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Prevalence and correlates of physical inactivity among older adults in Malaysia: Findings from the National Health and Morbidity Survey (NHMS) 2015

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A R T I C L E I N F O

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A B S T R A C T

Malaysia has an increasingly aging population. Despite the substantial benefits of physical activity for healthy aging, older adults are considered the most physically inactive segment of the Malaysian population. The purpose of this study was to determine the prevalence of physical inactivity among older adults in Malaysia and its correlates. We analysed data on adults aged ≥60 years (n = 3790) from the National Health and Morbidity Survey (NHMS) 2015, a cross-sectional, nationwide population-based survey covering information on sociodemographic characteristics, physical activity and other lifestyle-related variables, health conditions, and functional limitations. Individuals included in this study were classified as physically active or physically inactive. Logistic regression was used to determine factors associated with physical inactivity. The overall prevalence of physical inactivity among older adults aged ≥60 years old was 48.8%. Physical inactivity was significantly more prevalent among females, older age groups, Indians, those being single/widowed/divorced, those with no formal education, those who reported high sedentary time (≥7 h/day), those with diabetes, anaemia, and functional limitations ($p < 0.001$). In fully adjusted analyses, females, older age, high household income (≥MYR4000), inadequate fruits and vegetables consumption (< 5 servings/day), high sedentary time, having diabetes, and having mobility impairment were all associated with physical inactivity. Approximately half of the Malaysian older population are physically inactive. Identifying the correlates of physical inactivity among Malaysian older adults will help to develop public health policies and interventions that encourage active living among older people and promote healthy aging in Malaysia.

1. Introduction

Population aging is occurring in both developed and developing countries, mainly driven by low fertility rates and/or increased life expectancy in most regions of the world (He, Goodkind, & Kowal, 2016). Malaysia, like many other developing countries in Asia, is experiencing a rapid growth of the older population. Malaysia will be classified as an aging nation by the year 2030 when 14% of the population will be 60 years and over and this will further increase to 24% by 2050 (International Council on Management of Population Programmes (ICOMP, 2017). One of the biggest challenges of an increasing aging population is the increasing burden of illness in older people from non-communicable diseases (NCDs) such as heart disease, cancer, diabetes, and chronic respiratory diseases (World Health Organization (WHO, 2014). An unhealthy diet, physical inactivity, tobacco use, and excessive alcohol consumption are considered the most important modifiable risk factors for NCDs (Wu et al., 2015). All these factors may be affected by individual lifestyle choices that are often influenced by varying levels of economic development, rapid urbanization and environmental change. The World Health Organization

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(WHO) Policy Framework on Active Aging has endorsed the importance of physical activity and exercise among older people as an important strategy to overcome the global burden of NCDs (World Health Organization (WHO, 2002).

Although we cannot stop the biological process of aging, regular participation in sport activities and/or being physically active can minimize the physiological alterations due to aging and may contribute to healthier lives and well-being (Chodzko-Zajko, Proctor et al., 2009). Regular physical activity imparts substantial health benefits towards healthy aging and these benefits are well documented (Chodzko-Zajko, Schwingel, & Park, 2009; Chodzko-Zajko, Proctor et al., 2009; Taylor, 2014). Despite substantial evidence for the health benefits of physical activity in lowering the incidence of cardiovascular disease and improving quality of life, the number of those who are physically active worldwide is relatively small (Dumith, Hallal, Reis, & Kohl, 2011) and even fewer older adults participate in regular physical activity with sufficient intensity, frequency, and duration to obtain optimal health benefits (Chodzko-Zajko, Proctor et al., 2009). Based on the WHO guidelines "Global Recommendations on Physical Activity for Health" (World Health Organization (WHO, 2010), older adults should perform at least 150 min of moderate-intensity aerobic physical activity or at least 75 min of vigorous-intensity aerobic physical activity throughout the week, which is equal to a total physical activity of at least 600 metabolic equivalent (MET) minutes per week. It is recommended that older adults who have various health conditions should try to be as physically active as possible.

Recent statistics showed that physical inactivity caused 6 to 10% of all major NCDs worldwide and caused approximately 5.3 of the 57 million deaths in 2008 (Lee et al., 2012). It was estimated that complete cessation of physical inactivity would increase the global population life expectancy by 0.68 (range 0.41-0.95) years, which is comparable to quitting smoking and losing weight (Lee et al., 2012). In Malaysia, 16% of mortality from all causes and 18% of mortality from colon cancer is attributed to physical inactivity in the general adult population (Lee et al., 2012). In general, older adults tend to be more physically inactive than younger adults, despite physical inactivity having a major health impact among the older population. Older adults are the population at greater risk of developing chronic health conditions, leading to an increased use of health care systems by them and rising health care costs of the country. Though Malaysia has quite a comprehensive range of health care services and health promotion programs for the general population, special health programs or interventions to increase physical activity level among older adults are lacking. Considering the negative implications of physical inactivity, it is important to understand the factors associated with physical inactivity among older adults in order to optimize physical activity participation.

