PARTICIPATION IN PHYSICAL ACTIVITY AND ITS CORRELATES: AN AGE COMPARISON

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Received: 13 May 2020 **Accepted: 23 July 2020** **Published: 15 Sept 2020**

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PARTICIPATION IN PHYSICAL ACTIVITY AND ITS CORRELATES: AN AGE COMPARISON

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Abstract

Physical inactivity has become a serious public health concern in Malaysia. The present study examines age, education, income, demographic factors and insurance associated with participation in vigorous, moderate and total physical activity using data from a nationally representative survey (n = 10141). Regressions are stratified by age group. The purpose is to identify whether there are any differences or similarities in the factors associated with participation in physical activity amongst various age groups. Several findings are noteworthy. First, well-educated people of all age groups, except the elderly spend less time on physical activity than their less-educated counterparts. Second, higher income middle-aged adults spend less time on vigorous physical activity than lower income middle-aged adults, while higher income young adults spend less time in moderate physical activity than lower income young adults. Third, employed young, middle-aged and old-aged adults tend to spend more time on physical activity than their unemployed peers. In conclusion, age, education, income and demographic factors play an important role in determining participation in various intensity levels of physical activity among adults of different age groups. Policy makers should focus on the groups of adults that are unlikely to spend time in physical activity.

Keywords: *age; education; exercise; income; physical activity*

INTRODUCTION

Physical activity refers to any activity that uses skeletal muscles and energy to move the body (Caspersen et al., 1985). This includes sports, working, household production and travelling. According to the guideline of the World Health Organization, an individual needs to perform at least 150 minutes of moderate physical activity or 75 minutes of vigorous physical activity per week in order to stay physically active (World Health Organization, 2018b). It is clearly evident that physical activity is beneficial to health. Among the common benefits are improvement in cardiovascular health, prevention of various chronic diseases (e.g. diabetes, stroke, hypertension), osteoporosis and obesity, as well as improvement in mental health (Warburton et al., 2006).

Even the benefits of physical activity are well-advertised, people seldom spend enough of time on physical activity. In 2010, about one-fourth of adults across the globe was physically inactive (World Health Organization, 2018b). This is mainly due to the rapidly urbanising society, where people often engage in a sedentary lifestyle. To date, physical inactivity has become one of the main contributing factors of mortality. People who are physically active have a 20-30% lower likelihood of death than people who are physically inactive (Lear et al., 2017). In Malaysia, the prevalence of physical inactivity was about 35.2% in 2011, which is higher than the prevalence of physical inactivity worldwide (Institute for Public Health, 2011). This could be the main factor explaining the high prevalence of hypertension (30.3%), hypercholesterolemia (47.7%) and obesity (30.6%) (Institute for Public Health, 2011).

In view of the importance of physical activity, there is a growing economic study that explores factors associated with participation in physical activity in developed countries (Downward and Riordan, 2007; Downward and Rasciute, 2010; Eberth and Smith, 2010; Humphreys and Ruseski, 2011; Ruseski et al., 2011; Downward and Rasciute, 2015). These studies have consistently found that age, education, income and demographic factors play an important role in determining the decisions of people to spend time on physical activity. However, how these factors affect participation in physical activity among people in developing countries is still poorly understood. Obtaining a good knowledge of physical activity behaviour among people in developing countries is important given that physical inactivity related diseases are prevalent in developing countries. As pointed out by the World Health Organization (2018a), more than two-third of chronic diseases induced deaths take

place in developing countries. Furthermore, rising health care costs can be a serious issue in developing countries, especially those with low income. Hence, reductions in preventable diseases through promoting physically active lifestyle is crucial.

Cheah and Poh (2014) and Cheah et al. (2017) are among a few researchers who have conducted an in-depth investigation of the factors that affect participation in physical activity in Malaysia, but there is still room for improvement in their analyses. The present attempts to add to their analyses in two ways. First, the present study stratifies the analyses by age groups and examines how the effects of education, income, demographic factors and insurance on physical activity vary across age. Having a better understanding of these differences in physical activity participation in various age groups is important as it can assist policy makers in formulating better intervention measures directed toward promoting physically active lifestyle among different age groups of adults, especially given that the risk of developing diseases increases with age.

Second, the present study takes account of the intensity of physical activity. It is expected that the factors that affect participation in vigorous physical activity may be slightly different from the factors that affect participation in moderate physical activity. While vigorous physical activity is more unpleasant and riskier than moderate physical activity, it is more efficient and beneficial to health (Meltzer and Jena, 2010). Hence, there could be age, education, income, demographic and insurance differences in intensity of physical activity. For instance, Meltzer and Jena (2010) found that higher income people exercise more vigorously compared with lower income people.

CONCEPTUAL FRAMEWORK

The conceptual framework is developed based on the Grossman model and the findings of previous studies (Grossman, 1972; Farrell and Shields, 2002; Downward and Riordan, 2007; Downward, 2007; Brown and Roberts, 2011; Humphreys and Ruseski, 2011; Cheah, 2015; Downward and Rasciute, 2015). According to Grossman, the utility reaped by an individual is a function of health and consumption of non-health good. Given a single *t* period, the utility function can be expressed as:

$$U_t = f(H_t, C_t) \quad (1)$$

where *U* is utility, *H* is health, and *C* is composite good.

Utility is not a function of physical activity given that physical activity increase utility via health. Physical activity improves health, and consequently, health raises utility. Put simply, demand for physical activity is derived from the demand for health. Health and composite goods are two different components in the utility function, but they are associated with each other. For instance, if an individual consumes unhealthy food, the unit of composite good increases but the unit of health reduces.

While health can affect utility, it is not like a market good, which can be consumed directly. Market commodities and time have to be used to produce health. Also, the individual's health is determined by his/her history of health condition, i.e. stock of health. However, health can depreciate over time, which is similar to other capital goods. Put simply, health is a function of the individual's stock of health, time spent on producing health (T^H), medical care (M) and non-medical health goods (S), such as physical activity and healthy diet:

$$H_t = f((1-\theta)H_{t-1}, T_t^H, M_t, S_t) \quad (2)$$

where θ is depreciation rate ($0<\theta \leq 1$), and it is not constant.

