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The Income Elasticity of Participation in Physical Activity: Evidence from Malaysia

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ABSTRACT

Estimating the income elasticity of demand for market goods and services has received significant research attention. However, the income elasticity of participation in physical activity has never been studied thoroughly, especially in developing countries. To fill this research gap, the income elasticity of time spent in both vigorous and moderate physical activities is estimated using a two-part model. Data from the National Health and Morbidity Survey 2011 is used. After controlling for demographic variables, the present study finds that time spent in vigorous and moderate physical activities is negatively associated with income. However, the degree of sensitivity of time spent in vigorous and moderate physical activities is low, suggesting that income does not play an important role in promoting physically active lifestyle among adults. The present study concludes that acquiring a better understanding of the income elasticity of physical activity is important for policy development.

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INTRODUCTION

It is clearly evident that physical activity is beneficial to health. Extant studies suggest that physically active men and women are 20% to 35% less likely to die of cardiovascular disease than their physically inactive counterparts (Macera *et al*., 2003). In addition, the negative relationship between the intensity of physical activity and the risk of developing diabetes has been empirically identified (Helmrich *et al*., 1991). As the study by Helmrich and colleagues demonstrates, an additional 500 kilocalories in energy expenditure reduces the risk of type 2 diabetes by about 6%. In terms of cancer-related health benefits, individuals who adopt a physically active lifestyle have an approximately 30% lower likelihood of acquiring colon or breast cancer when compared with physically inactive individuals (Lee, 2003). Furthermore, participation in weight-bearing physical activity can help to prevent osteoporosis, most notably bone loss in the lumbar spine and hip fracture (Warburton *et al*., 2001).

The rising prevalence of noncommunicable diseases (NCDs) in Malaysia has become an alarming issue (Fallahi *et al*., 2015). In 2010, approximately 16% of mortalities in public hospitals were caused by heart diseases (World Health Organization, 2011). Additionally, ischemic heart disease (IHD) and other cardiovascular diseases (CVDs) account for about 10% and 6% of disability-adjusted life years (DALYs), respectively. In spite of these undesirable realities, Malaysian adults seldom spend enough time engaged in physical activity. As identified in Institute for Public Health (2011), about one-third of adults do not live a physically active lifestyle. Moreover, Poh *et al.* (2010), using the Malaysian Adult Nutrition Survey (MANS), find that only 14% of adults in Malaysia undertake adequate exercise.

There appear to be several reasons to explain physical inactivity among adults, especially those who reside in developing countries (Bauman *et al*., 2012). First, individuals who have low socioeconomic status are less likely to engage in a physically active lifestyle than their peers with high socioeconomic status (Bauman *et al*., 2012). This is simply because of financial constraints, as not all forms of exercise are without cost. Second, depression and distress can lower an individual's tendency to participate in physical activity (Bauman *et al*., 2012). This means that individuals who have psychological problems are less likely to be physically active. Third, poor access to facilities can demotivate individuals to participate in physical activity (Bauman *et al*., 2012). This is regarded as one of the more serious barriers to physical activity.

An investigation into the income elasticity of demand for market goods and services has received a great deal of attention in the economic literature because it can assist policy makers in developing effective intervention strategies. For instance, Di Matteo (2003), in examining the income elasticity of health expenditures, contends that information on income elasticity can assist the government in deciding the optimal amount of health expenditures, which can determine whether health care is a normal or an inferior good. It is inappropriate for policy makers to increase individuals' income if health care is an inferior good. Di Matteo also claims that the question of whether health care is a necessity or a luxury can also be answered based on income elasticity. The government should intervene if it is necessity. Otherwise, health care should be provided through the free

market. To date, little attention has been devoted to estimating the income elasticity of health behaviours, especially physical activity, despite the fact that there has been a sharp rise in the prevalence of chronic diseases across the globe (World Health Organization, 2014). Income has often been used exclusively as an explanatory variable or a control variable in the regression models of physical activity participation (Farrell and Shields, 2002; Downward, 2007; Humphreys and Ruseski, 2007; Wicker *et al*., 2009; Downward and Rasciute, 2015). Using the health survey of England, Farrell and Shields (2002) find that income is positively associated with participation in physical activity. Similar findings are evidenced in a study by Downward (2007) that incorporates the General Household Survey of the United Kingdom, as well as a study by Downward and Rasciute (2015) that draws from the Active People Survey of England. Studies conducted in Germany (Wicker *et al*., 2009) and the United States (Humphreys and Ruseski, 2007) also find a positive relationship between income and physical activity. However, the question arises as to whether or not time spent in physical activity is sensitive to income changes. The objective of the present study is to answer this question by estimating the income elasticity of participation in physical activity due to its relative importance in health policy.

