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Socioeconomic Disparities in Physical Activity Participation: An Exploratory Study Using Malay Sample

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The objective of the present study is to examine the effects of socioeconomic factors on participation in physical activity among Malays in Malaysia. Drawing on a nationally representative sample that contains 17,515 respondents, a logit model is developed to estimate the likelihood of adopting a physically active lifestyle. The results of the present study show that income, age, sex, education, house locality, and employment status are significantly related to the levels of physical activity. In particular, there are negative relationships between higher-income earners, the elderly, females, the less-educated, urban dwellers, and the non-working adults, and the likelihood of being physically active. In view of these findings, several public policies toward promoting physically active lifestyle are proposed.

Keywords: physical activity, socioeconomic disparities, urban, Malays, Malaysia

Lack of physical activity is one of the main determinants of negative health outcomes (World Health Organization, 2010). World Health Organization (2012) reported that three million mortalities and 32 million disability-adjusted life years (DALYs) yearly are associated with physical inactivity, ranking as one of the top health risk factors worldwide. Non-communicable diseases (NCDs), most notably, diabetes, cancers, and heart diseases are very common in adults with low levels of physical activity (Panagiotakos, Polystipioti, & Polychronopoulos, 2007; Humphreys & Ruseski, 2011).

There appears to be evidence suggesting that spending at least 150 minutes in medium-strenuous sport activities in a week can lower the likelihood of developing NCDs by one-third (World Health Organization, 2012). Research also shows that females who are active have a 50% lower likelihood of dying prematurely (Nicklett et al., 2012). Furthermore, Helmrich, Ragland, Leung, and Paffenbarger (1991) and LaMonte, Blair, and Church (2005) found that being physically active can lower the chances of being diagnosed with diabetes by 45%. Similar health outcomes are evidenced by Humphreys, Mcleod, and Ruseski (2014). Because of the unhealthy practices in today's society, the majority of the people are unlikely to allocate their time for physical activity. World Health

Organization (2012) reported that more than one-fourth of males and females were not physically active in 2008. For the case of Malaysia, the prevalence of physical inactivity was about 36% in 2011, and the majority of which were the elderly and female populations (Institute for Public Health, 2011). Poh et al. (2010) used the Malaysian Adults Nutrition Survey (MANS) and observed that only a small proportion of adults in Malaysia have ever-exercised (31%) and adequate exercise (14%).

In 2011, among all the ethnic groups in Malaysia, Malays faced the highest prevalence of hypertension (34%) and hypercholesterolemia (38.4%) (Institute for Public Health, 2011). Furthermore, the cases of diabetes (16.9%) and obesity (32%) in Malay ethnic group were the second highest of all the ethnicities (Institute for Public Health, 2011). To one's knowledge, the empirical studies have constantly found that Malays are highly associated with unhealthy behaviours. For example, Yen, Tan, and Nayga (2011) used a nationwide data and found that Malays have the lowest likelihood of adopting healthy diet practices. Tan, Yen, and Nayga (2009) observed that Malays possess the highest likelihood of indulging in smoking. Finally, based on a primary survey sample, Cheah (2011) found that Malays have the highest tendency to be physically inactive. As these facts and figures imply, there is an urgent need for paying special attention to Malay ethnic group.

In light of the importance of being physically active, there is a growing research on physical activity in economically developed countries (Farrell & Shields, 2002; Downward, 2007; Humphreys & Ruseski, 2007; Downward & Rasciute, 2010; Eberth & Smith, 2010; Humphreys & Ruseski, 2011; Wicker & Frick, 2015). Although Dan, Mohd Nasir, and Zalilah (2007), Aniza and Fairuz (2009), Cheah (2011), and Kee et al. (2011) have investigated the impact of socioeconomic factors on participation in physical activity in Malaysia, their analyses are restricted to a small population in certain districts. The influence of ethnicity on the probability to participate in physical activity is also not explored in great detail. Hence, the present study attempts to narrow this research void.

Overall, three contributions to the literature are generated. First, the country of interest is an economically developing country, Malaysia, that lacks studies examining the relationships between socioeconomic factors and participation in physical activity at a country level. A better understanding of which groups of people are physically active or inactive is important for the government to develop an appropriate intervention measure. Second, a large nationwide data allows the present study to explore the socioeconomic differences in physical activity participation among Malays, that is, the high risk group. Third, the results of the present study can facilitate a comparison of physical activity participation between a developing country and the results for the developed countries documented in the literature.

LITERATURE REVIEW: PHYSICAL ACTIVITY STUDIES

Age

Age and physical activity is negatively correlated. Based on the 2002 General Household Survey of United Kingdom (UK), Downward and Riordan (2007) found that age lowers the propensity to engage in physical activity. More lately, Downward and Rasciute (2010) explored the participation in physical activity among adults in England and found that older individuals are less likely to participate in physical activity than younger individuals. Their results confirm those of earlier studies conducted by Kaplan, Newsom, McFarland, and Lu (2001) and Farrell and Shields (2002) using the Canadian National Population Health Survey and Health Survey of England, respectively. Interestingly, reviewing

the studies conducted in India, Ranasinghe, Ranasinghe, Jayawardena, and Misra (2013) also found that age reduces the likelihood of being physically active. The explanation based on Cropper (1977), who focuses on how health investment varies in a life-cycle, is that since the pay-off period of health investment reduces with age, there is a higher tendency for older individuals to be less physically active relative to their younger counterparts.

Income

Income appears to have an impact on physical activity. Farrell and Shields (2002) examined the economic and non-economic determinants of participation in physical activity in England and observed that households with poor financial background have an 11.6% lower probability of participating in all types of sports compared to their counterparts with good financial background. In Malaysia, Cheah (2011) also found that income increases an individual's propensity to participate in physical activity. In contrast, study by Humphreys and Ruseski (2011) used the Behavioral Risk Factor Surveillance System (BRFSS) and found that an increase of United States dollar (USD) 10,000 in annual income reduces the time spent in physical activity by 41 minutes per week. The authors argued that if income is used to measure the opportunity forgone, a higher income is likely to cause non-market activities such as physical activity to become more expensive. Similar findings are shared by Downward and Riordan (2007).

Education

Previous studies provide significant relationships between education and physical activity. Wu and Porell (2000) found that higher educated individuals have a higher likelihood of participating in physical activity than lower educated individuals. At another study, Humphreys and Ruseski (2007) observed that education is positively correlated with the frequency of engaging in physical activity. Their findings are reaffirmed by three later studies conducted by Lechner (2009) using the German Socio-Economic Panel study (GSOEP), Eberth and Smith (2010) using 2003 Scottish Health Survey, and Cawley and Ruhm (2012) drawing on the National Health Interview Survey (NHIS). Fascinatingly, in an adolescent study, Hidayati, Hatthakit, and Isaramalai (2012) found that maternal education can alter an individual's decision to participate in physical activity in Asian countries. Several reasons may explain the positive effects of education on physical activity. First, education improves productive efficiency, that is, education increases the marginal product of health inputs (Grossman, 1972). Second, education promotes allocative efficiency, that is, better education leads to a better choice of health inputs (Grossman, 1972). Third, education reduces the rate of time preference. Individuals who have a lower time preference rate are more future oriented, and consequently are more devoted to participation in physical activity than individuals with a higher rate of time preference (Fuchs, 1982; Kosteas, 2015). From a different perspective, Humphreys and Ruseski (2011) claimed that level of education can be used to measure opportunity cost. According to them, the positive relationship between education and time spent in physical activity suggests that income effect is larger than substitution effect, whereas the negative relationship suggests that substitution effect is larger than income effect.

Sex

The relationship between sex and physical activity is well-documented in the literature. Drawing on the 2002 General Household Survey of UK, Downward (2007) and Downward and Riordan (2007) found that males have a higher

likelihood of being physically active than females. Findings of Scheerder, Vanreusel, and Taks (2005) suggested that females are 20% less likely to engage in physical activity compared to males, so do Wicker, Breuer, and Pawlowski (2009) and Eberth and Smith (2010). Humphreys and Ruseski (2011) found that women are less active in physical exercises compared to men. They claimed that women are likely to engage in the jobs that offer less flexibility compared to men, and thus have less time on hand for physical activity. Surprisingly, however, in Sri Lanka, Ranasinghe et al. (2013) discovered that males are more inactive than females. Similar findings are evidenced by Tudor-Locke et al. (2006), who use Filipino and Chinese youth data, as well as Seo et al. (2012), who looked into the college students from Singapore, Malaysia, Taiwan, Hong Kong, and South Korea.