Grossman argues that age and education are the important determinants of health. Particularly, health reduces with age and the well-educated is associated with better health. Therefore, we assume that age and education affect health through physical activity given that physical activity is a type of health investment. The function of physical activity can, thus, be expressed as:

$$P_t = f(A_t, E_t) \quad (3)$$

where *P* is physical activity, *A* is age and *E* is education.

The rate of depreciation of health increases with age. Put differently, health reduces at an increasing rate as a person age. In order to achieve the same level of health, individuals need to invest more in their health as they age. As such, older individuals would find it more costly to make health investments, especially the physically demanding investment, such as physical activity, compared with younger individuals. Given this fact, we hypothesise that age is negatively associated with participation in physical activity:

$$\frac{\partial P}{\partial A} < 0$$

Education enhances productive efficiency of health. This means that well-educated individuals are more efficient at producing health than less-educated individuals. This is simply because well-educated individuals have better understanding skills and health knowledge. For instance, for each minute spent on physical activity, well-educated individuals reap more health improvements compared with their less-educated counterparts, assuming that well-educated individuals understand better about the proper way to exercise. As such, we hypothesise education is positively associated with participation in physical activity:

$$\frac{\partial P}{\partial E} > 0$$

In addition to age and education, wage may also affect participation in physical activity. This is because wage determines opportunity costs of time. Hence, we extend the Grossman model by adding wage to equation (3). The extended model can be expressed as:

$$P_t = f(A_t, E_t, W_t) \quad (4)$$

where *W* is wage.

Since wage increases opportunity cost of time, we anticipate that wage is negatively associated with participation in physical activity. In other words, individuals who earn a higher wage spend less time on physical activity than their counterparts who earn a lower wage:

$$\frac{\partial P}{\partial W} < 0$$

In light of the past findings that participation in physical activity can be affected by demographic factors and insurance (Farrell and Shields, 2002; Downward, 2007; Eberth and Smith, 2010; Humphreys and Ruseski, 2011; Brown and Roberts, 2011; Cheah et al., 2017), we further extend our model by including demographic factors and insurance to equation (4). The revised model can, thus, be written as:

$$P_t = f(A_t, E_t, W_t, G_t, R_t, L_t, D_t, I_t) \quad (5)$$

where *G* is gender (being male), *R* is marital status (being married), *L* is family size, *D* is employment status (being employed) and *I* is insurance (having insurance).

Previous studies often found that gender is significantly associated with participation in physical activity. The findings of Farrell and Shields (2002) and Eberth and Smith (2010) show that men are more likely to participate in any sports than women. Also, Downward (2007)

found that men tend to spend more time on physical activity than women. Humphreys and Ruseski (2007) identified that although men are less likely to participate in household activities than women, they have a higher tendency to participate in sports. As explained by Humphreys and Ruseski (2011), men tend to work in a job that offers more time flexibility as compared to the job worked by women, thus they are able to allocate more time for physical activity. Men are, therefore, expected to spend more on physical activity than women:

$$\frac{\partial P}{\partial G} > 0$$

Being married has been found to be negatively associated with physical activity. As pointed out by Humphreys and Ruseski (2007), married people have less time on their hand than unmarried people because they have to allocate more time for household activities and consequently are less likely to participate in physical activity. Similar findings and arguments were provided by Downward and Rasciute (2010) and Eberth and Smith (2010). Brown and Roberts (2011) also found that married individuals tend to spend less time on physical activity than unmarried individuals. Based on these findings, we hypothesise that married individuals spend less time on physical activity than unmarried individuals:

$$\frac{\partial P}{\partial R} < 0$$

Brown and Roberts (2011) used presence of children as a proxy for household size and found that individuals who have children are less likely to engage in physical activity than individuals who do not have children because of household commitment. Using a two-part model, Humphreys and Ruseski (2011) found that household size is positively associated with the likelihood of participating in physical activity, but is negatively associated with the time spent on physical activity. This finding is interesting as it shows that household size has different effects on extensive and intensive margins. Since intensive margin (amount spent) is the interest of the present study, we expect that household size is negatively associated with the time spent on physical activity:

$$\frac{\partial P}{\partial L} < 0$$

Farrell and Shields (2002) found that employed individuals are less likely to participate in physical activity than unemployed individuals. This is simply because of time constraint. The amount of time that is available for leisure which employed individuals have is less than

unemployed individuals. Similar findings were evidenced by Downward and Riordan (2007) and Eberth and Smith (2010). Employed individuals are, thus, expected to spend less time on physical activity than unemployed individuals:

$$\frac{\partial P}{\partial D} < 0$$

The effect of insurance on physical activity has seldom been investigated by researchers, except Cheah et al. (2017). In particular, Cheah et al. (2017) found that individuals who have insurance are more likely to participate in physical activity than those who do not have insurance because they have a higher tendency to avoid risk and put more efforts into disease prevention. As such, we anticipate that having insurance is positively associated with the time spent on physical activity:

$$\frac{\partial P}{\partial I} > 0$$

METHODS

Data

The present study uses secondary data of the National Health and Morbidity Survey 2011 (NHMS 2011). It is a nationwide survey conducted by the Ministry of Health Malaysia. The survey period is between April and July 2011. Although NHMS 2011 is not the latest survey, it is nationally representative and has a large sample size (n = 10141). The survey is carried out in all the states in Malaysia. In terms of sampling, a two-stage stratified sampling is used. This sampling is designed based on the Malaysian National Population and Housing Census. In the first stage, geographically contiguous areas of the country [i.e. Enumeration Blocks (EBs)] are selected. Each EB consists of urban and rural areas. A gazetted area with ≥10000 population is categorised as an urban area. Overall, 794 EBs are selected, and each EB has 500 to 600 population. In the second stage, twelve living quarters (LQs) are randomly selected from each EB. Household members in the selected LQs are canvassed. Exclusion criteria are non-Malaysians and institutionalised individuals, such as those staying at hospitals and hotels.

