%)148	(24.8%)145	(29.7%)293	
High	(100%)	(100%)	(100%)	
Total				
HDL cholesterol	78	68	146	
Low	(52.7%)70	(46.9%)77	(49.8%)147	>0.05
High	(47.3%)148	(53.1%)145	(50.2%)293	
Total	(100%)	(100%)	(100%)	
Blood pressure	62	95	157	
	(41.9%)86	(65.5%)50	(53.6%)136	less than0.001
Low	(58.1%)148	(34.5%)145	(46.4%)293	
High	(100%)	(100%)	(100%)	
Total				
Fasting glucose	139	141	280	
	(93.9%)9	(97.2%)4	(95.6%)13	>0.05
Low	(6.1%)148	(2.8%)145	(4.4%)293	
High	(100%)	(100%)	(100%)	
Total				
Metabolic Syndrome (ATP 3 criteria)				
Present	41	20	61	
Absent	(27.7%)107	(13.8%)125	(20.8%)232	0.003
Total	(72.3%)148	(86.2)	(79.2%)293	
	(100%)	145 (100%)	(100%)	

Table 3
Association between various socio-demographic characteristics and metabolic syndrome in different ethnic groups.

Demographic Characteristic	Metabolic Syndrome			
	Present	Absent	Total	p-value
AGE				
Both races combined	23	127	150	
	(15.3%)16	(84.7%)45	(100%)61	>0.05
Less than 40 years	(26.2%)11	(73.8%)26	(100%)37	
40 – 49 years	(29.7%)11	(70.3%)34	(100%)45	
50 – 59 years	(24.4%)61	(75.6%)232	(100%)	
60 years or above	(20.8%)	(79.2%)	293(100%)	
Total				
Malay Less than 40 years	16 (27.6%)	42 (72.4%)	58 (100%)	
40 – 49 years	10 (31.3%)	22 (68.8%)	32 (100%)	>0.05
50 – 59 years	6 (22.2%)	21 (77.8%)	27 (100%)	
60 years or above	9 (29%)	22 (71%)	31 (100%)	
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
OA Less than 40 years	7 (7.6%)	85 (92.4%)	92 (100%)	
40 – 49 years	6 (20.7%)	23 (79.3%)	29 (100%)	less than0.01
50 – 59 years	5 (50%)	5 (50%)	10 (100%)	
60 years or above	2 (14.3%)	12 (85.7%)	14 (100%)	
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
AGE				
Both races combined	30	153	183	
Less than 45 years	(16.4%)31	(83.6%)79	(100%)110	less than0.05
45 years and above	(28.2%)61	(71.8%)232	(100%)	
Total	(20.8%)	(79.2%)	293(100%)	
Malay Less than 45 years	20 (28.2%)	51 (71.8%)	71 (100%)	>0.05
45 years and above	21 (27.3%)	56 (72.7%)	77 (100%)	
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
OA Less than 45 years	10 (8.9%)	102 (91.1%)	112 (100%)	0.002
45 years and above	10 (30.3%)	23 (69.7%)	33 (100%)	
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
GENDER				
Both races combined				
Male	18 (18.2%)	81 (81.8%)	99 (100%)	**>0.05**
Female	43 (22.2%)	151 (77.8%)232	194 (100%)293	
Total	61 (20.8%)	(79.2%)	(100%)	
Malay Male	14 (24.1%)	44 (75.9%)	58 (100%)	>0.05
Female	27 (30%)	63 (70%)	90 (100%)	
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
OA Male	4 (9.8%)	37 (90.2%)	41 (100%)	>0.05
Female	16 (15.4%)	88 (84.6%)	104 (100%)	
Total	20 (13.8%)	125 (86.2%)	145 (100%)	

Table 4
Association between lifestyle risk factors and metabolic syndrome.

Lifestyle Factors	Metabolic Syndrome			
	Present	Absent	Total	p-value
Cigarette smoking	15	52	67	
	(22.4%)46	(77.6%)180	(100%)226	>0.05
Smoker	(20.4%)61	(79.6%)232	(100%)293	
Non smoker	(20.8%)	(79.2%)	(100%)	
Total				
Alcohol use	1	17	18	
Alcohol user	(5.6%)60	(94.4%)215	(100%)275	>0.05
Non user	(21.8%)61	(78.2%)232	(100%)293	
Total	(20.8%)	(79.2%)	(100%)	
BMI category	20	30	50	
Obesity	(40%)26	(60%)62	(100%)88	less than0.001
Overweight	(29.5%)13	(70.5%)118	(100%)131	
Normal	(9.9%)2	(90.1%)22	(100%)24	
	(8.3%)61	(91.7%)232	(100%)293	
Underweight	(20.8%)	(79.2%)	(100%)	
Total				
Physical activity	15	78	93	
Good	(16.1%)46	(83.9%)154	(100%)200	>0.05
Poor	(23%)61	(77%)232	(100%)293	
Total	(20.8%)	(79.2%)	(100%)	

study showed that the prevalence of MetS among rural Malays was 27.7%, much higher as compared with 13.8% in Orang Aslis. Prevalence of Metabolic syndrome was significantly higher among Malays as compared to Orang Aslis (13.8%).