Marital Status

The existing literature documents that marital status is significantly associated with physical activity, but it is inconclusive. For instance, Downward (2007) found that being married promotes participation in physical activity. More recently, Humphreys and Ruseski (2011) realized that married individuals allocate more time for physical activity than unmarried individuals. From a different perspective, based on the samples of South Asians, Jepson et al. (2012) claimed that family relationships can improve social well-being, thus increasing the likelihood of being physically active. Conversely, Downward and Rasciute (2010) and Eberth and Smith (2010) found that individuals who are married have a lower likelihood of participating in physical activity compared to their single counterparts. Similar outcomes are identified by two earlier studies (Humphreys & Ruseski, 2007; Humphreys & Ruseski, 2009). The studies pointed out that married individuals tend to be constrained by household activities and thus are likely to reduce their frequency of participation in physical activity.

THEORETICAL APPROACH

The health capital model developed by Grossman (1972) is used in the present study. The main argument of Grossman is that "healthy time" can be produced using health capital. If an individual has healthy time, he/she is able to spend time on both market and non-market activities. Grossman also emphasises that individuals' utility is affected by their stock of health, consumption of other commodities (i.e. market goods and time), as well as exogenous observable and unobservable factors (Grossman, 1972; Humphreys et al., 2014).

Similar to physical capitals, health depreciates over time. In particular, Grossman (1972) emphasised that the depreciation rate is positively associated with age, meaning that older individuals face a more serious deterioration in health relative to their younger counterparts. In fact, the stock of health capital of each individual is different given that it is affected by genetic, demographic, and socioeconomic factors. To improve health capital, inputs of medical care, non-medical care and time are necessary. Grossman (1972) defined this as health investment. Humphreys et al. (2014) advanced Grossman's health capital model by including health behaviour factors. In accordance with their models, health is determined by health behaviours, medical care, non-medical care, environment, existing stock of health, and education. In short, based on Humphreys et al.'s model, the quantity of health, HEA, can be specified as a function of the following factors:

$$\text{HEA} = f(\text{health behaviour, medical care non-medical care, environment, existing health, education}) \quad (1)$$

Health behaviours do not directly affect health. Unhealthy behaviours such as heavy drinking and smoking can yield instance utility, but can result in depreciation of health capital. In contrast, healthy behaviours like participation in physical activity and healthy eating can reduce current utility, but it significantly improves health capital. It appears that there is a trade-off between direct satisfaction and health improvement. Therefore, the decisions to adopt healthy lifestyles and behaviours, such as physical activity may vary across individuals.

Grossman (1972) also provided insights into the factors affecting consumption of medical care. In particular, he predicted that age, income, and education are significantly associated with the amount of medical care consumed. Similar to medical care, participation in physical activity is an investment in health. Hence, the model of participation in physical activity can be developed based on these predictions. Mathematically, the model of physical activity is expressed as:

$$E = \gamma(a, i, e, o) \qquad (2)$$

where E is the amount of time spent in physical activity; a refers to age; i is income; e represent education; and o is other factors.

Because of biological process of aging, the rate of depreciation of health increases with age. Therefore, in order to increase the stock of health capital, older individuals are intended to spend more time in physical activity than younger individuals. However, the association between income and participation in physical activity is inconclusive. On one hand, income increases the opportunity cost of non-working time, thus causing higher income individuals to spend less time on physical activity than their lower income counterparts. On the other hand, income increases the value of healthy day. Hence, higher income individuals are devoted to spend more time in physical activity than lower income individuals. Somewhat surprisingly, education is predicted to be negatively correlated with participation in physical activity. This is simply because education improves productive efficiency. Higher educated individuals are more aware of the methods of staying physically active than their lower educated counterparts and consequently are able to spend lesser time in physical activity to achieve optimum health.

The research questions that remain unanswered with regard to physical activity are: i) What are the main factors that affect individuals' decisions to participate in physical activity? ii) What policies can be recommended to increase the prevalence of physical activity?

METHODS

Population and Sample Size

The sample size was 34,539 respondents which represented 12,923,504 adult populations in Malaysia. Since the focus of the present is on Malays, the non-Malays are deleted. As a result, only 17,515 respondents were retained for further analyses.

Data Collection

Third National Health and Morbidity Survey (NHMS III) was a nationwide, population-based survey carried out by the Ministry of Health Malaysia. The survey period was from April 2006 till January 2007. All the urban and rural areas in Malaysia were surveyed. The data collection was based on a two stage stratified sampling. The first stage sampling unit was in accordance with Enumeration Blocks (EBs), while the second stage sampling unit was based on the Living Quarters (LQs). All the residents in the selected LQs were canvassed. Specifically, each EB consisted of 80-120 LQs.