Although the relationship between income and physical activity may not be as strong as that of other health behaviours, such as smoking and drinking, it should be given particular attention. In brief, the present study attempts to contribute to the existing literature in several ways. First, the present study examines the income elasticity of different intensity levels of physical activity, which serves the interests of policy makers and researchers. Second, a large nationally representative data set is used in the analysis. Hence, statistical inferences regarding the population can be drawn based on the findings. Third, the country of interest is a developing country, Malaysia, which has a high prevalence of chronic diseases (World Health Organization, 2011) and lacks empirical studies related to physical activity.

METHODS

Data

The present study estimates the income elasticity of participation in physical activity using data from the National Health and Morbidity Survey 2011 (NHMS 2011) (Institute for Public Health, 2011). NHMS 2011 is a nationwide cross-sectional study carried out by the Ministry of Health Malaysia. The survey period was between April and July 2011. The survey was conducted based on two-stage stratified sampling. The first-stage sampling unit was based on enumeration blocks (EBs), while the second-stage sampling unit was based on living quarters (LQs). A total of 794 EBs were selected, each consisting of 12 LQs. All of the individuals in the selected LQs were surveyed, with the exception of those staying in hotels, hostels and hospitals. The survey was conducted in all the states comprising Malaysia, including the Federal Territories. To ensure the representativeness of the Malaysian population, the sampling frame was designed based on the National Population and Housing Census conducted by the Department of Statistics Malaysia. The sample size was calculated using a sample size calculation formula for a prevalence study. The calculation was based on three criteria: 1) the expected prevalence of diseases and health-related problems in the population; 2) the margin of error (between 0.01 and 0.05); and 3) a confidence interval of 95%. The overall response rate was 93%.After restricting the sample to respondents aged 18 years or older who reported complete information, only 10,141 observations were used for analysis.

Physical activity was measured by minutes per week engaged in moderate to vigorous physical activity. This information was obtained by asking the respondents: 'Over the past seven days, how many days did you engage in vigorous/moderate physical activity for at least 10 minutes per session?' and 'On the days you engaged in vigorous/moderate physical activity, how long did you carry out this activity?' The intensity of physical activity is measured using the metabolic equivalent (MET) (Ainsworth *et al*., 2000). The MET of a given exercise is the ratio of a respondent's metabolic rate during exercise when compared to the metabolic rate when the respondent is sitting quietly, which is typically defined as 1 MET. Hence, 3 MET means the activity requires three times the energy expenditure of a respondent when sitting quietly. Before the respondents answered the questions related to physical activity, the interviewers explained the definition of MET and provided the respondents with examples of vigorous (MET > 6) and moderate (MET ≤ 6) physical activity, as defined by Ainsworth *et al*. (1993). Bicycling, running and swimming, for instance, are considered vigorous physical activity. Walking, dancing and golf, for instance, are considered moderate physical activity. Complete examples of vigorous and moderate physical activity have been described in a study conducted by Ainsworth *et al*. (1993). After the respondents provided their answers, the interviewers ensured that the respondents had correctly classified the physical activity in which they had engaged as either vigorous or moderate physical activity based on the guidelines provided by the work of Ainsworth *et al*. (1993). Of the total respondents, 35.2% were physically inactive. During the survey, the respondents were also asked to provide demographic profiles. These included age, family size, gender, ethnicity, education, marital status and employment status. In order to avoid biased estimates, the present study made an effort to control for these variables.

