PREVALENCE AND FACTORS ASSOCIATED WITH PHYSICAL INACTIVITY AMONG MALAYSIAN ADULTS

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Abstract. Using data from the Third National Health and Morbidity Survey (NHMS III) in 2006, this study examined the association between socio-demographic factors and physical inactivity in a sample of 33,949 adults aged 18 years and above by gender. Physical activity levels were measured using the Global Physical Activity Questionnaire (GPAQ vers 1). Physical inactivity was defined as having a total physical activity level of less than 600 metabolic equivalents-minutes per week (METs-minutes/week) contributed by all three different life domains.Logistic regression analyses were conducted.The prevalence of overall physical inactivity was 43.7% (95% CI: 42.9-44.5). The mean total physical activity level was 894.2 METs-minutes/week. The means METs-minutes/week for the domain of work, travelling, and leisure time were 518.4, 288.1, and 134.8, respectively. Multivariable logistic regression analyses indicated that females were more likely to be physically inactive than males were (aOR=1.62; 95% CI: 1.53-1.72). Among women, being a housewife (aOR=1.78; 95% CI: 1.56-2.03), widow/divorcee (aOR=1.23; 95% CI: 1.05-1.43), and those with no formal education (aOR=1.20; 95% CI: 1.01-1.43) were found to be significantly associated with physical inactivity.Urban residents, older adults aged 65 years and above, private employees, nonworking group, and those with a monthly household income level of MYR5,000 and above appeared to be consistently associated with physical inactivity across men, women, and combined group (both). Specific health intervention strategies to promote physical activity should be targeted on population subgroups who are inactive.

Keywords: National Health and Morbidity Survey, physical inactivity, prevalence, socio-demographic factors, Malaysia

INTRODUCTION

Physical inactivity is the fourth leading risk factor for global mortality, causing an estimated 3.2 million deaths worldwide. Of these physical inactivity-attributable deaths, 2.6 million are in low- and middle-income countries (WHO, 2009, 2010). To provide an estimate of the global prevalence of physical inactivity, scholars have generated evidence from multisite research. From the pooled analyses of physical activity data in 76 countries, it appears that one-out-of-five adults is physically inactive (Dumith *et al*, 2011). Specifically, the global prevalence

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of physical inactivity among adults was 17% (WHO, 2009).As evident in the World Health Survey, 18% of the population in 51 countries were physically inactive. It is worth mentioning that physical inactivity in Malaysia was the highest (16.5%) among the participating Western Pacific Region countries (Guthold *et al*, 2008).

Physical inactivity levels are rising in developing countries, and Malaysia is of no exception (Guthold *et al*, 2008; Bauman *et al*, 2009).This suggests that there be continued efforts to promote physical activity in such countries. For example, in Malaysia, the Ministry of Health has conducted the Healthy Lifestyle Campaign since 1991 with the theme "Be Healthy for Life," which emphasizes four main components: healthy eating, exercise and physical activity, not smoking, and managing stress, to lead a healthy and wholesome lifestyle among Malaysians (Ministry of Health, 2010). In addition, the Malaysian Dietary Guidelines (MDG) has suggested a routine to promote physical activity, that is to accumulate at least 30 minutes of moderate intensity physical activity per day on at least five days per week, preferably daily (National Coordinating Committee on Food and Nutrition, 2010).

Daily participation of physical activity is associated with a host of physical, social, and mental health outcomes (Vuori, 2001; WHO, 2010).However, evidence from the previous National Health and Morbidity Surveys (NHMSs) suggested that Malaysians' participation of physical activity was far from satisfactory(Institute of Public Health, 1999). The NHMS II in 1996 examined physical activity of exercise during leisure time and found that the prevalences of 'ever exercise' and 'adequate exercise' were 30.9% and 11.6%, respectively. A few limitations of NHMS II warrant comment. First, the study only reported data on exercise and did not discuss the patterns or levels of physical activity. Second, the NHMS II did not reflect true physical activity status as other components of physical activity during travelling and at work were not captured.