Table 5
Association between dietary risk factors and metabolic syndrome among Malays.

Dietary risk factors	Metabolic Syndrome			
	Present	Absent	Total	p-value
Takes breakfast	35 (27.3%)	93 (72.7%)	128 (100%)	
Skips breakfast	6 (30%)	14 (70%)	20 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Takes only dinner	35 (27.6%)	92 (72.4%)	127 (100%)	
Takes both dinner and supper	6 (28.6%)	15 (71.4%)	21 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Less than 3 meals a day	15 (31.2%)	33 (68.8%)	48 (100%)	
3 or more meals a day	26 (26%)	74 (74%)	100 (100%)	>0.05
	41 (27.7%)	107 (72.3%)	148 (100%)	
Total				
No snacks between meals	15 (20.5%)	58 (79.5%)	73 (100%)	
Takes snacks between meals	26 (34.7%)	49 (65.3%)	75 (100%)	less than0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Don't like sweets	26 (25.2%)	77 (74.8%)	103 (100%)	
Like sweets	15 (33.3%)	30 (66.7%)	45 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Do not add sugar in food	34 (27.2%)	91 (72.8%)	125 (100%)	
Adds sugar in food	7 (30.4%)	16 (69.6%)	23 (100%)	>0.05
	41 (27.7%)	107 (72.3%)	148 (100%)	
Total				
No sweet drinks with meals	27 (25.5%)	79 (74.5%)	106 (100%)	
Takes sweet drinks with meals	14 (33.3%)	28 (66.7%)	42(100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Diet less rich in carbohydrates	39 (29.8%)	92 (70.2%)	131 (100%)	
Diet more rich in carbohydrates	2 (11.8%)	15 (88.2%)	17 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Likes fish and/chicken	29 (24.4%)	90 (75.6%)	119 (100%)	
Dislikes fish and/chicken	12 (41.4%)	17 (58.6%)	29 (100%)	>0.05
	41 (27.7%)	107 (72.3%)	148 (100%)	
Total				
Less use of red meat	38 (30.4%)	87 (69.6%)	125 (100%)	
More use of red meat	3 (13%)	20 (87%)	23 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
Less use of sweetened milk	32 (27.1%)	86 (72.9%)	118 (100%)	
More use of sweetened milk	9 (30%)	21 (70%)	30 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	
More Vegetables in diet	33 (26.8%)	90 (73.2%)	123 (100%)	
Less vegetables in diet	8 (32%)	17 (68%)	25 (100%)	>0.05
	41 (27.7%)	107 (72.3%)	148 (100%)	
Total				
More intake of fruits	18 (24.7%)	55 (75.3%)	73 (100%)	
Less intake of fruits	23 (30.7%)	52 (69.3%)	75 (100%)	>0.05
Total	41 (27.7%)	107 (72.3%)	148 (100%)	

Among Malays, prevalence of Metabolic syndrome was significantly higher among those who were of the habit of taking snacks between meals (Table 5).

A cross-sectional study of dietary patterns with glucose intolerance and other features of the metabolic syndrome done by Williams et al. (Williams et al., 2000) revealed that dietary patterns close to the Mediterranean diet, rich in fruit and vegetables and high in monounsaturated fats, were negatively associated with features of the metabolic syndrome. A reduced prevalence of the metabolic syndrome (38% lower) was observed among subjects of the Framingham Offspring Study among those with the highest intake of cereal fiber, compared with those with the lowest intake (McKeown et al., 2004). According to the ATTICA study (Panagiotakos et al., 2004), adherence to a Mediterranean-style dietary pattern was associated with a 20% lower risk of developing the metabolic syndrome.

In the present research there was no significant difference in prevalence of Metabolic syndrome among those with the mentioned dietary risk factors. This might be due to the fact that dietary risk factors were high among the study participants so that there was no significant difference between those with metabolic syndrome and those without metabolic syndrome.