Validity and Reliability

The NHMS research team members were requested to assess the validity and reliability of the survey tool and questionnaires. All the tools used to measure the respondents' weight and health, such as Body Meter SECA 206 and Omron Japan Model HEM-907 were validated and calibrated. During the field work, identification numbers (IDs) of the selected LQs were checked according to the guideline provided by the Department of Statistic Malaysia. To ensure validity and reliability, field supervisors were compulsory to supervise the interview process and review all the completed questionnaires. The completed questionnaires would, then, undergo various types of assessment by the data processing teams.

Instrument

The respondents were interviewed by the trained staffs using piloted multi-lingual questionnaires. During the interview, the respondents requested to self-report their duration of participating in physical activities. The interview also asked about the respondents' socioeconomic profiles.

Ethical Consideration

The study was approved by the Medical Research Ethics Committee of Ministry of Health Malaysia [Project code: (P42-251-170000-00500(00500099); Sub code project: 42005000990001)].

Variables

The outcome variable of the present study, being physically active, is a dichotomous variable. A code of 1 represents the respondent who adopts a physically active lifestyle, 0 otherwise. The respondents whose physical activity levels achieve 600 metabolic equivalents (METs) minutes per week are considered as being physically active (Institute for Public Health, 2008; Meltzer & Jena, 2010). This measurement of physical activity is somewhat different from those of most previous studies which do not take into account the exercise intensity and energy expenditure.

All of the explanatory variables used in the present study are categorical variables, except income which is formatted as a continuous variable to allow for a linear relationship. To explore the effect of life-cycle on physical activity, age is divided into four categories: 18-30, 31-40, 41-50, and ≥51. Since NHMS III does not provide information on an individual's wage, income is used as the proxy for measuring opportunity cost of time. Education variable is used for two purposes: first, to study the productive and allocative efficiencies, as well as time preference, and second, to examine the substitution and income effects. Since widowed, divorced, and single may display different participation and duration decisions from married individuals given the absence of spouses or extended family commitments, they are grouped as unmarried. The present study also includes house locality and employment status to control for other determining factors of physical activity.

Econometric Model

Given that the outcome variable of the present study is a binary variable (1 = being physically active, 0 = being physically inactive), a logit model is used for statistical inferences. Use of logit model can ensure the probability of an outcome that lies between 0 and 1 (Greene, 2007). In general, a logit model can be written as follow:

$$1n \frac{P}{1-P} = \beta_0 + \sum i=1^{k} \beta_i X_i + \varepsilon \quad (3)$$

where, P = the probability that a respondent is physically active; 1 – P = the probability that a respondent is physically inactive; P/(1 – P) = the odds that a respondent being physically active; X_i = the explanatory variables which are hypothesised to affect the probability of being physically active; β_0 = constant term; βi = coefficients of the explanatory variables; i = 1, 2, …, k, k is the number of explanatory variables; and ε is the error term.

The estimation form of the logit transformation is expressed as follow:

$$\ln \frac{P}{1-P} = \beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+ \beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10}+\beta_{11}X_{11}+\varepsilon \quad (4)$$

where, X_1 = monthly individual income [in hundred Malaysian Ringgit (RM)]; X_2 = 1 if the respondent aged 51 years and above, 0 otherwise; X_3 = 1 if the respondent aged between 41 and 50 years, 0 otherwise; X_4 = if the respondent aged between 31 and 40 years, 0 otherwise; X_5 = 1 if the respondent is male, 0 if female; X_6 = 1 if the respondent has tertiary education, 0 otherwise; X_7 = 1 if the respondent has secondary education, 0 otherwise; X_8 = 1 if the respondent is married, 0 if unmarried; X_9 = 1 if the respondent stays in urban areas, 0 if rural areas; X_{10} = 1 if the respondent is unemployed, 0 otherwise; and X_{11} = 1 if the respondent is a non-labour force participant such as student, housewife and retiree, 0 otherwise. The significance of these explanatory variables are tested based on *p*-values of less than 10%, 5% and 1% (two-sided).