Various studies have examined factors associated with physical inactivity of different age groups in specific populations (Newtonraj et al., 2017; Pengpid et al., 2015; Trude, Vedovato, Mui, Oliveira, & Martins, 2016) but very few have specifically focused on older people (a generally understudied population group). In Malaysia, some research has focused on physical inactivity. A study by Baharudin et al. (2014) evaluated the factors associated with physical inactivity in school-going adolescents. Another study reported the association between several socio-demographic factors (i.e. age, sex, marital status, and educational level) with physical inactivity among Malaysian adults aged 18 years and above (Chan et al., 2014). Only one study has described the demographic predictors of physical inactivity among the elderly in Malaysia (Kaur et al., 2015). However, this study only examined the socio-demographic factors associated with physical inactivity. Other relevant factors, such as personal health conditions and lifestyle factors, were not included. There is, thus, a gap in knowledge on older Malaysians on this issue. Considering the growing number of this understudied population group (older adults), and the potential consequences of being the most physically inactive segment of society, we intended to focus on physical inactivity among Malaysian older adults and its correlates. The aim of this study was to investigate the prevalence and factors associated (specifically, socio-demographic, chronic diseases, lifestyle factors, and functional limitations) with physical inactivity among older adults aged 60 years or more in Malaysia. We believe findings from this study will provide useful information for policy makers and program managers in decision-making and in the design of appropriate physical activity intervention programs for older people in Malaysia.

2. Materials and methods

2.1. Sampling and study population

The data for this study was obtained from the National Health and Morbidity Survey (NHMS) 2015, a cross-sectional population survey with two-stage stratified random sampling conducted in the year 2015. The target population was persons residing in non-institutionalized living quarters for at least 2 weeks prior to the data collection period. The sampling frame for this survey was provided by the Department of Statistics Malaysia. The primary sampling units were enumeration blocks (EBs) stratified by states and, within each randomly selected EB, the Living quarters (LQs) stratified by urban-rural residence were selected as the secondary sampling units. All households and eligible respondents within a selected LQ were included in the survey. The detail of the survey methodology has been described in the NHMS 2015 technical report (Institute for Public Health, 2015). In this study, data from 3790 samples of Malaysian older adult population aged 60 years and above was analysed.

2.2. Instruments and procedures

Data collection was carried out from March to June 2015. All eligible respondents were asked to give written consent prior to face-to-face interviews by trained enumerators. Those who were illiterate provided oral informed consent including his/her thumb print on the consent form. A standardised bilingual (English and Malay) structured questionnaire was made available through a mobile application, known as "e-NHMS 2015″, and the interview was done using mobile devices. All eligible adults aged 18 years and older from the selected households were invited to participate in this survey. For the purpose of this study, only the subsample data of adults aged 60 years and older (n = 3790) were used in the analysis. Ethical approval for this study was obtained from the Medical Research and Ethics Committee (MREC), Ministry of Health Malaysia (NMRR-14-1064-21877).

2.2.1. Physical activity assessment

Self-reported physical activity was assessed using the short version of the International Physical Activity Questionnaire (IPAQ), which has been proven to be valid and reliable for adults in twelve different countries (Craig et al., 2003). This instrument (both English and Malay versions) was pre-validated to measure physical activity levels in the Malaysian adult population, including for older adults, during the NHMS conducted in 2011 (Teh et al., 2014). In NHMS 2015, we adopted the pre-validated short version IPAQ comprising six questions assessing the frequency and duration of walking, moderate- and vigorous-intensity physical activity in the pass one week, as well as one additional question on time spent sitting or sedentary time on a typical day. Although there were some limitations with regard to the reliability of IPAQ in assessing physical activity level among elderly, the IPAQ remains a useful tool for physical activity assessment in larger population-based samples of elderly adults (Tomioka, Iwamoto, Saeki, & Okamoto, 2011). Based on the IPAQ scoring protocol, total physical activity was calculated in metabolic equivalent task minutes per week (MET-minutes/week) before classification into low, moderate and high PA levels (IPAQ, 2005). In the present study, individuals who achieved a low level of physical activity (less than 600 MET-minutes/week) were reclassified as "physically inactive", while individuals who achieved a moderate to high level of physical activity (600 or more MET-minutes/week) were reclassified as "physically active".

2.2.2. Sociodemographic variables

Data on socio-demographic information used in this study were: sex, age group (60–69 years, 70–79 years, 80 years and older), ethnicity (Malays, Chinese, Indians, Others), residential area (urban or rural), marital status (married, single/widowed/divorced), educational level (no formal education, primary, secondary or higher), and monthly household income. The monthly household income was divided into quintiles, with the lowest 20% of household income falling into the first quintile (Q1) and the highest 20% into the fifth quintile (Q5).

2.2.3. Lifestyle-related variables

These included body mass index (BMI), abdominal obesity, consumption of fruits and vegetables, smoking, alcohol drinking and sedentary time. Body weight and height were measured using TANITA Digital Weighing Scale HD 319 (TANITA Corp., Tokyo, Japan) and SECA Portable Stadiometer 213 (SECA GmbH & Co. KG, Hamburg, Germany) respectively. BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2), and classified as underweight (< 18.5), normal (18.5–24.9), overweight (25.0–29.9), and obese (≥30) (World Health Organization (WHO, 2000). Abdominal obesity was defined based on WHO international recommendations (World Health Organization (WHO, 2008), using waist circumference cut-offs of 102 and 88 cm to define increased risk for cardiometabolic disease in men and women, respectively. Fruits and vegetables consumption was assessed according to WHO STEPS criteria (World Health Organization (WHO, 2015) and classified as adequate (≥5 servings per day) and inadequate consumption of fruits and vegetables (< 5 servings per day). Smoking status was grouped into two categories: "never smoked" and "former smoker/current smoker". Alcohol drinking status was also divided into two categories: "never drank" and "former drinker/current drinker". Total sedentary time was grouped into five categories (quintiles) as " < 2 h/day" (Q1), "2 - < 3 h/day" (Q2), "3 - < 5 h/day" (Q3), "5 - < 7 h/day" (Q4), "≥7 h/day" (Q5).

