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Metabolic syndrome among non-obese adults in the teaching profession in Melaka, Malaysia

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ABSTRACT

Background: Non-obese individuals could have metabolic disorders that are typically associated with elevated body mass index (BMI), placing them at elevated risk for chronic diseases. This study aimed to describe the prevalence and distribution of metabolically obese, non-obese (MONO) individuals in Malaysia.

Methods: We conducted a cross-sectional study involving teachers recruited via multi-stage sampling from the state of Melaka, Malaysia. MONO was defined as individuals with BMI 18.5–29.9 kg/m^2 and metabolic syndrome. Metabolic syndrome was diagnosed based on the Harmonization criteria. Participants completed self-reported questionnaires that assessed alcohol intake, sleep duration, smoking, physical activity, and fruit and vegetable consumption.

Results: A total of 1168 teachers were included in the analysis. The prevalence of MONO was 17.7% (95% confidence interval [CI], 15.3–20.4). Prevalence of metabolic syndrome among the normal weight and overweight participants was 8.3% (95% CI, 5.8–11.8) and 29.9% (95% CI, 26.3–33.7), respectively. MONO prevalence was higher among males, Indians, and older participants and inversely associated with sleep duration. Metabolic syndrome was also more prevalent among those with central obesity, regardless of whether they were normal or overweight. The odds of metabolic syndrome increased exponentially from 1.9 (for those with BMI 23.0–24.9 kg/m^2) to 11.5 (for those with BMI 27.5–29.9 kg/m^2) compared to those with BMI 18.5–22.9 kg/m^2 after adjustment for confounders.

Conclusions: The prevalence of MONO was high, and participants with BMI ≥23.0 kg/m^2 had significantly higher odds of metabolic syndrome. Healthcare professionals and physicians should start to screen non-obese individuals for metabolic risk factors to facilitate early targeted intervention.

1. Introduction

The prevalence of metabolic syndrome in Malaysia is higher than in other Asian countries,[1] mainly due to the high prevalence of obesity.[2] However, there are many individuals who are not categorized as obese based on body mass index (BMI) but are predisposed to metabolic disorders.[3] Screening for metabolic disorders among these non-obese individuals is often ignored, as they are assumed to be healthy. The literature shows that normal weight individuals could have metabolic disorders, placing them at elevated risk for chronic diseases that are typically associated with elevated BMI.[4] Evidence also suggests that an abnormal metabolic profile, rather than high BMI, is associated with higher risk of diabetes and cardiovascular disease.[5]

Individuals who are normal-to over-weight with metabolic syndrome have been broadly classified as metabolically obese, non-obese (MONO).[6–8] However, the classification of MONO was complicated by the limitations associated with utilizing BMI in the definition. MONO was previously defined as individuals with BMI <27.0 kg/m^2 [6, 7] or <25.0 kg/m^2 [8] who have metabolic syndrome. However, based on World Health Organization (WHO) classification, the definition of non-obese is BMI 18.5–29.9 kg/m^2.[9] Malaysia has the highest prevalence of overweight population in the Southeast Asia,[10] so knowing the metabolic risk among this group is crucial for public health action and clinical practice.

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MONO offers insight into the risks of metabolic syndrome independent of obesity. Several studies have reported that non-obese individuals with metabolic risk factors display characteristic such as insulin resistance and higher visceral adiposity and plasma triglyceride, which together may confer an increased risk of cardiometabolic disease.[11] Moreover, identifying MONO may be more important among Asians, who are generally less obese but have relatively higher body fat than Westerners with the same BMI.[9,12]

Therefore, the aim of this study was to describe the prevalence and distribution of MONO using a BMI criterion of 18.5–29.9 kg/m^2 among the adult population in the state of Melaka, Malaysia.