RESULTS

Descriptive Analysis

The descriptive analysis of the variables is presented in Table 1. Pearson Chi-square (χ^2) test is conducted to assess the association between physical activity and socioeconomic factors. The *p*-values of Pearson χ^2 for all the categorical variables are less than the significant levels, except marital status. Of the total 17,515 respondents, 10,154 (57.97%) are physically active, while 7,361 (42.03%) are physically inactive. The average monthly individual income of the total respondents is approximately RM 1,752.59. Between 18 and 30 years of age composed 29.56% of the respondents, 28.68% are aged 51 years and above, 21.73% are aged between 41 and 50 years, and 20.02% are aged between 31 and 40 years. The age group that has the highest proportion of physically active respondents is 41-50 years (61.69%).

The total sample is comprised of 44.45% males and 55.55% females. About 66.19% of males are physically active, compared to only 51.40% of females. The proportions of the respondents that have primary, secondary, and tertiary education are 33.69%, 55.70% and 10.61%, respectively. About 60.89% of the secondary-educated respondents are physically active, compared to only 53.36% of the primary-educated respondents. In terms of marital status, around 71.21% of the respondents are married. About 52.04% of the total respondents reside in urban areas. The proportion of rural dwellers (61.30%) being physically active are slightly higher than urban dwellers (54.90%). A large proportion of the respondents are employed (59.39%). Physical activity is more frequent amongst the employed respondents (65.26%) than non-labour force participants (49.15%) and the unemployed (41.10%).

Marginal Effects of Explanatory Variables

Prior to interpreting the specific results, some discussions on the robustness of the estimated logit model are in order. The results of goodness-of-fit tests are shown at the bottom of Table 2. The *p*-value of likelihood ratio (LR) is less than 0.01, thus the null hypothesis that the model is not

Table 1. ***Descriptive Analysis of Variables***

Variables	Mean [SD] / Frequency [%]*			
	Physically active (n_1 = 10154)	Physically inactive (n_2 = 7361)	Total sample (n = 17515)	*p*-value
Income	1709.15 [1790.82]	1812.53 [2246.84]	1752.59 [1995.80]	–
Age				
≥51	2501 [49.78]	2523 [50.22]	5024 [28.68]	<0.001
41-50	2348 [61.69]	1458 [38.31]	3806 [21.73]	
31-40	2142 [61.08]	1365 [38.92]	3507 [20.02]	
18-30	3163 [61.09]	2015 [38.91]	5178 [29.56]	
Sex				
Male	5153 [66.19]	2632 [33.81]	7785 [44.45]	<0.001
Female	5001 [51.40]	4729 [48.60]	9730 [55.55]	
Education				
Tertiary	1065 [57.32]	793 [42.68]	1858 [10.61]	<0.001
Secondary	5940 [60.89]	3816 [39.11]	9756 [55.70]	
Primary	3149 [53.36]	2752 [46.64]	5901 [33.69]	
Marital status				
Married	7234 [58.00]	5239 [42.00]	12473 [71.21]	0.919
Unmarried	2920 [57.91]	2122 [42.09]	5042 [28.79]	
House locality				
Urban	5004 [54.90]	4110 [45.10]	9114 [52.04]	<0.001
Rural	5150 [61.30]	3251 [38.70]	8401 [47.96]	
Employment status				
Unemployed	667 [41.10]	956 [58.90]	1623 [9.27]	<0.001
Non-participant	2698 [49.15]	2791 [50.85]	5489 [31.34]	
Employed	6789 [65.26]	3614 [34.74]	10403 [59.39]	

Note: *For income, the value refers to mean [standard deviation]. For the others, the value refers to frequency [percentage]. *p*-value is based on Pearson χ^2 test statistic.

Table 2. ***Results of the Logit Analysis of Being Physically Active***

Variables	β	SE[a]	ME	SE[b]	z-stat.	*p*-value
Constant	0.681	0.057	–	–	11.990	<0.001
Income	-0.004	0.001	-0.001	0.001	-4.570	<0.001
Age						
≥51	-0.360	0.053	-0.089	0.013	-6.810	<0.001
41-50	0.011	0.051	0.003	0.013	0.210	0.831
31-40	-0.031	0.050	-0.008	0.012	-0.610	0.540
18-30	–	–	–	–	–	–
Sex						
Male	0.471	0.035	0.109	0.008	13.360	<0.001
Female	–	–	–	–	–	–
Education						
Tertiary	-0.036	0.067	-0.009	0.016	-0.530	0.595
Secondary	0.084	0.043	0.021	0.011	1.950	0.051
Primary	–	–	–	–	–	–
Marital status						
Married	-0.063	0.042	-0.015	0.010	-1.530	0.126
Unmarried	–	–	–	–	–	–
House locality						
Urban	-0.305	0.033	-0.072	0.008	-9.140	<0.001
Rural	–	–	–	–	–	–
Employment status						
Unemployed	-0.892	0.059	-0.219	0.014	-15.050	<0.001
Non-participant	-0.414	0.039	-0.103	0.010	-10.650	<0.001
Employed	–	–	–	–	–	–
LRχ^2 (11)	998.99	–	–	–	–	<0.001
HLχ^2 (8)	8.85	–	–	–	–	0.355
Mean VIF	1.540					
Correct predictions	62%					
Observation	17515					