2.2.4. Health conditions

Diabetes was screened based on finger-pricked fasting blood glucose level of 6.1 mmol/L or more or non-fasting blood glucose level of more than 11.1 mmol/L (Clinical Practice Guidelines (CPG, 2009) during the survey period; or self-reported medically-diagnosed diabetes. Hypercholesterolemia was measured based on finger-pricked total blood cholesterol level (≥5.2 mmol/L, fasting blood sample) (Clinical Practice Guidelines (CPG, 2011) during the survey period; or self-reported medically-diagnosed hypercholesterolemia. Both blood glucose and blood cholesterol levels were examined using a validated CardioCheck® PA Analyser (Ahmad, Yusoff, Daud, Abd Hamid, & Aris, 2012). Blood pressure was measured twice with a 10-minute interval using a calibrated digital blood pressure-measuring device (OMRON HEM-907) during the survey period. Hypertension was defined as having a systolic blood pressure of 140 mmHg or more and/or a diastolic blood pressure of 90 mmHg or more (Clinical Practice Guidelines (CPG, 2013); or self-reported medically-diagnosed hypertension. For anaemia, haemoglobin (Hb) level in capillary blood sample was measured using HemoCue point-of-care testing (POCT) devices. Anaemia was defined based on WHO cut-offs for men (Hb < 130 g/L) and women (Hb < 120 g/L) (World Health Organization (WHO, 2001). All finger-prick tests and blood pressure measurements were performed by trained nurses.

2.2.5. Functional limitations

Functional limitations or difficulties were captured using the Washington Group (WG) Questionnaire (short version) (WG, 2010). There were six questions asking whether people have difficulty performing basic activities in six functional domains; seeing (even while wearing glasses), hearing (even while using a hearing aid), walking, cognitive status, self-care and communication. Each question has four possible responses: (1) No, no difficulty, (2) Yes, some difficulty, (3) Yes, a lot of difficulty, (4) Cannot do it at all. In this study, for each type of functional limitation, respondents who answered they either have "some difficulty", "a lot of difficulty', or "cannot do it at all" were categorized as "Yes", while those who answered they have no difficulty were categorized as "No".

2.3. Statistical analysis

Descriptive statistics and multivariable logistic regression analysis were performed to examine the prevalence of physical inactivity and its potential correlates. Chi-square test (χ^2) was performed to investigate the bivariate relationships between the studied variables and physical inactivity. Adjusted logistic regression was used to examine possible correlates of physical inactivity using three models: Model 1 included socio-demographic characteristics, Model 2 added lifestyle-related variables, and Model 3 further adjusted for health conditions and functional limitations. Results were presented as odds ratios (ORs) with 95% confidence intervals (CIs) and statistical significance at p-value < 0.05. All analyses were performed using the Statistical Package of Social Sciences (SPSS) for Windows version 21.0 (IBM Corp., Armonk, NY, USA), taking into consideration the sample weighting and complex sampling design.

3. Results

There were 3790 older adults aged 60 years and above participated in the NHMS 2015. A total of 3753 older adults completed the physical activity module of the survey, giving a response rate of 99.0% to this module. Only 37 respondents did not complete the physical activity module and were excluded from the analysis.

Table 1 shows the descriptive statistics on physical activity (inactive and active) by socio-demographic variables, lifestyle-related variables, health conditions and functional limitations. Of the 3753 respondents, 1774 (48.8%) were found to be physically inactive. The prevalence of physical inactivity significantly increased with increasing age from 40.6% among adults aged 60–69 years, to 57.6% among adults aged 70–79 years, and 79.1% among adults aged ≥80 years. Females, Indian ethnicity, single/widowed/divorced status, and those with lower education were also found to have a significantly higher prevalence of physical inactivity. Physical inactivity was also found to be significantly associated with high sedentary time, diabetes, anaemia, visual impairment, hearing impairment, mobility impairment, cognitive impairment, self-care difficulties and communication difficulties (all with $p < 0.001$).

Table 2 shows the adjusted logistic regression analyses for physical inactivity in three different models. After adjusting for socio-demographic variables (model 1), females, older age, Indian ethnicity, single/widowed/divorced status, and those residing in urban areas were associated with higher odds of physical inactivity. However, those who reported having secondary or a higher educational level were less likely to be physically inactive. After additional adjustment for lifestyle-related variables (model 2), older age, Indian ethnicity, single/widowed/divorced status, and those residing in urban areas were the socio-demographic factors that remained significantly associated with higher odds of physical inactivity. Individuals with secondary or a higher educational level remained less likely to be physically inactive. Individuals who consumed less fruits and vegetables (< 5 servings per day) and with high sedentary time (≥7 h per day) were significantly more likely to be physically inactive. Further adjustment for health conditions and functional limitations (model 3) attenuated associations of several socio-demographic variables with physical inactivity. Females (OR 1.33, 95% CI 1.01–1.74) and older age (70–79 years, OR 1.62, 95% CI 1.26–2.08; ≥80 years, OR 3.12, 95% CI 1.86–5.26) remained significantly associated with higher odds of physical inactivity.