2. Methods

This was a cross-sectional study carried out using multi-stage sampling in a school setting. A total of 51 public secondary schools were randomly selected. All permanent school teachers from the selected schools were invited to participate. Teachers who had psychiatric illnesses, were pregnant, or had a BMI <18.5 or ≥30.0 kg/m^2 were excluded. Data collection was carried out from October 2013 until February 2014. Information on socio-demographic characteristics and lifestyle behaviours were enquired using self-administered questionnaires. Anthropometric measurements and metabolic risk assessments were conducted by trained research assistants as per protocol.[13] This study is part of a cohort study on clustering of lifestyle risk factors and understanding its association with stress on health and wellbeing among school teachers in Malaysia (CLUSTer).[13]

This study was approved by the University Malaya Medical Ethics Committee (Ref No. 950.1) and written permission was granted from the Ministry of Education, the Education Department, and the school principals. Informed consent was obtained from all participants.

2.1. Definition of metabolic syndrome

Metabolic syndrome was defined using the Harmonization criteria as having any three or more of the following risk factors: (1) central obesity (waist circumference [WC] ≥80 cm in women or ≥90 cm in men); (2) elevated triglyceride (TG; ≥1.7 mmol/L); (3) low high-density lipoprotein cholesterol (HDL-C; ≤1.3 mmol/L in women or ≤1.0 mmol/L in men); (4) high blood pressure (BP; ≥130/85 mm Hg or on antihypertensive treatment); and (5) high fasting blood glucose (FBG; ≥5.6 mmol/L or on treatment for elevated glucose).[14]

2.2. Definition of MONO

MONO was defined as individuals with BMI 18.5–29.9 kg/m^2 with metabolic syndrome. These individuals were subdivided into four BMI categories (18.5–22.99, 23.00–24.99, 25.00–27.49, and 27.50–29.99 kg/m^2) according to the BMI cut-off points as defined by WHO.[9]

2.3. Statistical analyses

Data entry and analysis were undertaken using the IBM SPSS Statistic version 21.0 (IBM Corp, Armonk, NY, USA). Samples were weighted to account for unequal probabilities of selection and non-response rate. Complex sample multivariate logistic regression

Table 1
Socio-demographic characteristics and lifestyle risk factors of participants.

	Total n	MONO		*P* value
		Yes (n = 218) n (weighted %)	No (n = 950) n (weighted %)	
Age group, years				
20–29	113	6 (5.6)	107 (94.4)	<0.001
30–39	319	32 (10.5)	287 (89.5)	
40–49	430	87 (17.5)	343 (82.5)	
50–59	306	92 (29.4)	214 (70.6)	
Gender				
Male	280	72 (25.9)	208 (74.1)	0.004
Female	888	146 (15.2)	742 (84.8)	
Ethnicity				
Malay	897	165 (17.7)	732 (82.3)	0.005
Chinese	216	34 (14.9)	182 (85.1)	
Indian	40	16 (39.3)	24 (60.7)	
Others	15	2 (7.8)	13 (92.2)	
Level of education				
Diploma	37	5 (19.1)	32 (80.9)	0.451
Degree	1035	1868 (17.2)	847 (82.8)	
Master/PhD	96	25 (23.3)	71 (76.7)	
Level of physical activity				
Low	103	21 (15.2)	82 (84.8)	0.617
Moderate	453	84 (18.6)	369 (81.4)	
High	275	59 (20.0)	216 (80.0)	
Smoking status				
Current	28	7 (21.5)	21 (78.5)	0.870
Former	43	9 (19.2)	34 (80.8)	
Never	955	177 (17.6)	778 (82.4)	
Alcohol consumption				
Yes	34	10 (25.7)	24 (74.3)	0.219
No	1020	186 (17.2)	834 (82.8)	
	Mean (SE)	Mean (SE)	Mean (SE)	*P* value
Age, years	42.51 (0.49)	46.72 (0.72)	41.60 (0.50)	<0.001
Servings of fruits and vegetables/day	2.35 (0.04)	2.39 (0.10)	2.34 (0.05)	0.644
Sleep, hours per day	6.26 (0.05)	5.97 (0.08)	6.32 (0.06)	0.001

MONO, metabolically obese, non-obese; SE, standard error.

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