Two types of questionnaires are used in the survey. One is for face-to-face interview, while another one is for self-administration. Given the multi-ethnic population, both types of questionnaires are prepared in four languages (English, Malay, Chinese, Tamil) in order to

facilitate a better understanding. All the interviewers are required to attend a comprehensive training course prior to the survey. This training course covers mock interview and pilot study. Every respondent is required to fill and sign the consent form before the interview, whereas for illiterate respondents, thumb prints are taken. More details about NHMS 2011 have been described elsewhere (Institute for Public Health, 2011).

Dependent variables

Dependent variables used in the present study are the time spent on moderate, vigorous and total physical activity. The units are minutes per week. The sum of moderate and vigorous physical activity is total physical activity. During the survey, the respondents are asked: 'Over the last seven days, how many days did you participate in physical activity for at least ten minutes per session?' and 'On the days you participated in physical activity, how many minutes did you spend?' In order to determine the intensity of physical activity, metabolic equivalent (MET) is calculated. MET is measured as the ratio of metabolic rate during exercise to metabolic rate when sitting quietly (Ainsworth et al., 1993). When a person sits quietly, the MET is 1. If the physical activity requires two times the energy of sitting quietly, the MET is 2. Vigorous physical activity has >6 MET, while moderate physical activity has ≤6 MET. The details and examples of vigorous and moderate physical activity have been described by Ainsworth et al. (1993).

Independent variables

The independent variables are selected based on the conceptual framework discussed earlier. The respondents' age is recorded based on their date of birth. It is categorised into five categories: ≤29 years, 30-39 years, 40-49 years, 50-59 years and ≥60 years. The respondents are asked to report their highest education level. Based on their responses, three education categories are formed: primary, secondary and tertiary. In terms of income, the respondents are asked: 'What is your monthly individual income [in Ringgit Malaysia (RM)]?' It is grouped into five categories: ≤RM999, RM1000-1999, RM2000-2999, RM3000-3999 and ≥RM4000, in order to allow for a non-linear relationship between income and physical activity. Ethnic variable is categorised into four categories: Malay, Chinese, Indian and Others. Malay is the ethnic majority in Malaysia.

The survey asks the respondents about their marital status: 'What is your marital status?' The possible answers are single, married, widowed and divorced. Owing to the small number

of observations for widowed and divorced, these two categories are merged. Household size is grouped according to the study of Mok et al. (2011): small (≤4 members), medium (5-7 members) and large (≥8 members). The respondents also report their employment status when asked 'Are you currently working?' They respond with either 'yes' or 'no'. Those who respond 'no' are considered to be unemployed. In addition, the respondents are asked: 'Are you covered by health insurance?' The respondents are coded as having health insurance if they answer 'yes'. Health insurance refers to any insurance organisation that pays for medical care costs if an individual gets sick or injured. The types of health insurance include government guarantee letter, employer-sponsored insurance and private insurance.

Statistical analysis

The descriptive statistics of all the independent variables are calculated. In terms of multivariate analysis, we regress the time spent on vigorous, moderate and total physical activity on age, education, income, gender, marital status, family size, employment status and insurance, and draw ceteris paribus conclusions. The regressions are developed by specifying a functional form to equation (5) and estimated using least square. Additional regressions are estimated for each age group. The age variable is formatted as a continuous variable (including age in squared term) in the regressions stratified by age group. It is possible that our regressions may not have the most appropriate functional form and least square may not be the best method to estimate factors affecting physical activity, but identifying the best model and statistical method is beyond the scope of this study.

RESULTS

Summary statistics of independent variables are presented in Table 1 (pg 21-22). The majority of the respondents aged ≤29 years (28.18%), followed by those with 30-39 years (21.44%), 40-49 years (20.43%), 50-59 years (16.96%) and ≥60 (12.99%). A large proportion of the respondents have secondary-level education (44.77-56.61%), except those aged 60 years or more. The income breakdown consists of 30.13-71.15% ≤RM999, 17.69-31.21% RM1000-1999, 6.30-18.81% RM2000-2999, 2.43-12.10% RM3000-3999 and 2.34-16.31% ≥RM4000. Slightly less than half of the respondents are males (44.71-48.32%). Most of the respondents are either Malay (48.78-60.18%) or Chinese (42.60%). Approximately 2.28-67.91%, 31.74-89.53% and 0.35-32.42% of the respondents are single, married and widowed/divorced,

respectively. Of the total sample, the majority have a small family size (48.46-67.27%), 25.51-45.70% have a medium family size and only 5.84-9.59% have a large family size. More than half of the respondents are employed (58.55-79.62%) and have medical insurance (52.03-60.63%), except those aged 60 years or more.

The correlates of age, education, income, demographic factors and insurance to vigorous, moderate and total physical activity are presented in Table 2 (pg 23). Compared with individuals aged ≤29 years, those aged ≥60 years spend 81.478 mins less on vigorous physical activity, whereas individuals aged 40-49 and 50-59 years spend 54.963 mins and 51.693 mins more on moderate physical activity, respectively. Overall, individuals aged 40-49 years spend 61.889 mins more on total physical activity than those aged ≤29 years, while individuals aged ≥60 years spend 111.586 mins less on total physical activity than their counterparts aged ≤29 years. In terms of education, individuals with secondary-level education allocate 51.362 mins and 58.395 mins less for vigorous and total physical activity, respectively, compared with their peers who have only primary-level education. If individuals have tertiary-level education instead of primary-level education, they would spend 86.745 mins, 36.337 mins and 123.082 mins less on vigorous, moderate and total physical activity, respectively. Holding other factors constant, individuals with monthly income of RM 3000-3999 and ≥RM4000 spend 42.992 mins and 64.511 mins less on vigorous physical activity than their lower income counterparts (≤RM999). Compared with individuals having monthly income of ≤RM999, those with monthly income of RM1000-1999, RM2000-2999, RM3000-3999 and ≥RM4000 spend about 41.697 mins, 46.344 mins, 97.088 mins and 108.175 mins less on moderate physical activity, respectively. In terms of total physical activity, if individuals' monthly income increases from ≤RM999 to RM2000-2999, they would spend 53.964 mins less on total physical activity. If their income increases to RM3000-3999 or ≥RM4000, they would spend even less on physical activity (140.081 mins or 172.686 mins). Men allocate 180.386 mins and 156.146 mins more on vigorous and total physical activity, respectively, than women, but they spend 24.240 mins less on moderate physical activity. Compared to Malays, Chinese spend 25.923 mins more on moderate physical activity, Indians spend 69.952 mins and 48.514 mins more on moderate and total physical activity, respectively. Individuals from other ethnic background spend 42.420 mins, 117.594 mins and 160.013 mins more on vigorous, moderate and total physical activity, respectively, than Malays. Individuals who have a large family size spend 37.473 mins more on vigorous physical activity than their counterparts who have a small family size. Employed

individuals spend 83.970 mins, 72.508 mins and 156.479 mins more on vigorous, moderate and total physical activity, respectively, than unemployed individuals. Having insurance reduces the time spent in vigorous physical activity by 27.940 mins.