Econometric specification

Generally, individuals consume all available goods and services in order to maximise their utilities. However, there are goods and services which are not consumed by some individuals. For instance, not all individuals consume alcohol and tobacco. In the present study, there can be individuals who do not participate in physical activity. These individuals make an optimal choice at a corner point, that is, they maximise their utilities by not spending time in physical activity. This is called 'corner point solution'. As a result, the dependent variables of the present study, time spent in vigorous and moderate physical activities, have zero values for a large proportion of observations. Time spent in physical activity is created based on the minutes per week of physical activity. Hence, zero indicates that individuals spending zero minute in physical activity a week.

To deal with such data that contains a lot of zeros, a two-part model is used. The first part of the model is to use probit to examine the probability of participating in physical activity (participation equation), assuming the cumulative distribution function is normally distributed. The second part of the model is to use ordinary least square (OLS) to estimate time spent in physical activity among those who participate in physical activity (time spent equation). The participation equation measures the adjustment on the extensive margin, while the time spent equation measures the adjustment on the intensive margin. Mathematically, the two-part model can be expressed as:

$$f(y|\mathbf{x}) = \begin{cases} \Pr[d=0|\mathbf{x}] & \text{if } y=0 \\ \Pr[d=1|x] f(y|d=1,\mathbf{x}) & \text{if } y>0 \end{cases} \quad (1)$$

where y is time spent in physical activity (minutes per week), d is a binary variable (1 = participate in physical activity; 0 = do not participate in physical activity), and $\mathbf{x}$ is the matrix of explanatory variables. Hence, $y = 0$ is non-participants and $\Pr[d = 0|\mathbf{x}]$ is observed, while $y > 0$ is participants and $\Pr[d = 1|\mathbf{x}]$ is observed. Two-part model is discussed at greater length in Wooldridge (2010).

To calculate the income elasticity of time spent in physical activity, the following formula is used:

$$\frac{\partial y}{\partial inc} \cdot \frac{inc}{y} \quad (2)$$

where *inc* is income. The mean value of income and time spent in physical activity are substituted into *inc* and *y* in Equation 2, respectively. The proof of this formula has been described by Chiang and Wainwright (2005).

Variables

The explanatory variables used in the present study consist of income, age, family size, gender, ethnicity, education, marital status and employment status. Only income, age and family size are formatted as continuous variables, while the rest are formatted as categorical variables. They were selected based on the findings from previous empirical studies (e.g., Farrell and Shields, 2002; Downward and Riordan, 2007; Downward and Rasciute, 2010; Meltzer and Jena, 2010; Humphreys and Ruseski, 2011; Maruyama and Yin, 2012; Humphreys and Ruseski, 2015).

The relationship between income and physical activity is mixed. Meltzer and Jena (2010) found that individuals with higher incomes tend to spend more time in vigorous physical activity than their lower-income counterparts. This is simply because the price of physical activity (i.e. wage) faced by higher-income individuals is higher. Thus, they are less willing to spend time in low-intensity physical activity. However, participating in vigorous physical activity can be stressful. Hence, lower-income individuals, that is, those who face a lower price for physical activity, are less devoted to spending time in vigorous physical activity. These findings have also been corroborated by Maruyama and Yin (2012). In other studies on physical activity, Downward (2007), Downward and Riordan (2007), Humphreys and Ruseski (2011) and Humphreys and Ruseski (2015) have examined the extensive and intensive margins of physical activity. They found that the probability of participation increases with income, while time spent exercising diminishes with income.

The effect of age on physical activity has been well-identified in previous studies. The effect of age on physical activity has been well-documented in previous studies. Downward and Riordan (2007) and Downward and Rasciute (2010) observed that older individuals are less likely to participate in physical activity than younger individuals in the United Kingdom (UK). Similarly, Humphreys and Ruseski (2011) found that age is negatively associated with decisions related to participation in as well as the amount of physical activity. Since older individuals tend to encounter greater physical constraints than younger individuals, they are more inclined to use medical care to improve their health

rather than physical activity.

The association between family structure and physical activity is noteworthy. Using health survey data from England, Farrell and Shields (2002) observed that the presence of children in a household can promote participation in physical activity. Surprisingly, however, the findings of Brown and Roberts (2011) demonstrate otherwise. