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Original research

Association between physical activity and metabolic syndrome among Malay adults in a developing country, Malaysia

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ABSTRACT

Objectives: Metabolic syndrome is a highly prevalent health problem within the adult population in developing countries. We aimed to study the association of physical activity levels and metabolic risk factors among Malay adults in Malaysia.
Design: Cross-sectional.
Methods: Body mass index, waist circumference, and systolic/diastolic blood pressure, fasting blood glucose, fasting triglyceride and high-density lipoprotein cholesterol levels were measured in 686 Malay participants (aged 35–74 years). Self-reported physical activity was obtained with the validated International Physical Activity Questionnaire (Malay version) and categorized into low, moderate or high activity levels.
Results: Individuals who were classified as overweight and obese predominated (65.6%). On the basis of the modified NCEP ATP III criteria, metabolic syndrome was diagnosed in 31.9% of all participants, of whom 46.1% were men and 53.9% were women. The prevalence of metabolic syndrome among participants with low, moderate or high activity levels was 13.3%, 11.7% and 7.0%, respectively ($p < 0.001$). Statistically significant negative associations were found between a number of metabolic risk factors and activity categories ($p < 0.05$). The odds ratios for metabolic syndrome in the moderate and high activity categories were 0.42 (95% CI: 0.27–0.65) and 0.52 (95% CI: 0.35–0.76), respectively, adjusted for gender.
Conclusions: Moderate and high activity levels were each associated with reduced odds for metabolic syndrome independent of gender. Although a slightly lower prevalence of metabolic syndrome was associated with high activity than with moderate activity, potential health benefits were observed when moderate activity was performed.

1. Introduction

Physical inactivity and energy imbalance have resulted in an obesity epidemic. Both developed and developing countries face the challenges of obesity and its comorbidities such as diabetes mellitus and cardiovascular diseases. All of these non-communicable diseases affect an individual's physical and social functioning, as well as quality of life. Cardiovascular disease is responsible for one in three deaths worldwide and is the number one cause of mortality.[1]

Interest is growing in a constellation of cardiovascular risk factors, including visceral obesity, dyslipidaemia, hyperglycaemia and hypertension that constitute another important health problem – the metabolic syndrome. This syndrome is highly prevalent in the adult population worldwide, with a suggested ethnic predisposition in Asians.[2] The chance of having metabolic syndrome is closely linked to modifiable lifestyle factors, such as overweight, obesity and physical inactivity. This problem is even more pronounced among middle-aged populations.

Malaysia has been identified as a country with an increased prevalence of non-communicable diseases because of high levels of physical inactivity.[3] With increasing urbanization and the availability of motorized transportation, people tend to reduce their physical activity levels. According to Malaysia's Third National Health and Morbidity Survey (NHMS III) conducted in 2006, which used the International Physical Activity Questionnaire (IPAQ), 43.7% of the Malaysian adult population was physically inactive.[4] The World Health Survey also found Malaysia to be one of the countries with an outstandingly high prevalence of physical inactivity, the highest among all of Western Pacific Region countries.[5]

Although inverse associations between moderate and high physical activity levels with obesity and metabolic syndrome have been well-established in a number of Western and Asian countries,

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there is still insufficient evidence in Malaysia. We aimed to fill this gap in our local setting to show the need to combat obesity and metabolic risks through physical activity intervention studies. The primary goal of this study was to explore the associations between different levels of physical activity with obesity and metabolic risk factors in middle-aged Malay adults.

2. Methods

This was an analytical cross-sectional study. All eligible employees (aged 35 years and older) of a public university in Kuala Lumpur, Malaysia, were invited to participate in a free annual worksite health screening. A random sample of 1000 employees was selected and invited to participate in our study. Of these employees, 686 agreed to participate, providing a *response rate* of 68.6%. Study inclusion criteria consisted of the following: (1) self-identified race as Malay (as the IPAQ-M was in the Malay language); (2) absence of physical illness or disabilities that would limit daily physical activities such as walking; and (3) the ability to read and write well enough to record physical activities. Written informed consent was obtained from all participants. Ethics clearance was obtained from the Medical Ethics Committee of the university (Reference Number: MEC 782.18).

Data were collected from August 2010 to August 2011. Anthropometric parameters (weight, height and waist circumference), systolic/diastolic blood pressure, fasting blood glucose and fasting lipid profiles were measured. Weight was measured using the SECA digital scale and height with the SECA stadiometer (Hamburg, Germany). Body mass index (kg/m^2) was calculated using the formula weight (kg) divided by height^2 (m^2). Central obesity was measured with a circumference measurement tape. The waist was measured as the point midway between the iliac crest and the costal margin (lower rib). All measurements were performed by trained staff and quality checks were conducted regularly. Blood pressure was measured using a clinically validated digital automatic blood pressure monitor (Omron HEM-907, Kyoto, Japan). The analysis of biochemical indicators, which included fasting blood glucose and a full lipid profile, was conducted by the Clinical Diagnostic Laboratory of the University Malaya Medical Center.