The correlates of age, education, income, demographic factors and insurance to vigorous physical activity across all age groups are presented in Table 3 (pg 24). Among individuals aged ≤29 years, an additional year of age increases the time spent on vigorous activity by 95.317 mins. There is an inverted-U shape relationship between age and physical activity in this age group. Individuals who are ≤29 years old and have tertiary-level education spend about 93.991 mins less on physical activity than their counterparts having only primary-level education. Among individuals aged 30-39 years, having secondary-level or tertiary-level education instead of primary-level education reduces the time spent on vigorous physical activity by 62.703-92.328 mins. In the age group of 40-49 years, secondary- and tertiary-educated individuals spend about 69.730 mins and 98.737 mins less on vigorous physical activity, respectively, compared with their primary-educated counterparts. Furthermore, individuals in this age group spend 82.244-121.713 mins less on vigorous physical activity if their income increases. Secondary-educated individuals who are 50-59 years old spend 67.297 mins less on vigorous physical activity than their peers who have only primary-level education. Among individuals in this age group, having income of ≥RM4000 is negatively associated with the time spent in vigorous physical activity. Males in all the age groups, except ≥60 years spend 131.713-218.950 mins more on vigorous physical activity than females. Among individuals aged ≤29 years, Chinese spend 52.187 mins less on vigorous physical activity than Malays, while those from other ethnic background spend 66.253 mins more than Malays. Having a large family size is associated with an increase of 65.379 mins and 87.730 mins in the time spent in vigorous physical activity among individuals aged ≥60 and 30-39 years, respectively. Being employed increases the time spent in vigorous physical activity by 53.836-106.187 mins among all age groups of individuals. Individuals aged 30-39 years with insurance spend 56.214 mins less on vigorous physical activity than their counterparts who do not have insurance.

The correlates of age, education, income, demographic factors and insurance to moderate physical activity across all age groups are presented in Table 4 (pg 25). Among individuals who are ≤29 years old, taking those with income of ≤RM999 as the base group,

those having income of RM1000-1999, RM2000-2999, RM3000-3999 and ≥RM4000 allocate 61.509 mins, 63.693 mins, 95.513 mins and 139.714 mins less for moderate physical activity, respectively. In the age group of 30-39 years, an increase in a unit of age raises the time spent on moderate physical activity by 240.376 mins. The relationship between age and moderate physical activity in this age group seems to be an inverted-U. In terms of income, if individuals' income is RM1000-1999, RM2000-2999, RM3000-3999 or ≥RM4000 instead of ≤RM999, their time allocated for moderate physical activity reduces by 81.783 mins, 105.316 mins, 128.027 mins and 143.885 mins, respectively. Individuals who are 40-49 years old with tertiary-level education spend 127.482 mins less on moderate physical activity than their counterparts who have obtained low educational attainment. Compared with individuals aged 50-59 years that have income of ≤RM999, individuals that have income of ≥RM4000 spend 114.315 mins less on moderate physical activity. In the age group of ≤29 years, males spend 49.360 mins more on moderate physical activity than females, whereas in the age groups of 40-49 years, 50-59 years and ≥60 years, males spend 76.797 mins, 73.894 mins and 61.084 mins less in moderate physical activity, respectively, than females. Chinese aged 50-59 years spend 58.912 mins more on moderate physical activity than their Malay counterparts. Indians aged 30-39 years and 40-49 years spend 99.090 mins and 84.527 mins less on moderate physical activity, respectively, than Malays. Among individuals aged ≤29 years, 30-39 years and 50-59 years, those from other ethnic background spend 128.708 mins, 156.098 mins and 89.393 mins more on moderate physical activity, respectively, than Malays. Married individuals aged ≤29 years spend 46.981 mins more on moderate physical activity than single individuals. Individuals who are 30-39 years old and have a large family size spend 79.671 mins more on moderate physical activity than those who have a small family size. Employed individuals aged ≤29 years, 50-59 years and ≥60 years spend 77.266 mins, 118.878 mins and 139.391 mins more on moderate physical activity, respectively, than unemployed individuals.

The correlates of age, education, income, demographic factors and insurance to total physical activity across age group are presented in Table 5 (pg 26). Among individuals aged ≤29 years, those having tertiary-level education and income of ≥RM4000 spend 150.088 mins and 170.927 mins less on total physical activity, respectively, than their less-educated and lower income counterparts. In the age group of 30-39 years, having secondary-level (-101.381 mins) and tertiary-level education (-144.147 mins) is associated with reduced time spent in total physical activity. In addition, individuals with income of RM2000-2999, RM3000-3999

or ≥RM4000 spend 116.644 mins, 188.195 mins and 188.155 mins less on total physical activity, respectively, than their peers who have only ≤RM999 income. Among individuals aged 40-49 years, having secondary-level or tertiary-level education reduces the time spent on total physical activity by 124.875 mins and 226.219 mins, respectively. Compared with individuals who have income of ≤RM999, those with income of RM3000-3999 and ≥RM4000 spend 212.870 mins and 163.373 mins less on overall physical activity, respectively. Individuals who are 50-59 years old with income of ≥RM4000 spend 236.361 mins less on overall physical activity than their counterparts who have only ≤RM999 income. Males in the age groups of ≤29 years, 30-39 years and 40-49 years spend 263.576 mins, 195.076 mins and 135.559 mins more on total physical activity, respectively, than their female counterparts. However, in the age group of ≥60 years, males spend 61.084 mins less than females. Among individuals aged 50-59 years, Chinese spend 99.277 mins more on total physical activity than Malays. Individuals from other ethnic background aged ≤29 years and 30-39 years spend 194.961 mins and 167.690 mins more on total physical activity, respectively, than their Malay counterparts. Having a medium family size increases the time spent in total physical activity among individuals aged ≤29 years by 67.255 mins, while having a large family size increases the time spent in total physical activity among individuals aged 30-39 years by 167.401 mins. Among individuals in all age groups, employed individuals spend 129.826-225.065 mins more on total physical activity than unemployed individuals.