Table 1
Physical activity status by socio-demographic characteristics, lifestyle-related variables, health conditions and functional limitations (N = 3753).

Variables	Total sample N (%)	Physical activity status		P value (χ^2)
		Inactive N (%)	Active N (%)	
Overall	3753 (100.0)	1774 (48.8)	1979 (51.2)	–
Socio-demographic characteristics				
Sex				< 0.001
Male	1754 (49.1)	743 (43.7)	1011 (56.3)	
Female	1999 (50.9)	1031 (53.7)	968 (46.3)	
Age group (years)				< 0.001
60–69	2333 (62.6)	901 (40.6)	1432 (59.4)	
70–79	1118 (28.9)	629 (57.6)	489 (42.4)	
≥80	302 (8.5)	244 (79.1)	58 (20.9)	
Ethnicity				0.036
Malays	2411 (48.3)	1106 (46.9)	1305 (53.1)	
Chinese	807 (35.0)	383 (47.8)	424 (52.2)	
Indians	230 (6.7)	139 (61.2)	91 (38.8)	
Others	305 (10.0)	146 (52.9)	159 (47.1)	
Residential area				0.051
Rural	1918 (27.9)	864 (45.4)	1054 (54.6)	
Urban	1835 (72.1)	910 (50.1)	925 (49.9)	
Marital status				< 0.001
Married	2525 (68.1)	1063 (44.2)	1462 (55.8)	
Single/widowed/divorced	1228 (31.9)	711 (58.7)	517 (41.3)	
Educational level				< 0.001
No formal education	760 (20.7)	445 (61.4)	315 (38.6)	
Primary	1941 (47.9)	909 (48.7)	1031 (51.3)	
Secondary or higher	1016 (31.4)	395 (40.0)	621 (60.0)	
Household income quintiles				0.805
Q1 (< MYR300)	672 (19.2)	343 (46.1)	329 (53.9)	
Q2 (MYR300-MYR1099)	804 (17.8)	378 (49.7)	426 (50.3)	
Q3 (MYR1100-MYR2012)	777 (18.9)	361 (50.1)	416 (49.9)	
Q4 (MYR2013-MYR3999)	738 (18.6)	328 (48.2)	410 (51.8)	
Q5 (≥MYR4000)	762 (25.4)	364 (49.7)	398 (50.3)	
Lifestyle-related variables				
BMI status (kg/m^2)				0.148
Underweight (< 18.5)	191 (5.6)	107 (53.2)	84 (46.8)	
Normal (18.5-24.9)	1481 (44.9)	662 (47.4)	819 (52.6)	
Overweight (25.0-29.9)	1163 (33.7)	479 (44.0)	684 (56.0)	
Obese (≥30)	538 (15.8)	234 (42.3)	304 (57.7)	
Abdominal obesity				0.851
Yes	2122 (63.0)	935 (45.6)	1187 (54.4)	
No	1254 (37.0)	548 (46.0)	706 (54.0)	
Consumption of fruits and vegetables				0.001
< 5 servings/day	3505 (93.5)	1691 (49.6)	1814 (50.4)	
≥5 servings/day	243 (6.5)	79 (35.0)	164 (65.0)	
Smoking				0.020
Never smoked	3056 (83.4)	1500 (50.0)	1556 (50.0)	
Former smoker/ Current smoker	694 (16.6)	273 (43.0)	421 (57.0)	
Alcohol drinking				0.001
Never drank	3473 (95.1)	1662 (49.8)	1811 (50.2)	
Former drinker/ Current drinker	131 (4.9%)	44 (31.6)	87 (68.4)	
Sedentary time quintiles				< 0.001
Q1 (< 2 h/day)	553 (13.5)	209 (43.3)	344 (56.7)	
Q2 (2 - < 3 h/day)	618 (15.3)	242 (40.0)	376 (60.0)	
Q3 (3 – < 5 h/day)	1026 (25.0)	440 (42.7)	586 (57.3)	
Q4 (5 – < 7 h/day)	753 (21.1)	374 (48.2)	379 (51.8)	
Q5 (≥7 h/day)	803 (25.2)	509 (63.7)	294 (36.3)	
Health conditions				
Diabetes				< 0.001
Yes	1452 (38.2)	757 (42.3)	695 (34.3)	
No	2301 (61.8)	1017 (45.6)	1284 (54.4)	
Hypertension				0.330
Yes	2605 (69.2)	1265 (49.5)	1340 (50.5)	
No	1148 (30.8)	509 (47.2)	639 (52.8)	
Hypercholesterolaemia				0.116
Yes	2444 (62.5)	1130 (47.4)	1314 (52.6)	

(*continued on next page*)

Table 1 (*continued*)