A recent study (Malaysian Adult Nutrition Survey, 2003) reported that the prevalence of physical inactivity was 39.7%, and the prevalence was higher for women (42.6%) than for men(36.7%) (Poh *et al*, 2010). The authors also documented that the population spent the majority of their time (74% of the day) in sedentary activities, such as sleeping or lying down (Poh *et al*, 2010).In another study (The Malaysia Non-Communicable Disease Surveillance 2005/2006; MyNCDS-1), Malaysian adults aged 25-64 years old were found to exhibit a very high prevalence of physical inactivity(60.1%). Consistent with Poh *et al*'s findings, women(65.1%) had higher prevalence than men did (55.4%) (Disease Control Division, 2006). These statistics suggest that adult physical inactivity is an important public health concern in Malaysia.

Socio-demographic variables such as gender, age, ethnicity, socio-economic status, educational level, and occupational level have been found to exert significant influences on physical activity (Sallis *et al*, 2000; Trost *et al*, 2002; Bauman *et al*, 2012, Ibrahim *et al*, 2013).Identification of socio-demographic pertaining to physical inactivity can help to design prevention and intervention programs and to redefine existing health promotion strategies. Empirical studies on socio-demographic correlates of physical inactivity among adults are currently limited in Malaysia. A decade later, the NHMS III was conducted in 2006 to access physical activity in Malaysia. Specifically, our study aimed

to determine the prevalence and patterns of physical inactivity across three life domains (work, travelling, and leisure time), and to explore socio-demographic correlates of physical inactivity among Malaysian adults by gender using the NHMS III data.

MATERIALS AND METHODS

Study design and sampling method

The Third National Health and Morbidity Survey (NHMS III) was a nationwide, cross sectional, population-based survey. The study sample was selected using a two-stage, proportional population size stratified sampling design and the Labour Force Survey (LFS) 2004 sampling frame from the Department of Statistics, Malaysia. Malaysia is divided into contiguous geographical areas called Enumeration Blocks (EBs).Each EB contains about 80-120 Living Quarters (LQs). At first stage, the sample unit was the EB, while at the second stage, the sample unit was the LQ. One LQ was estimated to house 4.4 individuals. All respondents aged 18 years and above from the selected LQs were recruited in this survey. A total of 2,150 EBs (1,424 urban and 726 rural) comprising 17,251 LQs were randomly selected in this study. The sample selection method has been described in more detail in the NHMS III official report (IPH, 2008).

Data collection

The NHMS III household survey was carried out from April to July 2006 in Malaysia. Socio-demographic and physical activity information was obtained via face-to-face interviews by trained enumerators. To ensure a high response rate, three visits were attempted before the selected LQs were classified as non-response.

Ethical considerations

The Malaysian Medical and Research Ethics Committee (MREC), Ministry of Health, Malaysia approved this study (Ref N^{o}KKM/JEPP/02 Jld.3 (170); 2006 May 24). Prior to data collection, detailed explanation was given to participants. Informed consents were obtained from all participants.

Physical activity measures

The Global Physical Activity Questionnaire (GPAQ ver 1) was employed in this study, and it measures one's physical activity performance in a typical or usual week. GPAQ collects information on physical activity participation in three domains: 1) work (paid and unpaid including household chores), 2) travelling (walking and cycling), and 3) leisure time (sports, fitness, or recreational activities) (WHO, 2004).

METs (Metabolic Equivalents) are commonly used to express the intensity of physical activities and are also used for the analysis of GPAQ data. One MET is defined as 1 cal/kg/hour and is equivalent to the energy cost of sitting quietly. A value of 4 METs was assigned to the time spent in moderate activities, and 8 METs to the time spent in vigorous activities for calculating a person's overall energy expenditure.The total physical activity level is computed as the sum of all METs-minutes/week from moderate- to vigorous-intensity physical activities performed across work, travelling, and leisure time domains. An overall cut-off level of 600 METs-minutes/week was used to define physical inactivity (WHO, 2004).

According to the GPAQ analysis framework (WHO, 2004), physical activity levels could be classified into low, moderate, or high intensity: 1) 'Low,' which provides an indication that no

activity or some activities are reported but not enough to meet moderate and high categories; 2) 'Moderate,' which provides an indication that 3 or more days of vigorous-intensity activity of at least 20 minutes/day, or 5 or more days of moderate-intensity activity or walking of at least 30 minutes/day, or 5 or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 600 METs-minutes/week; and 3) 'High', which provides an indication that vigorous-intensity activity on at least 3 days achieving a minimum of at least 1,500 METs-minutes/week, or 7 or more days of any combination of walking, moderate- or vigorous-intensity activities achieving a minimum of at least 3,000 METs-minutes/week.

These three levels were then categorized into "active" or "inactive" groups: 1) "active", which provides an indication that one has met physical activity recommendations for moderate- or high-intensity categories, or one has met the minimum recommendations of 30 minutes of moderate-intensity physical activity for 5 or more days per week, or a total physical activity level of ≥600 METs-minutes/week; and 2) "inactive", which provides an indication that one had met the physical activity requirements for the low category, or a total physical activity level of less than 600 METs-minutes/week.

Statistical analyses

Statistical analyses were performed using SPSSfor Windows®(version 16.0; SPSS, Chicago, IL). All analyses were done using complex sampling design to ensure that sample weight and study design were accounted for. Descriptive statistics were used to illustrate the prevalence of physical inactivity across gender by socio-demographic variables. Multivariable logistic regression analysis was performed across gender to determinethe adjusted odds ratios (aOR) of each variable for physical inactivity while simultaneously controlling for potential confounding effects by other variables. We reported 95% confidence intervals (CI) without *p*-values, as the large sample size could generate significant results even if statistical differences or associations were small.

RESULTS

With a response rate of 98.2%, we collected data from a sample of 33,949 respondents (15,205 males and 18,744 females) aged 18 years and above.

Table 1 shows the prevalence of physical inactivity for Malaysian adults across gender by socio-demographic information. The overall prevalence of physical inactivity was 43.7%, and women (50.5%) had a significantly higher prevalence than men did (35.3%). Among men, prevalence of physical inactivity appeared to increase with age, with the oldest age group having the highest prevalence (55.2%). Physical inactivity in men also increased with increasing monthly household income levels.

Among women, no significant differences in physical inactivity prevalence were found for age groups between 18-24, between 25-34, and between 55-64. However, women of the oldest age group (≥65years) reported a significantly higher prevalence of physical inactivity (70.4%) than with other younger age groups. For women, prevalence of physical inactivity did not differ significantly by monthly household income levels. Among a combined group (both men and women), Chinese (47.1%) had the highest prevalence of physical inactivity, followed by Indians (44.4%), other Bumiputera (44.0%),

Table 1
Prevalence of physical inactivity for Malaysian adults aged 18 years and above across gender by socio-demographic variables.

Variables	Men (*N*=15,205) % (95% CI)	Women (*N*=18,744) % (95% CI)	Both (*N*=33,949) % (95% CI)
Overall	35.3 (34.4-36.2)	50.5 (49.5-51.4)	43.7 (42.9-44.5)
Residence			
Urban	38.0 (36.7-39.2)	51.5 (50.3-52.7)	45.6 (44.6-46.6)
Rural	30.7 (29.2-32.1)	48.5 (46.9-50.0)	40.1 (38.9-41.4)
Age group (years)			
18-24	30.0 (28.1-32.0)	50.4 (48.3-52.4)	41.0 (39.5-42.5)
25-34	29.7 (27.9-31.5)	50.7 (49.0-52.3)	41.6 (40.3-42.9)
35-44	33.0 (31.3-34.8)	46.4 (44.8-48.1)	40.6 (39.3-41.9)
45-54	35.0 (33.2-36.8)	45.7 (43.9-47.4)	41.0 (39.6-42.3)
55-64	40.8 (38.5-43.0)	50.5 (48.3-52.8)	45.8 (44.2-47.5)
≥65	55.2 (52.6-57.8)	70.4 (68.1-72.6)	63.5 (61.8-65.3)
Ethnicity			
Malays	34.1 (32.9-35.3)	49.0 (47.8-50.2)	42.3 (41.4-43.3)
Chinese	40.8 (38.9-42.8)	52.5 (50.6-54.4)	47.1 (45.6-48.6)
Indians	37.1 (34.2-40.1)	49.8 (47.0-52.6)	44.4 (42.2-46.7)
Other Bumiputera	31.5 (28.9-34.2)	53.9 (51.2-56.5)	44.0 (41.9-46.2)
Others	27.6 (23.8-31.8)	52.3 (48.6-56.0)	41.3 (38.3-44.4)
Marital status			
Single	31.3 (29.6-33.0)	48.1 (46.1-50.0)	39.3 (37.9-40.7)
Married	36.2 (35.1-37.2)	49.7 (48.6-50.8)	43.6 (42.7-44.4)
Widow/Widower/Divorcee	48.5 (43.5-53.6)	58.8 (56.6-60.9)	57.2 (55.2-59.2)
Education level			
No formal education	43.8 (40.5-47.2)	62.1 (60.1-64.0)	57.4 (55.6-59.1)
Primary education	35.9 (34.3-37.4)	49.0 (47.4-50.5)	42.9 (41.7-44.1)
Secondary education	32.7 (31.6-33.9)	48.4 (47.2-49.7)	41.1 (40.2-42.1)
Tertiary education	40.7 (38.2-43.3)	48.9 (46.3-51.5)	44.9 (43.0-46.9)
Employment status			
Government employee	30.7 (28.3-33.1)	40.2 (37.6-42.9)	35.1 (33.2-37.0)
Private employee	32.3 (30.9-33.7)	45.5 (43.8-47.2)	37.8 (36.6-39.0)
Self employed	31.3 (29.8-32.9)	41.2 (39.0-43.5)	34.7 (33.3-36.0)
Housewife	-	54.4 (53.1-55.7)	54.4 (53.1-55.7)
Nonworking (retired, student, unemployed)	49.3 (47.4-51.1)	59.4 (57.4-61.4)	54.1 (52.6-55.6)
Monthly household income			
<MYR1,000	33.0 (31.6-34.5)	49.8 (48.3-51.2)	42.5 (41.3-43.7)
MYR1,000-MYR1,999	33.8 (32.2-35.4)	51.5 (49.9-53.2)	43.4 (42.2-44.7)
MYR2,000-MYR2,999	35.3 (33.2-37.4)	48.6 (46.6-50.6)	42.6 (41.0-44.1)
MYR3,000-MYR3,999	36.8 (33.9-39.8)	52.4 (49.5-55.2)	45.3 (43.0-47.5)
MYR4,000-MYR4,999	36.8 (33.0-40.8)	49.4 (45.3-53.2)	43.5 (40.5-46.5)
≥MYR5,000	41.9 (38.9-45.0)	50.4 (47.7-53.2)	46.6 (44.3-48.8)

Table 2
Physical activity in mean metabolic equivalents(METs)-minutes/week across three different domains among Malaysian adults aged 18 years and above in relation to age groups and gender.

Age groups and gender	Physical activity domains [mean (95% CI)]			Total physical activity
	Work	Travelling	Leisure time	
Men (*n*=15,205)				
18-24	599.9 (552.8-647.0)	336.6 (305.8-367.5)	247.6 (230.9-264.3)	1,184.2 (1,121.9-1,246.5)
25-34	745.4 (696.9-794.0)	357.9 (329.7-386.1)	190.1 (175.0-205.1)	1,293.4 (1,233.4-1,353.4)
35-44	697.0 (652.0-742.0)	343.6 (318.0-369.2)	162.0 (148.6-175.4)	1,202.6 (1,146.4-1,258.9)
45-54	689.1 (642.1-736.2)	337.2 (311.8-362.5)	153.9 (139.5-168.3)	1,180.2 (1,124.3-1,236.1)
55-64	462.1 (420.3-503.9)	307.9 (280.6-335.2)	138.1 (120.0-156.2)	908.1 (851.2-965.1)
≥65	234.3 (199.9-268.7)	225.9 (199.9-251.8)	86.0 (72.9-99.1)	546.1 (499.5-592.8)
Overall	615.6 (591.7-639.5)	328.6 (314.5-342.6)	170.3 (163.2-177.4)	1,114.5 (1,085.2-1,143.8)
Women (*n*=18,744)				
18-24	328.8 (295.3-362.4)	240.0 (218.9-261.2)	109.1 (98.4-119.8)	678.0 (632.7-723.2)
25-34	402.4 (369.8-434.9)	256.3 (237.2-275.3)	107.4 (95.5-119.2)	766.0 (722.8-809.1)
35-44	406.6 (376.2-437.0)	296.8 (275.4-316.2)	116.1 (105.0-127.1)	818.4 (776.0-860.9)
45-54	413.1 (382.0-444.1)	265.1 (246.1-284.2)	121.9 (110.0-133.8)	800.1 (758.9-841.4)
55-64	287.5 (253.9-321.1)	255.7 (233.7-277.7)	106.7 (91.3-122.1)	649.9 (600.4-699.4)
≥65	130.8 (108.1-153.5)	148.9 (127.5-170.2)	36.2 (29.1-43.2)	315.9 (280.8-350.9)
Overall	356.2 (338.8-373.5)	254.5 (244.4-264.6)	105.9 (100.4-111.4)	716.6 (693.6-739.5)
Both (*n*=33,949)				
18-24	453.5 (423.4-483.6)	284.5 (265.6-303.3)	172.8 (162.5-183.1)	910.8 (870.3-951.3)
25-34	550.5 (519.4-581.6)	300.2 (283.2-317.1)	143.1 (133.6-152.5)	993.7 (954.9-1,032.6)
35-44	532.1 (503.5-560.7)	316.5 (299.6-333.3)	135.9 (127.2-144.6)	984.5 (947.5-1,021.5)
45-54	534.8 (505.3-564.2)	296.9 (280.7-313.1)	136.0 (126.7-145.3)	967.6 (931.2-1,004.1)
55-64	372.0 (343.6-400.5)	281.0 (262.6-299.4)	121.9 (109.7-134.1)	774.9 (735.2-814.7)
≥65	177.4 (156.8-198.1)	183.6 (166.4-200.7)	58.6 (51.5-65.8)	419.7 (389.4-449.9)
Overall	518.4 (499.0-537.9)	288.1 (277.5-298.5)	134.8 (129.9-139.8)	894.2 (871.6-916.8)

Malays (42.3%), and others (41.3%).

A significantly higher prevalence of physical inactivity was consistently observed among those residing in urban areas compared with those residing in rural areas for men (38.0% *vs* 30.7%), women (51.5% *vs* 48.5%), and combined group (45.6% *vs* 40.1%). In addition, the widow/widower/divorcee, nonworking group, and those with no formal education were consistently found to have high prevalence of physical inactivity in both men and women subsamples.

Table 2 shows levels of physical inactivity in mean METs-minutes/week across three different domains among Malaysian adults in relation to age groups and gender. Physical activity of work domain constituted the most in total physical activity level, followed by physical activity of travelling and leisure time domains. The means total METs-minutes/week for all age groups in men, women, and combined group were 1,114.5, 716.6 and 894.2, respectively. Women had much lower level of physical activity compared to men across three different domains (work, travelling, and leisure time) as well as for total physical activity. In terms of age groups, older adults aged 65 years and above consistently demonstrated the lowest METs-minutes/week across all three domains in both men and women subsamples.

Table 3 shows socio-demographic correlates of physical inactivity among Malaysian adults by gender. There was a gender difference pertaining to physical inactivity, whereby females were more likely to be physically inactive compared to males (aOR=1.62; 95% CI: 1.53-1.72). In men subsample, variables that significantly associated with physical inactivity included urban residential area, older age groups, private employees, nonworking group, and a monthly household income level of MYR5,000 and above. In women subsample, urban residents, older adults aged 65 years and above, ethnicity of "Other Bumiputera", widows/divorcees, private employees, housewifes, nonworking group, those with no formal education, and those with high monthly household income were found to be associated with physical inactivity. In combined group of men and women, physical inactivity was positively associated with monthly household income. Urban residents, older adults aged 65 years and above, private employees, nonworking group and those with a monthly household income level of MYR5,000 and above appeared as consistent predictors for physical inactivity across men, women, and combined group.

DISCUSSION

Using data from the third National Health and Morbidity Survey (NHMS III, 2006), our study suggested that the prevalence of physical inactivity was 43.7% (5.5 millions) in Malaysian adults aged 18 years and above. The prevalence is comparable to that of Japan (43.3%) and Taiwan (42.3%). However, it was much higher than that reported in China (6.9%), Hong Kong (15.3%) and India (23.4%) (Bauman *et al*, 2009). Nevertheless, these comparisons across different countries need to be interpreted with caution by taking into account the agreement for the definition of physical activity, the questionnaire used and the characteristics of the study population (Craig *et al*, 2004; Armstrong and Bull, 2006; Guthold *et al*, 2008). The prevalence was lower than that reported in the Malaysia Non-Communicable Diseases Surveillance-1 (MyNCDS-1) (60.1%) (Disease Control

Table 3
Association between socio-demographic factors and physical inactivity by gender in Malaysian adults aged ≥18years.

Variables	Physical inactivity		
	Men aOR (95% CI)	Women a OR (95% CI)	Both aOR (95% CI)
Gender			
Male	n.a.	n.a.	Ref
Female	n.a.	n.a.	1.62 (1.53-1.72)
Residence			
Urban	1.25 (1.13-1.38)	1.19 (1.09-1.30)	1.22 (1.13-1.31)
Rural	Ref	Ref	Ref
Age group (years)			
18-24	Ref	Ref	Ref
25-34	1.12 (0.97-1.30)	1.01 (0.89-1.13)	1.03 (0.94-1.13)
35-44	1.36 (1.16-1.60)	0.83 (0.73-0.94)	0.99 (0.89-1.09)
45-54	1.45 (1.23-1.71)	0.78 (0.68-0.89)	0.98 (0.89-1.09)
55-64	1.61 (1.34-1.93)	0.85 (0.74-0.99)	1.10 (0.99-1.24)
≥65	2.38 (1.95-2.91)	1.53 (1.27-1.85)	1.83 (1.59-2.09)
Ethnicity			
Malays	Ref	Ref	Ref
Chinese	1.06 (0.95-1.18)	1.03 (0.93-1.13)	1.04 (0.96-1.13)
Indians	1.00 (0.86-1.15)	0.94 (0.83-1.07)	0.96 (0.87-1.07)
Other Bumiputera	0.95 (0.83-1.10)	1.18 (1.04-1.33)	1.09 (0.99-1.21)
Others	0.77 (0.63-0.95)	1.12 (0.94-1.33)	0.98 (0.86-1.12)
Marital status			
Single	Ref	Ref	Ref
Married	1.00 (0.88-1.13)	1.09 (0.97-1.22)	1.13 (1.04-1.23)
Widow/Widower/Divorcee	1.12 (0.87-1.43)	1.23 (1.05-1.43)	1.21 (1.07-1.37)
Education level			
No formal education	0.89 (0.73-1.09)	1.20 (1.01-1.43)	1.02 (0.90-1.16)
Primary education	0.77 (0.67-0.90)	0.90 (0.78-1.03)	0.81 (0.73-0.90)
Secondary education	0.78 (0.69-0.89)	0.90 (0.79-1.02)	0.83 (0.76-0.91)
Tertiary education	Ref	Ref	Ref
Employment status			
Government employee	Ref	Ref	Ref
Private employee	1.17 (1.02-1.34)	1.24 (1.08-1.42)	1.22 (1.10-1.34)
Self employed	1.05 (0.91-1.21)	1.10 (0.95-1.28)	1.09 (0.98-1.21)
Housewife	n.a.	1.78 (1.56-2.03)	1.72 (1.55-1.91)
Nonworking (retired, student, unemployed)	1.93 (1.65-2.26)	1.90 (1.62-2.22)	1.98 (1.76-2.22)
Monthly household income			
<MYR1,000	Ref	Ref	Ref
MYR1,000-MYR1,999	1.09 (0.98-1.21)	1.18 (1.08-1.28)	1.14 (1.07-1.22)
MYR2,000-MYR2,999	1.13 (1.00-1.28)	1.08 (0.98-1.20)	1.10 (1.02-1.20)
MYR3,000-MYR3,999	1.20 (1.03-1.40)	1.30 (1.13-1.48)	1.25 (1.12-1.39)
MYR4,000-MYR4,999	1.17 (0.97-1.42)	1.21 (1.01-1.45)	1.19 (1.04-1.36)
≥MYR5,000	1.36 (1.15-1.60)	1.21 (1.06-1.39)	1.28 (1.14-1.43)

[a]OR, adjusted odds ratios (OR adjusted for all other variables in the Table 3).
Ref, reference group; n.a., not applicable.

Division, 2006). These discrepancy might be attributed to theinclusion of different age groups in MyNCDS-1's study (aged 25-64 years) and NHMS III's study(aged 18 years and above).

The total physical activity level of Malaysian adults (894.2 METs-minutes/week) was above the average for health benefit (600 METs-minutes/week), and the highest physical activity level took place in the work domain, followed by travelling and leisure time domains. Such findings are not surprising in developing countries such as Malaysia, whereby a majority of the population, especially working-aged adults, are exposed to long work hours that represents the largest component of total physical activity relative to travelling and leisure time domains. Looking into leisure time domain, younger participants aged 18-24 years, especially men, were reported to have the highest level of physical activity compared to participants of older age groups.Our results were similar to other studies that have documented that physical activity level during leisure time decreased with age (Martins *et al*, 2009; Momenan *et al*, 2011). However, this finding did not support Chen *et al*'s study (2011), which reported that age was positively associated with physical activity participation during leisure time. In Chen *et al*'s study (2011), physical activity was measured by a self-developed structured questionnaire that measures involvement in 24 kinds of leisure-time physical activity in the past year. Therefore, this suggests that such inconsistent findings could be due to a different physical activity questionnaire. Other possible reasons might include age differences. It appears that young adults aged 18-24 years are mostly singles and have not entered working life; therefore, they escape from common barriers of leisure time physical activity such as long work hours and family responsibilities (Chen *et al*, 2011).

Women demonstrated a higher prevalence of physical inactivity than men did. Such findings are consistent with results reported elsewhere (Teh and Ong, 2004; Lim and Taylor, 2005; Pitsavos *et al*, 2005; Bauman *et al*, 2009; Shibata *et al*, 2009). One possible explanation is that women tend to participate in light- and moderate-intensity activities such as household chores, whereas men tend to participate in vigorous-intensity activities such as playing sports, running, and cycling.The possibility of recall and measurement error tend to be greater for light- and moderate-intensity activities than for vigorous activities, which would ultimately lead to an underestimation of overall physical activity level in women compared to men (Livingstone *et al*, 2001).

Among women, housewives were found to be significantly associated with physical inactivity. Household chores (for example, housekeeping, carrying babies, shopping, and food preparation activities) are the routine daily activities of housewives and might be underestimated or not fully captured under the physical activity of work domain. Additionally, there was no spesific domain (that is, household domain) to accurately measure household activities in the questionnaire.

For men, those of "other" ethnic group (including other races in Sabah and Sarawak, indigenous in peninsular Malaysia, and others) was associated with a lower odds for physical inactivity compared to Malays. This could be due to a majority of men in "other" ethnic group are resided in remote areas, and therefore practising walking, climbing, and cycling instead of modern transportation and involved intensively in agricultural work.

For women, other Bumiputera (including Kadazan, Murut, Bajau, Melanau, Iban and Bidayuh) were more likely to be physically inactive than Malays were. The variation in physical activity levels across different ethnicity may be due to complex interaction between social-economic and cultural factors in daily lives of different ethnic groups (Cheah, 2011). Potential factors contributing to the association between ethnicity and physical inactivity deserve further investigation.

Older adults aged 65 years and above were consistenly associated with a higher odds of physical inactivity compared to younger adults aged 18 to 24 years across men, women, and combined group.This finding is supported by previous studies which reported that physical inactivity increased with advancing age group (Livingstone *et al*, 2001; CDC, 2003; Bauman *et al*, 2009). A possible reason is that participants of this age group mostly are retired persons and may be associated with a more sedentary lifestyle after retirement (Touvier *et al*, 2010). In addition, older people are reluctant to participate in physical activity due to various factors including lack of interest, physical symptoms (for example, shortness of breath, joint pain, lack of energy), difficulties with access, doubting that exercise can lengthen life, and a lower self-afficacy in relation to physical activity (Crombie *et al*, 2004; Netz and Raviv, 2004).

In this study, urban residents were more likely to be physically inactive than rural residents in both men and women subsamples, as well as in the combined group.This finding is similar to a study conducted in China (Muntner *et al*, 2005). In Malaysia, work-related activities in urban areas have experienced a major shift toward computerization and automation, which would lead to a more sedentary working environment and subsequently a lower level of physical activity. In contrast, a majority of rural residents are engaged in labor intensive jobs of heavy physical activities, such as farming and fishing. However, in contrast to our findings, a study in Korea found that women who were living in rural areas were more likely to be physically inactive than their urban counterparts were (Lee *et al*, 2007). The researchers explained that this may be related to the survey question that measured only leisure-time physical activity. Another study in Saudi Arabia reported that there was no significant difference in physical activity levels between rural and urban residents (Al-Nozha *et al*, 2007). These contradictions could be attributed to different survey questions, interaction effects between social support (for example, friends or relatives who encourage exercise or exercise with) and environmental factors (for example, safe places to exercise, availability and accessibility of neighborhood physical activity facilities) that vary across different geographic areas (Parks *et al*, 2003; Lee *et al*, 2007).

Concerning marital status, no significant association was found between marital status and physical inactivity in the men subsample. However, in the women subsample, widows/divorcees were associated with higher odds of physical inactivity compared to those who were single. Such findings are in concordance with a study that found that singles were physically more active possibly due to the fact that single people have more leisure time, fewer family responsibilities and are not yet caught up by life stressors (Al-Nozha *et al*, 2007).

Conversely, widows/divorcees could be affected by additional life responsibliities and so their participation in regular physical activity could be discouraged.

Taken together, work and other social responsibilities, as well as cultural differences may influence the association between marital status and physical inactivity (Pitsavos *et al*, 2005).

With respect to education level, our study indicated that men with primary or secondary academic background were less likely to be physically inactive than those with tertiary qualification were. It is plausible that those who obtained low levels of education would secure jobs in physical labor and this strenuous work-related activity may translate into physical activity (He and Baker, 2005). However, no significant association was found between men with no formal education and physical inactivity.

In contrast, women with no formal education were significantly associated with physical inactivitycompared to women with a tertiary degree.A possible explanation is that there may be a lack of awareness about the health benefits of physical activity among women with no formal education, leading to poor adherence to physical activity (McNeil *et al*, 2006).

In terms of employment status, private employees were more likely to be physically inactive than government employees were, across men, women, and the combined group. It is plausible that work burdens in private sector could lead to a lack of time for sufficient physical activity participation. The nonworking group (retirees, students, unemployed) was reported to have the highest odds of physical inactivity as compared to housewives, private employees, and government employees. In Malaysia, retirees tend to adopt a sedentary lifestyle after retirement. For students, the burdens of homework, housework, tuition, and other activities might occupy most of their time. Therefore, they left limited time to involve in physical activity (Aniza and Fairuz, 2009).

Among the combined group of men and women, physical inactivity is positively associated with monthly household income. Our results were similar to findings of a study that reported that high income was significantly associated with insufficient physical activity (Trinh *et al*, 2008). People with higher income may tend to live a more sedentary lifestyle compared to those with lower income. Furthermore, the higher income group also tended to engage in comfortable jobs with sedentary nature compared to those from lower income group. However, in contrast to our findings, previous studies have indicated that adults with a higher household income were more likely to be physically active (Bauman *et al*, 2002; Trost *et al*, 2002). Possibly the higher income group in those studies were more health conscious, could easily access and afford various physical activity facilities that require additional expenses compared to the lower income group (Burgoyne *et al*, 2008). Further investigations into these aspects are needed to provide evidence-based information for physical inactivity intervention among lower income groups.

The major strength of this study is the population-based research involving a large sample that is representative of the Malaysian population. The use of GPAQ in this study allowed us to determine the level of physical activity in each of three physical activity domains, which is very important to provide an insight into the pattern of physical activity among Malaysian adults. However, a cross sectional study design was used; therefore it could not explain the causal relationships between the socio-demographic factors and physical inactivity. Converserly, level

of physical activity was assessed using questionnaires. Thus, inaccurate estimation of physical activity level and recall bias are unavoidable. Over-reporting of physical activity may also occur due to recall or social desirability, which would overestimate the prevalence of physical activity.

Despite these limitations, our study provides useful data on the prevalence of physical inactivity, and their socio-demographic correlates among Malaysian adults by gender.This study also suggested that the prevalence of physical inactivity among Malaysian adults was high. It was also noted that physical inactivity was more prevalent among women, urban residents, the elderly, and higher socio-economic groups. Specific physical activity programs tailored to targeted population groups (for example, exercise activities at workplace for employees, weight loss competitions for women) could be investigated for the enhancement of physical activity at the community level. Attempts to design health intervention strategies to increase participation of physical activity particularly in leisure time domain among Malaysian adults are needed, because positive relationship between leisure time physical activity and good health is well-documented. Further studies are needed to further investigate the social and physical environmental barriers that affect physical activity among the Malaysian population.

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