DISCUSSION

The effect of age on physical activity is mixed. Compared to young adults, adults who are in their middle age spend more time on moderate and total physical activity, whereas the elderly spend less time on vigorous and total physical activity. To some extent, our findings are consistent with our hypothesis and the findings of previous studies that age is negatively associated with physical activity (Farrell and Shields, 2002; Downward and Riordan, 2007; Downward and Rasciute, 2010; Eberth and Smith, 2010; Humphreys and Ruseski, 2011; Brown and Roberts, 2011). Our findings can be explained in two different ways. First, middle-aged adults are more aware of their health than young adults and consequently are more likely to allocate time for physical activity. Second, as discussed earlier, the elderly may find it more difficult and costlier to perform physical activity, especially vigorous physical activity, even though they may be more aware of their health than young adults. Given these findings, policy

makers should design the intervention carefully. The age-based policy that has the characteristic of 'one size fits all' may not work well in these circumstances.

Evidences of the present study show that well-educated individuals spend less time on physical activity than less-educated individuals, which contradict our hypothesis, as well as the findings of previous studies that education promotes physical activity participation (Farrell and Shields, 2002; Lechner, 2009; Downward and Rasciute, 2010; Eberth and Smith, 2010; Humphreys and Ruseski, 2011; Ruseski et al., 2011). The reasons are straightforward. Less-educated individuals are usually blue-collar workers, thus they are more physically active than well-educated individuals in general (Cheah and Poh, 2014). Besides, well-educated individuals tend to use other health inputs, such as dietary supplements and healthy foods, instead of physical activity to improve their health (Cheah et al., 2017). However, our finding shows that there are no differences in physical activity participation between well- and less-educated old adults. This may be because they are retirees, given that the physical activity measured in the present study comprises work related physical activity. In terms of policy implications, policy makers should focus on promoting physically active lifestyle among well-educated young and middle-aged adults.

Owing to the data limitation, income is used as a proxy for wage. Our findings show that higher income individuals spend less time on physical activity than lower income individuals. However, not all the income categories are significant, and this implies that the assumption of linearity in the relationship between income and physical activity may be inappropriate. While this finding supports our hypothesis that higher income earners face higher opportunity costs of not working than lower income earners, it contradicts the findings of previous studies (Downward, 2007; Downward and Rasciute, 2010; Lechner, 2009; Maruyama and Yin, 2012; Downward and Rasciute, 2015). It is noteworthy that income does not play an important role in influencing participation in physical activity among the elderly. This is not surprising because the majority of the elderly are retired and earn non-work income, and thus do not face high opportunity costs. Considering this finding, policy makers may have to put efforts into promoting physically active lifestyle among all age groups of high income earners, except those aged 60 years or more.

Although middle-aged men spend less time on moderate physical activity than women, they are more physically active in overall. Perhaps, this is due to the fact that they spend more

time on vigorous physical activity. However, among young adults, men spend more time on vigorous and moderate physical activity than women. The positive relationship between being male and physical activity supports our hypothesis and has also been evidenced in previous studies (Farrell and Shields, 2002; Downward and Riordan, 2007; Downward, 2007; Humphreys and Ruseski, 2011; Downward and Rasciute, 2015). In addition to the explanation provided by Humphreys and Ruseski (2011), another likely explanation for this outcome is that people often relate vigorous physical activity to masculine characteristics (Cheah et al., 2016). As a result, women have a lower preference for vigorous physical activity than men. In terms of policy implication, policy makers are suggested to put more efforts into promoting physically active lifestyle among women than men.

Of all the ethnic groups, Malays are least likely to be physically active. They allocate less time for physical activity, especially moderate physical activity than their non-Malay counterparts (i.e. Chinese, Indians, Others). Findings of Cheah et al. (2017) show likewise that Malays spend less time on physical activity compared with those who are from other ethnic groups. In terms of vigorous physical activity, young Chinese adults spend less time on it than Malays, even though they are more physically active. However, ethnicity does not affect participation in physical activity among the elderly. To some extent, it can be concluded that cultural and religious factors play a significant role in determining participation in physical activity among different age groups of people. This can be a direction of future qualitative research, if a better understanding of how culture and religion affect physical activity participation among different ethnic groups of people is to be acquired.

Among middle-aged adults, those who have a large family size are found to spend more time on physical activity than those who have a small family size. This finding contradicts our hypothesis and the findings of previous studies (Brown and Roberts, 2011; Humphreys and Ruseski, 2011). A likely explanation is that people who have a large family size tend to carry more household responsibilities to look after their family members than people who have a small family size, and consequently have greater incentive to adopt a healthy lifestyle. As discussed by Sinderlar (1982) and Cheah (2016), household members' well-being can be affected if one of the members is sick. Hence, the costs of sickness faced by people who have a large family are high. Given these findings, intervention measures directed toward promoting physically active lifestyle among individuals with a small family size, especially those aged 30-39 years may yield promising outcomes.

Findings of the present study show that employed individuals of all ages are more physically active than unemployed individuals, which are in contrast to our hypothesis and the findings of previous studies that being employed reduces the time spent on physical activity (Farrell and Shields, 2002; Downward and Riordan, 2007). This is not surprising. The physical activity analysed in the present study includes work and travel related physical activity, whereas previous studies have considered only leisure physical activity in their analyses. Hence, employed individuals tend to have a higher level of physical activity than unemployed individuals (Cheah and Poh, 2014). Based on these findings, one can conclude that although employed individuals spend less time on leisure physical activity than the unemployed, they are more physically active in overall. Therefore, policy makers may want to pay special attention to unemployed individuals rather than employed individuals if the goal of reducing the prevalence of physical inactivity is to be achieved.

The effect of insurance on physical activity is not very obvious, although it is significant. It appears that insurance can only affect participation in vigorous physical activity among individuals aged 30-39 years. Specifically, these individuals who have insurance spend less time on vigorous physical activity than those who do not have insurance. This finding contradicts our hypothesis and the finding of Cheah et al. (2017). One can relate it to moral hazard as people who have insurance may have less incentive to prevent diseases.

Given the use of secondary data, the present study has several limitations. First, the causal effects of demographic factors on physical activity are not well-identified because the data used in the present study is a cross-sectional data, instead of a longitudinal data. Second, due to data limitation, the present study is unable to segregate physical activity into leisure, work and travel activities for a more in-depth analysis. Third, all the information is self-reported. Hence, reporting error is likely to occur. Despite these limitations, the present study has made significant contributions to the literature, especially given that physical activity is not well-examined in developing countries.

CONCLUSION

In light of the importance of physical activity, the present study attempts to examine the effects age, education, income, demographic factors and insurance on the time spent on vigorous,

moderate and total physical activity. Analysis is stratified by age group in order to explore how these effects change across age. Findings of the present study show that education, income, gender, ethnicity, family size, employment status and insurance are significantly associated with physical activity. The effects of these factor seem to be varied across age. Policy makers who want to reduce the prevalence of physical inactivity among Malaysia adults should pay special attention the groups of people that are less likely to spend time on physical activity.

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Table 1. Summary statistics of independent variables, by age

Variables	Age					Total
	≤29	30-39	40-49	50-59	≥60	
Age						
≤29 years	–	–	–	–	–	2858
	–	–	–	–	–	(28.18)
30-39 years	–	–	–	–	–	2174
	–	–	–	–	–	(21.44)
40-49 years	–	–	–	–	–	2072
	–	–	–	–	–	(20.43)
50-59 years	–	–	–	–	–	1720
	–	–	–	–	–	(16.96)
≥60 years	–	–	–	–	–	1317
	–	–	–	–	–	(12.99)
Education						
Primary	263	293	423	722	945	2646
	(9.20)	(13.48)	(20.42)	(41.98)	(71.75)	(26.09)
Secondary	1438	1160	1173	770	278	4819
	(50.31)	(53.36)	(56.61)	(44.77)	(21.11)	(47.52)
Tertiary	1157	721	476	228	94	2676
	(40.48)	(33.16)	(22.97)	(13.26)	(7.14)	(26.39)
Income						
≤RM999	1409	655	698	797	937	4496
	(49.30)	(30.13)	(33.69)	(46.34)	(71.15)	(44.33)
RM1000-1999	895	569	486	377	233	2560
	(31.32)	(26.17)	(23.46)	(21.92)	(17.69)	(25.24)
RM2000-2999	370	409	302	222	83	1386
	(12.95)	(18.81)	(14.58)	(12.91)	(6.30)	(13.67)
RM3000-3999	117	263	248	136	32	796
	(4.09)	(12.10)	(11.97)	(7.91)	(2.43)	(7.85)
≥RM4000	67	278	338	188	32	903
	(2.34)	(12.79)	(16.31)	(10.93)	(2.43)	(8.90)
Gender						
Male	1381	992	932	769	602	4676
	(48.32)	(45.63)	(44.98)	(44.71)	(45.71)	(46.11)
Female	1477	1182	1140	951	715	5465
	(51.68)	(54.37)	(55.02)	(55.29)	(54.29)	(53.89)
Ethnicity						
Malay	1720	1115	1040	839	537	5251
	(60.18)	(51.29)	(50.19)	(48.78)	(40.77)	(51.78)
Chinese	447	498	548	525	561	2579
	(15.64)	(22.91)	(26.45)	(30.52)	(42.60)	(25.43)
Indian	240	203	229	203	155	1030
	(8.40)	(9.34)	(11.05)	(11.80)	(11.77)	(10.16)
Others	451	358	255	153	64	1281

	(15.78)	(16.47)	(12.31)	(8.90)	(4.86)	(12.63)
Marital status						
Single	1941	299	129	71	30	2470
	(67.91)	(13.75)	(6.23)	(4.13)	(2.28)	(24.36)
Married	907	1824	1855	1471	860	6917
	(31.74)	(83.90)	(89.53)	(85.52)	(65.30)	(68.21)
Widow/divorce	10	51	88	178	427	754
	(0.35)	(2.35)	(4.25)	(10.53)	(32.42)	(7.44)
Family size						
Small	1623	1102	1004	1094	886	5709
	(56.79)	(50.69)	(48.46)	(63.60)	(67.27)	(56.30)
Medium	961	898	947	504	336	3646
	(33.62)	(41.31)	(45.70)	(29.30)	(25.51)	(35.95)
Large	274	174	121	122	95	786
	(9.59)	(8.00)	(5.84)	(7.09)	(7.21)	(7.75)
Employment						
Employed	2001	1731	1566	1007	252	6557
	(70.01)	(79.62)	(75.58)	(58.55)	(19.13)	(64.66)
Unemployed	857	443	506	713	1065	3584
	(29.99)	(20.38)	(24.42)	(41.45)	(80.87)	(35.34)
Insurance						
Insured	1487	1318	1147	913	447	5312
	(52.03)	(60.63)	(55.36)	(53.08)	(33.94)	(52.38)
Uninsured	1371	856	925	807	870	4829
	(47.97)	(39.37)	(44.64)	(46.92)	(66.06)	(47.62)
Observations	2858	2174	2072	1720	1317	10141

Notes: The entries refer to frequencies. Percentages in parentheses.
Source: NHMS 2011

Table 2. Age, education, income, demographic factors and insurance associated with vigorous, moderate and total physical activity