Variables	Total sample N (%)	Physical activity status		P value (χ^2)
		Inactive N (%)	Active N (%)	
No	1309 (37.5)	644 (51.2)	665 (48.8)	
Anaemia				< 0.001
Yes	1293 (35.0)	684 (54.1)	609 (45.9)	
No	2231 (65.0)	959 (44.7)	1272 (55.3)	
Functional limitations				
Visual impairment				< 0.001
Yes	1427 (39.0)	792 (58.4)	635 (41.6)	
No	2326 (61.0)	982 (42.7)	1344 (57.3)	
Hearing impairment				< 0.001
Yes	843 (22.4)	522 (63.7)	321 (36.3)	
No	2909 (77.6)	1252 (44.5)	1657 (55.5)	
Mobility impairment				< 0.001
Yes	1477 (40.7)	951 (64.6)	526 (35.4)	
No	2276 (59.3)	823 (37.9)	1453 (62.1)	
Cognitive impairment				< 0.001
Yes	933 (27.1)	608 (65.9)	325 (34.1)	
No	2819 (72.9)	1166 (57.5)	1653 (57.5)	
Self-care difficulties				< 0.001
Yes	393 (10.3)	339 (84.8)	54 (15.2)	
No	3359 (89.7)	1435 (44.7)	1924 (55.3)	
Communication difficulties				< 0.001
Yes	439 (12.2)	330 (75.9)	109 (24.1)	
No	3314 (87.8)	1444 (45.0)	1870 (55.0)	

Individuals with high household income (≥MYR4000) were slightly more likely to be classified as physically inactive (OR 1.42, 95% CI 1.02–1.99). Associations between low intake of fruits and vegetables (OR 1.66, 95% CI 1.03–2.67) and high sedentary time (OR 1.92, 95% CI 1.30–2.84) with physical inactivity remained significant. With regards to health conditions and functional limitations, only diabetes (OR 1.43, 95% CI 1.16–1.77) and mobility impairment (OR 1.55, 95% CI 1.22–1.97) showed significant associations with physical inactivity.

4. Discussion

This study provides important information on prevalence and correlates of physical inactivity among older adults aged 60 years and over in Malaysia. Our findings identified specific subgroups who are at greater risk of physical inactivity among Malaysian older adults and the associated socio-demographic, lifestyle, health conditions and functional impairment factors.

We found that the prevalence of physical inactivity among older adults was 48.8%, i.e., approximately half of the Malaysian older population were physically inactive. This prevalence is lower than those reported in the previous NHMS 2011 (55.6%, among older adults aged ≥65 years) (Teh et al., 2014) and NHMS 2006 (88.0%, among older adults aged ≥60 years) (Kaur et al., 2015), indicating improvements in physical activity participation among older adults. This is encouraging in light of intensive efforts by the Malaysian government to promote healthy lifestyles over the past 10 years. However, the prevalence of physical inactivity among older persons is still considered high, particularly among females and older age groups. Compared to other countries, the Malaysian prevalence is higher than those reported in China (24.1%, among adults aged ≥50 years) and India (22.0%, among adults aged ≥50 years), but is lower than in South Africa (50.9%, among adults aged ≥50 years) and Brazil (62%, among older adults aged ≥60 years) (Koyanagi, Stubbs, Smith, Gardner, & Vancampfort, 2017; Souza, Fillenbaum, & Blay, 2015). The prevalence of physical inactivity varies substantially across different countries, age groups and settings. Different age boundaries, measurement methods and questionnaires used may also contribute to the variations in the prevalence of physical inactivity.

Our findings on physical inactivity significantly increasing as age increases, and females being more likely to be inactive than males are consistent with previous studies (Chen, While, & Hicks, 2015; Hong, 2016; Kaur et al., 2015; Murtagh et al., 2015; Vagetti et al., 2013). With regards to age, both the ≥80 (3.12 times) and 70–79 (1.6 times) age groups were more likely to be physically inactive than those aged 60–69 years. This finding is not unexpected. There is evidence to suggest that the increased inactivity with age may be due to poor health and psychosocial factors such as fear of physical injury during exercise, loneliness, lack of company, lack of family support, and lack of interest (Moschny, Platen, Klaassen-Mielke, Trampisch, & Hinrichs, 2011; Smith, Banting, Eime, O'Sullivan, & van Uffelen, 2017). Besides individual and psychosocial factors, environmental factors, such as lack of sports or recreational facilities in the neighbourhood (e.g., walking/cycling paths, recreational parks, green open spaces) and safety issues (e.g., traffic safety, personal safety) have also correlated with physical inactivity in older adults (Thornton et al., 2017). With regards to gender, females were 1.3 times more likely to be inactive than males in our fully adjusted analysis (model 3). The gender difference in physical activity has been widely documented and attributed to various factors, including family and societal roles, physical and psychological issues, and life conditions between men and women (Giuli, Papa, Mocchegiani, & Marcellini, 2012). Primarily, women are the main caregivers and home managers in the family which tend to restrict their participation in physical activities. It is important to educate and raise awareness on the health benefits of physical activity among women. In summary, our findings highlight the need to target both these vulnerable groups (older age and women) in public health programs and interventions in order to support their involvement in physical activities according to recommended guidelines. Moreover, a healthy and active lifestyle should be cultivated early in life, particularly in communities with high levels of physical inactivity. A healthy lifestyle with appropriate physical activity level once established at an early age will be maintained throughout life. This will make a difference in the long term for health,

Table 2
Logistic regression analyses for physical inactivity among older adults aged 60 years and above, NHMS 2015.

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Socio-demographic characteristics									
Sex									
Male	1.00	–	–	1.00	–	–	1.00	–	–
Female	1.24	1.01-1.52	0.040	1.16	0.89-1.51	0.277	1.33	1.01-1.74	0.042
Age group (years)									
60–69	1.00	–	–	1.00	–	–	1.00	–	–
70–79	1.92	1.52-2.42	< 0.001	1.84	1.45-2.35	< 0.001	1.62	1.26-2.08	< 0.001
≥80	4.89	3.28-7.29	< 0.001	3.96	2.47-6.37	< 0.001	3.12	1.86-5.26	< 0.001
Ethnicity									
Malays	1.00	–	–	1.00	–	–	1.00	–	–
Chinese	0.92	0.71-1.18	0.497	0.98	0.73-1.31	0.886	1.02	0.75-1.37	0.912
Indians	1.71	1.12-2.61	0.012	1.65	1.05-2.59	0.029	1.56	0.96-2.56	0.076
Others	1.14	0.79-1.64	0.494	1.17	0.74-1.84	0.498	1.10	0.71-1.71	0.682
Residential area									
Rural	1.00	–	–	1.00	–	–	1.00	–	–
Urban	1.46	1.15-1.84	0.002	1.36	1.05-1.75	0.019	1.28	0.99-1.67	0.064
Marital status									
Married	1.00	–	–	1.00	–	–	1.00	–	–
Single/widowed/divorced	1.31	1.05-1.63	0.018	1.31	1.03-1.66	0.028	1.23	0.96-1.58	0.107
Educational level									
No formal education	1.00	–	–	1.00	–	–	1.00	–	–
Primary	0.78	0.60-1.01	0.063	0.79	0.59-1.07	0.127	0.88	0.64-1.21	0.430
Secondary or higher	0.60	0.44-0.82	0.001	0.62	0.44-0.88	0.007	0.73	0.51-1.06	0.099
Household income quintiles									
Q1 (< MYR300)	1.00	–	–	1.00	–	–	1.00	–	–
Q2 (MYR300-MYR1099)	1.19	0.88-1.62	0.253	1.21	0.86-1.70	0.264	1.21	0.85-1.73	0.286
Q3 (MYR1100-MYR2012)	1.30	0.97-1.75	0.079	1.29	0.93-1.77	0.124	1.29	0.92-1.80	0.146
Q4 (MYR2013-MYR3999)	1.24	0.92-1.68	0.166	1.20	0.86-1.69	0.285	1.20	0.85-1.70	0.302
Q5 (≥MYR4000)	1.31	0.97-1.78	0.082	1.36	0.98-1.88	0.066	1.42	1.02-1.99	0.038
Lifestyle-related variables									
BMI status (kg/m^2)									
Underweight (< 18.5)				1.10	0.72-1.67	0.668	1.07	0.70-1.61	0.767
Normal (18.5–24.9)				1.00	–	–	1.00	–	–
Overweight (25.0–29.9)				0.84	0.64-1.11	0.211	0.85	0.64-1.13	0.263
Obese (≥30)				0.87	0.62-1.22	0.423	1.07	0.70-1.61	0.322
Abdominal obesity									
Yes				1.09	0.81-1.46	0.585	0.97	0.72-1.31	0.849
No				1.00	–	–	1.00	–	–
Consumption of fruits and vegetables									
< 5 servings/day				1.78	1.14-2.77	0.012	1.66	1.03-2.67	0.039
≥5 servings/day				1.00	–	–	1.00	–	–
Smoking									
Never smoked				1.00	–	–	1.00	–	–
Former smoker/ Current smoker				0.91	0.66-1.25	0.563	0.95	0.69-1.30	0.731
Alcohol drinking									
Never drank				1.00	–	–	1.00	–	–
Former drinker/ Current drinker				0.48	0.27-0.85	0.012	0.61	0.33-1.12	0.109
Sedentary time quintiles									
Q1 (< 2 h/day)				1.00	–	–	1.00	–	–
Q2 (2 - < 3 h/day)				0.97	0.68-1.38	0.860	0.93	0.65-1.35	0.713
Q3 (3 - < 5 h/day)				1.11	0.78-1.56	0.568	1.10	0.77-1.58	0.608
Q4 (5 - < 7 h/day)				1.21	0.86-1.71	0.266	1.24	0.87-1.78	0.234
Q5 (≥7 h/day)				1.90	1.31-2.75	0.001	1.92	1.30-2.84	0.001
Health conditions									
Diabetes									
Yes							1.43	1.16-1.77	0.001
No							1.00	–	–
Hypertension									
Yes							0.95	0.75-1.20	0.658
No							1.00	–	–
Hypercholesterolaemia									
Yes							0.83	0.66-1.05	0.127
No							1.00	–	–
Anaemia									

(*continued on next page*)

Table 2 (*continued*)

Variables	Model 1			Model 2			Model 3		
	OR	95% CI	P value	OR	95% CI	P value	OR	95% CI	P value
Yes							0.99	0.80-1.24	0.936
No							1.00	–	–
Functional limitations									
Visual impairment									
Yes							1.11	0.86-1.44	0.423
No							1.00	–	–
Hearing impairment									
Yes							1.08	0.77-1.52	0.647
No							1.00	–	–
Mobility impairment									
Yes							1.55	1.22-1.97	< 0.001
No							1.00	–	–
Cognitive impairment									
Yes							1.11	0.82-1.51	0.511
No							1.00	–	–
Self-care difficulties									
Yes							1.47	0.80-2.69	0.210
No							1.00	–	–
Communication difficulties									
Yes							1.46	0.92-2.30	0.108
No							1.00	–	–
Pseudo R2		0.087			0.101			0.133	

Model 1: adjusted for socio-demographic variables (sex, age group, ethnicity, residential area, marital status, educational level, household income quintiles);
Model 2: Model 1 + lifestyle factors (BMI, abdominal obesity, consumption of fruits and vegetables, smoking, alcohol drinking, sedentary time quintiles);
Model 3: Model 2 + health conditions (diabetes, hypertension, hypercholesterolaemia, anaemia) + functional limitations (visual impairment, hearing impairment, mobility impairment, cognitive impairment, self-care difficulties, communication difficulties).

well-being, and longevity as the population ages.

With regards to socio-demographic influences on physical inactivity (model 1) and after further adjustment for lifestyle factors (model 2), we observed that older adults of Indian ethnicity, residing in urban areas, those being single/widowed/divorced were more likely to be physically inactive, while those with secondary or higher educational levels were less likely to be physically inactive. Previous studies have shown that physical inactivity varies with ethnicity and is greatly influenced by cultural factors and social environment surrounding the individual (Kaur et al., 2015; Tam, Bonn, Yeoh, Yap, & Wong, 2016). In keeping with previous findings (Kaur et al., 2015), older adults living in urban areas were more inactive than their rural counterparts. The modern facilities and sedentary lifestyle with increased use of passive modes of transport may contribute to the decline in physical activity among older urban dwellers. The surrounding environment, lacking in parks, sidewalks and sport/recreation facilities, as well as neighbourhood safety concerns (i.e. crime-related safety and traffic-related safety issues in urban areas) may also result in the differences in physical inactivity levels among older persons in urban and rural areas (Moran et al., 2014). In agreement with a study by Peetee et al. (2006), marital status was an important determinant for physical activity participation among older adults, where those being single/widowed/divorced were more inactive compared with their married counterparts. Older adults with higher educational levels were more physically active possibly due to a higher awareness of the health benefits of physical activity. However, further adjustment with health conditions and functional limitations covariates (model 3) attenuated the associations of ethnicity, residential area, marital status and educational level with physical inactivity among older adults, with other variables such as diabetes and mobility impairment playing an important role.

In the fully adjusted analysis, we observed that older adults with high household monthly income (≥MYR4000) were 1.4 times more likely to be physically inactive compared to those with low household monthly income (< MYR300). Educational level did not show any significant association with physical activity levels of the older adults. These findings are in contrast with previous studies, which reported that older people with higher socioeconomic status tend to maintain high levels of physical activity; while those with lower socioeconomic status tend to remain inactive (McPhee et al., 2016; Smith, Gardner, Fisher, & Hamer, 2015; Souza et al., 2015). However, a recent study found mixed findings with regards to the socio-demographic correlates of physical inactivity among adults aged 50 or more depending on the country (Koyanagi et al., 2017). The wealthier strata in high-income countries were associated with lower odds for physical inactivity; while the wealthier strata in middle-income countries were associated with higher odds for physical inactivity (Koyanagi et al., 2017). It is postulated that middle-income countries such as Malaysia is experiencing high levels of urbanization where the increasing levels of wealth are parallel with less labor-demanding jobs and sedentary lifestyles. Our finding suggests that interventions to improve physical activity levels should be targeted to older adults with higher household incomes.

Among the lifestyle-related variables, older adults with inadequate fruits and vegetables consumption were significantly more likely to be physically inactive. This is consistent with previous studies which reported that older people who consumed adequate amount of fruits and vegetables were more active than those who did not consume adequately (Doubova, Sánchez-García, Infante-Castañeda, & Pérez-Cuevas, 2016; Koyanagi et al., 2017; Lim & Taylor, 2005). Both inadequate fruits and vegetables consumption and physical inactivity are unhealthy behaviours that may co-exist within an individual's lifestyle and tends to cluster throughout one's life (Meader et al., 2016). Healthy eating and physical activity are important modifiable lifestyle factors that are essential for heathy aging and are, therefore, amenable to public health interventions and health promotion programs.

There were no significant associations between BMI and abdominal obesity with physical inactivity among Malaysian older adults. The non-significant findings may be due to the influence of energy (food) intake which was not captured and controlled for in the statistical model. Another study which found no significant association between BMI and physical activity practice (Vagetti et al., 2013) suggested that the different criteria used to determine the exposure (e.g., different BMI cutoff points) and outcome variables (e.g., total physical activity) might affect the results. Recall problems and social desirability on self-reported physical activity may also explain the differences between studies. Smoking and alcohol drinking also showed no significant association with physical inactivity among older adults in the fully adjusted model (model 3). However, for alcohol drinking, older adults who were former or current drinkers were less likely to be physically inactive, after controlling for socio-demographic and lifestyle-related variables (model 2). Previous literature supports a positive association between alcohol drinking and physical activity across all ages, indicating that people who drink alcohol are more physically active (Leasure, Neighbors, Henderson, & Young, 2015; Piazza-Gardner & Barry, 2012). It may be that physical activity is an integral aspect of people's social life, so it often involves social situations or events where alcohol is consumed (Finlay, Ram, Maggs, & Caldwell, 2012). Future research should focus specifically on identifying the precise reason why alcohol drinkers were more physically active than nondrinking peers.

In support of a previous study by McKee, Kearney, and Kenny (2015), this study found that self-reported sitting time or sedentary time was strongly associated with physical inactivity among older adults. This finding may be somewhat expected, as people who are sedentary and have a high sitting time may be very inactive or do very little exercise, resulting in low physical activity levels. Older people were most likely to have prolonged sitting time or high levels of sedentary time along with low levels of physical activity, and these combinations of behaviours might be most at risk of the associated non-communicable diseases (Loyen et al., 2016). Thus, older people with these behaviours (highly sedentary and inactive) deserve special attention in both research as well as in interventions and policy planning.

The fully adjusted logistic regression analyses showed that older adults with diabetes were associated with significantly greater likelihood of physical inactivity compared to older adults without diabetes. This finding is consistent with previous study in the United States that older adults with diabetes mellitus were less likely to engage in physical activity at the recommended levels (Zhao, Ford, Li, & Balluz, 2011). Furthermore, older people with diabetes were more likely to perform poorly on the walking speed and balance tests, which might increase their risks of falling and more likely to have fall-related injuries and complications requiring hospitalization than those without diabetes (Yau et al., 2013). Hence, the fear of falling and risk of injurious falls may be the reasons for being physically inactive among older adults with diabetes. It is recommended that physical activity interventions or educational programs targeting older adults with diabetes mellitus should be personalized or tailored toward their culture so as to provide support and encourage them to perform physical activity safely. It is also important to provide specific counselling or advice on the health benefits of physical activity as a routine part of the care for older people with health problems such as diabetes in primary health care setting. Other health conditions such as hypertension, hypercholesterolaemia and anaemia showed no significant association with physical inactivity among older adults. It may be that some older adults with these health problems are able to overcome their health-related obstacles and be physically active in their daily lives, but some others are not. The needs, safety and comfort of the individual older person should be prioritized when planning specific physical activity programs for older adults, especially those with specific health conditions.

Of the six different types of functional limitations, only mobility impairment was found to be significantly associated with physical inactivity in the fully adjusted model (model 3). The association with mobility impairment is expected, since people with difficulties in walking or moving around are usually having difficulties in performing any form of physical activity. Other types of functional limitations such as visual impairment, hearing impairment, cognitive impairment, self-care difficulties and communication difficulties were associated with a higher likelihood of physical inactivity among older adults; however the associations were not statistically significant. A possible explanation is that most of the older people with these functional limitations may be facing only mild to moderate level of difficulties, and not totally unable to do it. Hence, they may be still able to perform certain types of light-to moderate-intensity physical activity or exercise according to their functional status.

There are several limitations in this study. First, the study design was cross-sectional; therefore the causal relationships between the studied factors and physical inactivity cannot be deduced. Second, data on physical activity were self-reported and subjected to recall bias or social desirability which may result in under- or over-estimation of levels of physical activity. There were no direct measures of physical activity levels in the NHMS 2015 because the use of objective devices, such as accelerometers, is expensive and may not be practical in a large sample survey. Also, it should be noted that the use of IPAQ in older adults aged 50 years or over may be not considered a good indicator for assessing individual older adult physical activity behaviour but is better suited for larger population-based samples (Grimm, Swartz, Hart, Miller, & Strath, 2012). IPAQ was used in the NHMS 2015 for a large population-based sample of adults aged 16 years and above, and the current study was a subset analysis on adults aged 60 years and older from the NHMS 2015 dataset. This represents an unavoidable limitation for application in older adults as the NHMS 2015 involved large populations of all age groups and not specifically targeted to elderly populations only. Although there were some limitations with regard to the reliability of IPAQ in assessing physical activity level among older adults, the IPAQ is a cost-effective and useful tool for physical activity assessment in larger population-based samples (Tomioka et al., 2011). Future research focusing on determining physical activity level among older people should consider using physical activity questionnaires or instruments that are validated specifically for use in older adults. Despite these limitations, our study's main strength is the multivariable analysis of a variety of factors, including lifestyle factors, health conditions, and different types of functional limitations collected in this study.

5. Conclusions

The prevalence of physical inactivity among Malaysian older adults was generally high, particularly among older age groups and females. Increasing age, female sex, high household income, unhealthy diet (inadequate fruits and vegetables consumption), sedentary behaviour (high sitting time), diabetes and mobility impairment were associated with a higher likelihood of older persons being physically inactive. Identifying determinants of physical inactivity is an essential step to develop effective interventions for promoting regular physical activity among older people. We believe our findings have important public health implications by highlighting the demographics and profiles of subgroups that are at greater risk of being physically inactive. Future interventions should consider the diversity within the older population and be flexible according to different needs of different older people. Prevention programs aimed at promoting healthy and active aging should focus on the importance and benefits of healthy behaviours from early ages.

Availability of the data and materials

For data protection purposes, the data used for this study are not publicly available but are available from the Institute for Public Health, Ministry of Health Malaysia upon reasonable request and with permission from the Director General of Health Malaysia.

Conflict of interest statement

The authors declare that they have no competing interests.

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