Note: β = estimated coefficient, ME = marginal effect, SE[a] = standard errors for β, SE[b] = standard errors for ME, LR = likelihood ratio, HL = Hosmer-Lemeshow. VIF refers to variance inflation factor.

fit is rejected. In addition, the *p*-value of Hosmer-Lemeshow (HL) is more than 0.01, thus the null hypothesis that the model is fit cannot be rejected. The proportions of correct predictions from the model are around 62%. Taken as a whole, the current model seems to fit the data very well.

The marginal effects of explanatory variables on physical activity are demonstrated in Table 2. Turning to specific result, an increase of RM 100 in monthly individual income reduces the probability of being physically active by 0.1%. Holding other factors constant, the probability of adopting a physically active lifestyle among individuals aged 51 years and above is 8.9% lower compared to individuals aged between 18 and 30 years. In terms of sex, males have a 10.9% higher likelihood of participating in physical activity relative to females. Individuals with secondary education are 2.1% more probable to engage in physical activity compared to their primary-educated peers. In terms of house locality, urban dwellers face a 7.2% lower likelihood of participating in physical activity compared to rural dwellers. Individuals who are unemployed and non-labour force participants are 21.9% and 10.3% less likely to be physically active, respectively, compared to their employed counterparts.

DISCUSSION

Consistent with Downward and Riordan (2007) and Humphreys and Ruseski (2011), the present study finds a negative relationship between income and the probability of being physically active. While the impact of income is not large, it highlights the significance of substitution effect as pointed out by Humphreys and Ruseski (2011). According to the authors, opportunity cost increases with increasing income. Therefore, individuals with greater income may view that market activities are more valuable than leisure activities and thus are less intended to put efforts into performing sport activities. In fact, it will be more appropriate to use wage to measure the relationship between opportunity cost and participation decisions, but owing to the limited availability of data, income is used instead of wage.

The findings of the present study suggest that older individuals, especially those aged 51 years and above, are less likely to adopt healthy physical practices than their younger counterparts, which are somewhat consistent with those of Kaplan et al. (2001), Farrell and Shields (2002), Downward and Riordan (2007) and Downward and Rasciute (2010). This is simply because when an individual reaches a certain age, his/her pay-off period of participating in physical activity will become too short that may even pose as a disincentive to invest in health. This is due to the fact that health investment only yields returns or utility in the future (Cropper, 1977; Kenkel, 2000). Nevertheless, older individuals are also likely to encounter a higher depreciation rate of health capital. As a result, they possess a greater physical constraint in performing vigorous activities compared to their younger peers.

It is evident that sex is associated with participation in physical activity. Specifically, males are more probable to engage in physical activity than females. This finding is shared by Scheerder et al. (2005), Downward (2007), Downward and Riordan (2007), Wicker et al. (2009), Eberth and Smith (2010) and Humphreys and Ruseski (2011). This is simply because females face a greater barrier to participation in physical activity than males as they need to allocate extra time for household activities (Humphreys & Ruseski, 2006; Ruseski et al., 2011). It is worthwhile to note that since the sample used in the present study consists of males and females who are in the labour market, the explanation of Humphreys and Ruseski (2011) that the opportunity costs of time for males in the labour market are dissimilar to those of females is not applicable in the present context.

In terms of education, the present study finds that secondary-educated individuals have a higher likelihood of being physically active than primary-educated individuals, but no statistical disparities in the levels of physical activity between tertiary- and primary-educated individuals. To some extent, this finding follows those of Wu and Porell (2000), Humphreys and Ruseski (2007), Lechner (2009), Eberth and Smith (2010) and Cawley and Ruhm (2012). Although education can significantly improve allocative and productive efficiencies as well as reduce time preference (Grossman, 1972; Fuchs, 1982; Kosteas, 2015), it also raises the opportunity cost of time (Humphreys & Ruseski, 2011). It is widely documented in the economics literature that level of education is positively associated with wage. Therefore, a higher level of education may bring about a higher shadow price of non-market activities. Taken together, the result on secondary education suggests that education-related factors that possess a positive effect on physical activity are stronger than those have a negative impact, whereas the finding on tertiary education does not lead to any significant conclusion.