Variables	Vigorous	Moderate	Total
Constant	80.992*	176.526*	257.518*
	(17.559)	(18.734)	(26.777)
30-39 years	-3.099	20.433	17.334
	(14.208)	(15.158)	(21.666)
40-49 years	6.927	54.963*	61.889*
	(15.126)	(16.137)	(23.066)
50-59 years	-18.484	51.693*	33.210
	(16.287)	(17.376)	(24.836)
≥60 years	-81.478*	-30.108	-111.586*
	(19.644)	(20.958)	(29.957)
Secondary	-51.362*	-7.033	-58.395*
	(12.125)	(12.936)	(18.490)
Tertiary	-86.745*	-36.337*	-123.082*
	(15.289)	(16.311)	(23.314)
RM1000-1999	13.762	-41.697*	-27.936
	(11.726)	(12.510)	(17.881)
RM2000-2999	-7.620	-46.344*	-53.964*
	(15.202)	(16.219)	(23.183)
RM3000-3999	-42.992*	-97.088*	-140.081*
	(18.809)	(20.067)	(28.682)
≥RM4000	-64.511*	-108.175*	-172.686*
	(19.127)	(20.406)	(29.167)
Male	180.386*	-24.240*	156.146*
	(9.246)	(9.864)	(14.099)
Chinese	-10.464	25.923*	15.459
	(10.622)	(11.332)	(16.198)
Indian	-17.537	69.952*	48.514*
	(14.608)	(15.585)	(22.276)
Others	42.420*	117.594*	160.013*
	(13.849)	(14.775)	(21.119)
Married	-5.213	24.490	19.277
	(13.139)	(14.017)	(20.036)
Widow/divorce	-14.550	-0.425	-14.975
	(21.945)	(23.413)	(33.466)
Medium	13.562	10.008	23.370
	(9.159)	(9.771)	(13.967)
Large	37.473*	-3.736	33.737
	(16.374)	(17.469)	(24.970)
Employed	83.970*	72.508*	156.479*
	(11.229)	(11.980)	(17.123)
Insured	-27.940*	2.887	-25.023
	(9.469)	(10.102)	(14.440)
F-statistics	39.320	12.600	28.730
p-value	<0.001	<0.001	<0.001
Observations		10141	

Note: *p-value<0.05. The entries refer to estimates. Standard errors in parentheses.
Source: NHMS 2011.

Table 3. Age, education, income, demographic factors and insurance associated with vigorous physical activity, by age

Variables	**≤29**	**30-39**	**40-49**	**50-59**	**≥60**
Constant	-1041.972*	759.971	4082.766	3731.750	596.494
	(458.424)	(1472.723)	(2727.632)	(4253.744)	(574.161)
Age (in years)	95.317*	-40.450	-181.455	-130.213	-15.978
	(39.263)	(85.914)	(123.274)	(156.979)	(15.902)
Age^2 (in years)	-2.013*	0.598	2.060	1.143	0.101
	(0.830)	(1.246)	(1.387)	(1.445)	(0.109)
Secondary	-34.415	-62.703*	-69.730*	-67.297*	11.911
	(32.389)	(29.655)	(28.677)	(24.257)	(21.025)
Tertiary	-93.991*	-92.328*	-98.737*	-58.139	0.662
	(35.087)	(34.572)	(37.953)	(38.951)	(32.845)
RM1000-1999	5.962	17.377	-14.545	40.080	22.534
	(22.510)	(26.748)	(29.256)	(28.870)	(21.932)
RM2000-2999	46.362	-11.327	-82.244*	-50.910	66.629
	(30.770)	(31.491)	(36.488)	(37.084)	(34.157)
RM3000-3999	72.562	-60.167	-143.535*	-33.419	-8.617
	(46.763)	(36.487)	(39.920)	(44.816)	(52.681)
≥RM4000	-31.213	-44.269	-121.713*	-122.046*	5.915
	(58.949)	(37.950)	(39.883)	(44.405)	(52.839)
Male	214.216*	218.950*	212.356*	131.713*	20.526
	(17.608)	(20.469)	(23.225)	(23.568)	(17.958)
Chinese	-52.187*	-19.404	-18.861	40.365	-20.825
	(24.371)	(23.880)	(25.403)	(24.557)	(17.148)
Indian	-13.413	-24.128	-65.719	16.261	-33.579
	(31.126)	(32.717)	(34.568)	(33.989)	(24.975)
Others	66.253*	11.593	28.175	26.020	-1.760
	(25.677)	(27.569)	(34.812)	(38.526)	(36.136)
Married	-8.275	9.784	28.235	-10.284	73.813
	(21.860)	(27.805)	(42.860)	(52.937)	(51.189)
Widow/divorce	-29.561	-78.243	-15.647	-38.470	50.044
	(143.284)	(65.587)	(64.465)	(60.636)	(52.395)
Medium	35.546	-14.104	12.672	39.185	-15.040
	(18.756)	(19.620)	(21.353)	(23.298)	(17.553)
Large	31.150	87.730*	-44.243	42.505	65.379*
	(29.897)	(35.117)	(45.066)	(41.677)	(29.817)
Employed	53.836*	93.377*	105.009*	106.187*	102.709*
	(21.707)	(27.957)	(28.535)	(26.120)	(21.417)
Insured	-21.820	-56.214*	-44.687	7.270	-22.451
	(18.588)	(21.353)	(22.971)	(22.574)	(17.592)
F-statistics	13.700	12.910	10.400	6.270	4.300
p-value	<0.001	<0.001	<0.001	<0.001	<0.001
Observations	2858	2174	2072	1720	1317

*Note: *p-value<0.05. The entries refer to estimates. Standard errors in parentheses.*
Source: NHMS 2011.