In the current research, prevalence of MetS was significantly higher among those who were obese and overweight. This finding is in agreement with previous studies (Yusuf et al., 2005; Diaz et al., 2007), according to which the overweight or obesity increased the risk of MetS by 14.5 and seven folds in men and women, respectively. The study done by Sa'ida Munira Johari Suzana Shahar found that body weight is an important determinant of MetS (Johari and Shahar, 2014).

Difficulties in travelling and identifying indigenous community was challenging and demanded travelling on multiple occasions to the same villages. Researchers recommend more studies from different indigenous communities in Malaysia to understand the trend in cardiovascular risk factors. More community interventions can be applied to reduce the emergence of risk factors.

Sedentary lifestyle with high carbohydrate/high calorie diet is a risk factor for metabolic syndrome and cardiovascular morbidities. The research findings of this research which emphasized on lifestyle and dietary risk factors of metabolic syndrome could be applicable to other fast developing countries.

7. Conclusions

This community based cross-sectional study revealed that the prevalence of MetS was significantly higher among Malays

Table 6
Association between dietary risk factors and metabolic syndrome among Orang Aslis.

Dietary risk factors	Metabolic Syndrome			
	Present	Absent	Total	p-value
Takes breakfast	13 (11.2%)	103 (88.8%)	116 (100%)	
Skips breakfast	7 (24.1%)	22 (75.9%)	29 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Takes only dinner	17 (14.4%)	101 (85.6%)	118 (100%)	
Takes both dinner and supper	3 (11.1%)	24 (88.9%)	27 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Less than 3 meals a day	8 (12.9%)	54 (87.1%)	62 (100%)	
3 or more meals a day	12 (14.5%)	71 (85.5%)	83 (100%)	>0.05
	20 (13.8%)	125 (86.2%)	145 (100%)	
Total				
No snacks between meals	16 (17.8%)	74 (82.2%)	90 (100%)	
Takes snacks between meals	4 (7.3%)	51 (92.7%)	55 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Don't like sweets	11 (11.3%)	86 (88.7%)	97 (100%)	
Like sweets	9 (18.8%)	39 (81.3%)	48 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Do not add sugar in food	15 (12.2%)	108 (87.8%)	123 (100%)	
Adds sugar in food	5 (22.7%)	17 (77.3%)	22 (100%)	>0.05
	20 (13.8%)	125 (86.2%)	145 (100%)	
Total				
No sweet drinks with meals	14 (13.5%)	90 (86.5%)	104 (100%)	
Takes sweet drinks with meals	6 (14.6%)	35 (85.4%)	41 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Diet less rich in carbohydrates	15 (12.1%)	109 (87.9%)	124 (100%)	
Diet more rich in carbohydrates	5 (23.8%)	16 (76.2%)	21 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Likes fish and/chicken	13 (14%)	80 (86%)	93 (100%)	
Dislikes fish and/chicken	7 (13.5%)	45 (86.5%)	52 (100%)	>0.05
	20 (13.8%)	125 (86.2%)	145 (100%)	
Total				
Dislikes red meat	18 (13.2%)	118 (86.8%)	136 (100%)	
Likes red meat	2 (22.2%)	7 (77.8%)	9 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
Less use of sweetened milk	12 (11.3%)	94 (88.7%)	106 (100%)	
use of sweetened milk daily	8 (20.5%)	31 (79.5%)	39 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	
More Vegetables in diet	16 (14.5%)	94 (85.5%)	110 (100%)	
Less vegetables in diet	4 (11.4%)	31 (88.6%)	35 (100%)	>0.05
	20 (13.8%)	125 (86.2%)	145 (100%)	
Total				
More intake of fruits	3 (7.9%)	35 (92.1%)	38 (100%)	
Less intake of fruits	17 (15.9%)	90 (84.1%)	107 (100%)	>0.05
Total	20 (13.8%)	125 (86.2%)	145 (100%)	

(27.7%) as compared to Orang Aslis (13.8%). Overall Prevalence of Metabolic syndrome in the rural indigenous Malaysian population was 20.8%. Prevalence of abdominal obesity and high blood pressure were significantly higher among Malays. Overall and among OA, Metabolic syndrome was significantly higher among those above 45 years of age group. The prevalence of MetS was significantly higher among those who were obese and overweight. Among Malays, prevalence of Metabolic syndrome was significantly higher among those who were of the habit of taking snacks between meals. There was no significant association between other dietary risk factors, smoking, alcohol use or physical activity with metabolic syndrome

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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