House locality also affects physical activity. The result shows that urban dwellers have a lower likelihood of being physically active than their rural counterparts. Because of the stressful lifestyle, urbanites are less devoted to spend time on physical activity. In the context of literature, Ruseski, Humphreys, Hallmann, and Breuer (2011) found that the cost of engaging in physical activity such as travelling a longer distance to physical activity settings is positively associated with the efforts put into being physically active. However, Scheerder et al. (2005) and Wicker et al. (2009) provided a different result. They claimed that an undersupply of sport facilities is the main factor causing physical inactivity. Since the present study is unable to use travel distance and availability of sport facilities as the explanatory variables, the impacts of these variables are reflected by house locality. It appears that the results of the present study lend some supports to Ruseski et al. (2011) rather than Scheerder et al. (2005) and Wicker et al. (2009), concluding that barriers to participation may increase one's physical activity level.

There appears to be a notable association between employment status and physical activity, as individuals who are employed full-time have a higher propensity to engage in physically active behaviours compared to the unemployed and non-labour force participants. The "generalization theory" pointed out by Wu and Porell (2000) may be the explanation for this outcome. According to their theory, being employed increases an individual's tendency to utilise leisure time for physical activity. It can, therefore, be concluded that although employed individuals are constrained by their working hours, they are devoted to indulge in physical activity.

CONCLUSIONS

Considering the importance of being physically active, the present study puts efforts into shedding light on the determining factors of physical activity participation among Malays in Malaysia. Better information on the factors affecting Malays' physical activity behaviour can assist government in implementing appropriate health policies. Using a nationally representative sample, the present study finds that income, age, sex, education, house locality, and employment status are the significant contributing factors. Specifically, higher income earners, the elderly, females, the less-educated, urban dwellers, and the non-working adults are associated with a lower likelihood of being physically active.

Several important policies toward increasing physical activity level among Malays are discussed in light of the findings of the present

study. First, a comprehensive sports promotion programme should be targeted specifically at the elderly population. Sports facilities that are elderly-friendly should be built. This is to achieve the goal of encouraging the elderly to actively engage in physical activity. Second, a physical activity promotion programme directed towards high income earners can guarantee positive outcomes. Government is, thus, suggested to introduce population-based health awareness programmes with the aim of educating the rich about the time-saving methods of staying physically active.

Third, special attentions should be paid to females instead of males if the objective of promoting physical activity is to be met. A successful intervention should consider increasing the availability of Malay language-based home-fitness programmes teaching females how to be physically active without spending time doing exercises away from home. Last but not least, it is worthwhile to advocate promoting physically active lifestyle among less-educated individuals by providing them with more information on the importance of physical activity, as well as the proper approaches to stay physically active. Previous study also finds that frequent participation in physical activity can improve academic performance (Lunn & Kelly, 2015).

Because of data limitation, several limitations are unavoidable. First, some important variables, such as wage, household size, and availability of sport facilities are excluded from the model. Second, the present study does not divide physical activity into various categories for a more detailed individual analysis. Third, the present study is unable to analyse how physical activity is linked to morbidity patterns. Despite these limitations, the present study uses a nationally representative data to provide the first in-depth analysis of the factors determining physical activity in Malaysia with particular attention on Malays. The findings of the present study can also serve as a useful predictor for the design of intervention programmes.

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Appendix 1. ***VIF Test for All the Explanatory Variables***

Variables	VIF	1/VIF
Income	1.23	0.81
Age		
≥51	2.34	0.43
41-50	1.80	0.56
31-40	1.62	0.62
18-30	–	–
Sex		
Male	1.24	0.81
Female	–	–
Education		
Tertiary	1.73	0.58
Secondary	1.84	0.54
Primary	–	–
Marital status		
Married	1.42	0.70
Unmarried	–	–
House locality		
Urban	1.11	0.89
Rural	–	–
Employment status		
Unemployed	1.21	0.82
Non-participant	1.37	0.73
Employed	–	–

Note: VIF refers to variance inflation factor.