Table 4. Age, education, income, demographic factors and insurance associated with moderate physical activity, by age

Variables	**≤29**	**30-39**	**40-49**	**50-59**	**≥60**
Constant	267.063	-3902.184*	1114.549	2429.396	426.663
	(445.333)	(1584.723)	(2831.576)	(4907.467)	(779.961)
Age (in years)	-12.014	240.376*	-24.611	-84.628	-1.956
	(38.141)	(92.448)	(127.971)	(181.104)	(21.602)
Age^2 (in years)	0.298	-3.468*	0.181	0.828	-0.015
	(0.806)	(1.341)	(1.440)	(1.667)	(0.149)
Secondary	-34.967	-38.678	-55.144	17.435	10.459
	(31.464)	(31.910)	(29.770)	(27.985)	(28.561)
Tertiary	-56.097	-51.819	-127.482*	40.748	81.217
	(34.085)	(37.201)	(39.399)	(44.937)	(44.618)
RM1000-1999	-61.509*	-81.783*	-53.928	7.979	21.030
	(21.867)	(28.783)	(30.371)	(33.307)	(29.793)
RM2000-2999	-63.693*	-105.316*	10.805	-37.622	45.982
	(29.892)	(33.886)	(37.879)	(42.783)	(46.400)
RM3000-3999	-95.513*	-128.027*	-69.335	-82.295	-67.164
	(45.427)	(39.262)	(41.441)	(51.703)	(71.564)
≥RM4000	-139.714*	-143.885*	-41.660	-114.315*	-127.062
	(57.265)	(40.836)	(41.403)	(51.230)	(71.778)
Male	49.360*	-23.874	-76.797*	-73.894*	-61.084*
	(17.105)	(22.026)	(24.110)	(27.190)	(24.394)
Chinese	11.496	21.184	-15.446	58.912*	-4.398
	(23.675)	(25.696)	(26.371)	(28.331)	(23.294)
Indian	43.824	51.210	99.090*	84.527*	-5.084
	(30.237)	(35.205)	(35.885)	(39.312)	(33.926)
Others	128.708*	156.098*	23.072	89.393*	23.659
	(24.944)	(29.665)	(36.139)	(44.447)	(49.088)
Married	46.981*	26.359	-16.569	-64.594	-35.845
	(21.235)	(29.919)	(44.493)	(61.073)	(69.536)
Widow/divorce	12.724	60.947	40.804	-55.655	-74.566
	(139.192)	(70.575)	(66.922)	(69.954)	(71.175)
Medium	31.709	19.480	12.515	5.599	-20.194
	(18.220)	(21.112)	(22.167)	(26.878)	(23.844)
Large	-10.321	79.671*	-21.500	-52.331	-40.294
	(29.043)	(37.787)	(46.784)	(48.081)	(40.504)
Employed	77.266*	52.890	24.817	118.878*	139.391*
	(21.087)	(30.083)	(29.622)	(30.135)	(29.093)
Insured	11.016	25.807	-8.029	-25.126	1.533
	(18.057)	(22.977)	(23.847)	(26.043)	(23.898)
F-statistics	5.490	5.230	3.770	2.300	3.340
p-value	<0.001	<0.001	<0.001	<0.001	<0.001
Observations	2858	2174	2072	1720	1317

*Note: *p-value<0.05. The entries refer to estimates. Standard errors in parentheses.*
Source: NHMS 2011.

Table 5. Age, education, income, demographic factors and insurance associated with total physical activity, by age

Variables	**≤29**	**30-39**	**40-49**	**50-59**	**≥60**
Constant	-774.909	-3142.214	5197.315	6161.146	426.663
	(663.099)	(2263.518)	(4018.976)	(6954.239)	(779.961)
Age (in years)	83.303	199.926	-206.066	-214.841	-1.956
	(56.792)	(132.047)	(181.635)	(256.638)	(21.602)
Age^2 (in years)	-1.715	-2.871	2.240	1.971	-0.015
	(1.200)	(1.915)	(2.044)	(2.362)	(0.149)
Secondary	-69.382	-101.381*	-124.875*	-49.862	10.459
	(46.849)	(45.578)	(42.254)	(39.657)	(28.561)
Tertiary	-150.088*	-144.147*	-226.219*	-17.391	81.217
	(50.752)	(53.136)	(55.921)	(63.679)	(44.618)
RM1000-1999	-55.547	-64.406	-68.473	48.059	21.030
	(32.559)	(41.111)	(43.107)	(47.198)	(29.793)
RM2000-2999	-17.330	-116.644*	-71.439	-88.532	45.982
	(44.508)	(48.400)	(53.763)	(60.627)	(46.400)
RM3000-3999	-22.951	-188.195*	-212.870*	-115.714	-67.164
	(67.641)	(56.079)	(58.819)	(73.267)	(71.564)
≥RM4000	-170.927*	-188.155*	-163.373*	-236.361*	-127.062
	(85.268)	(58.327)	(58.765)	(72.596)	(71.778)
Male	263.576*	195.076*	135.559*	57.818	-61.084*
	(25.470)	(31.460)	(34.220)	(38.530)	(24.394)
Chinese	-40.690	1.780	-34.307	99.277*	-4.398
	(35.252)	(36.703)	(37.429)	(40.147)	(23.294)
Indian	30.411	27.082	33.371	100.789	-5.084
	(45.023)	(50.284)	(50.933)	(55.567)	(33.926)
Others	194.961*	167.690*	51.247	115.413	23.659
	(37.141)	(43.372)	(51.293)	(62.985)	(49.088)
Married	38.705	36.143	11.666	-74.878	-35.845
	(31.620)	(42.735)	(63.151)	(86.545)	(69.536)
Widow/divorce	-16.837	-17.296	25.157	-94.125	-74.566
	(207.256)	(100.805)	(94.985)	(99.130)	(71.175)
Medium	67.255*	5.376	25.187	44.784	-20.194
	(27.129)	(30.155)	(31.462)	(38.089)	(23.844)
Large	20.829	167.401*	-65.742	-9.827	-40.294
	(43.246)	(53.973)	(66.402)	(68.135)	(40.504)
Employed	131.102*	146.267*	129.826*	225.065*	139.391*
	(31.399)	(42.968)	(42.044)	(42.703)	(29.093)
Insured	-10.803	-30.407	-52.716	-17.857	1.533
	(26.887)	(32.819)	(33.847)	(36.905)	(23.898)
F-statistics	13.600	8.490	5.970	4.130	5.590
p-value	<0.001	<0.001	<0.001	<0.001	<0.001
Observations	2858	2174	2072	1720	1317

*Note: *p-value<0.05. The entries refer to estimates. Standard errors in parentheses.*
Source: NHMS 2011.