The validated self-administered, long-form Malay version of the IPAQ (IPAQ-M)[6] was used to assess the levels of physical activity among participants. The IPAQ-M has previously been tested for test-retest reliability and criterion validity. The intraclass correlation coefficient revealed moderate to good reliability ranging from 0.54 to 0.92 ($p < 0.001$) and the kappa coefficient of 0.89 showed good validity (95% confidence interval [CI] = 0.79–0.98). The questionnaire included 31 questions on frequency and time spent on walking and moderate and vigorous activities in four domains (work, transportation, home and leisure-time activity), as well as time spent sitting. Participants were asked to recall their activities during the last 7 days.

For the analysis of the IPAQ-M data, the following metabolic equivalent of task (MET) values were used: walking = 3.3 METs; moderate physical activity = 4.0 METs; vigorous physical activity = 8.0 METs. The results were presented as the estimation of energy expenditure in metabolic equivalent-minutes per week (MET-min $week^{-1}$). The MET-min $week^{-1}$ was calculated as minutes of activity/day × days per week × MET level. According to the IPAQ Research Committee, the continuous indicator should be presented as median values and interquartile ranges rather than means. Both continuous and categorical indicators of physical activity were calculated from the data obtained from the IPAQ-M. A total physical activity score obtained from the IPAQ-M was calculated, as well as separate scores for each of the four physical activity domains and activity levels. On the basis of the IPAQ guidelines, participants with total physical activity scores of <600 MET-min $week^{-1}$ were categorized as being in the "low" category, those with 600–2999 MET-min $week^{-1}$ as being in the "moderate" category and those with ≥3000 MET-min $week^{-1}$ as being in the "high" category. For the estimation of energy expenditure, the IPAQ scoring guide stated that MET-minute scores are equivalent to kilocalories for a 60-kg person, and that kilocalories may be computed from MET-minutes using the following equation: MET-min × (weight in kilograms/60 kg). Thus these data were also converted to energy expenditure/week adjusted for weight (kcal/week/kg).

According to the modified NCEP ATP III criteria that is more suitable for the Malay population,[7] the presence of any three or more of the following five factors is required for a working definition of metabolic syndrome: abdominal obesity, hypertriglyceridaemia (triglycerides ≥1.7 mmol/L) or specific treatment for this lipid abnormality; low HDL cholesterol (HDL cholesterol ≤1.03 mmol/L for men and ≤1.29 mmol/L for women) or specific treatment for this lipid abnormality; elevated blood pressure (systolic blood pressure ≥ 130 mmHg and/or diastolic blood pressure ≥85 mmHg) or current use of antihypertensive drugs; impaired fasting glucose (fasting plasma glucose ≥ 5.6 mmol/L) or drug treatment for elevated glucose (previously diagnosed type 2 diabetes). The NCEP ATP III criteria suggested the cutoff points of waist circumference should be ethnic specific, with adoption of the Asian criteria for abdominal obesity (waist circumference >90 cm in men and >80 cm in women).

Data were entered and analyzed using SPSS for Windows version 16.0. The significance level was set at $p < 0.05$. Participants' activity scores (MET-min $week^{-1}$) were presented as medians with 95% CI and interquartile range for each domain and type of activity and further categorized into three categories: low, moderate and high levels of physical activity. Distributions of continuous variables were tested for normality using the Kolmogorov–Smirnov test. Associations between categorical variables were tested using the chi-squared test. The non-parametric Mann–Whitney *U* test was used for asymmetric continuous variables. Differences in the frequencies of obesity and each metabolic risk factor across categories of physical activity were analyzed using the chi-squared test stratified by gender. Logistic regression was used to estimate the odds ratio (OR) with 95% CI of having metabolic syndrome in each physical activity category. The analyses were further adjusted for gender. We ruled out the presence of an interaction between age and the main independent variables (physical activity categories), which was not statistically significant.

3. Results

A total of 686 employees (39.7% men, 60.3% women) were recruited. Their demographic, clinical and anthropometric characteristics are presented in Table 1. Participants were 35–74 years old (mean age: 45.9 ± 6.5 years). There was no significant difference in age groups by gender.

Most participants were in the moderate activity level category (46.1%), followed by those in the low activity level (27.1%) and the high activity level (26.8%). Individuals who were classified as overweight and obese predominated (65.6%). Male participants were significantly heavier than female participants; had a larger waist circumference; had higher systolic/diastolic blood pressure, triglyceride and fasting glucose levels; and had lower HDL cholesterol levels ($p < 0.001$).

From the modified NCEP ATP III definition, metabolic syndrome was diagnosed in 31.9% of participants. There was a significant difference in the prevalence of metabolic syndrome between men (37.1%) and women (24.2%) ($p < 0.05$).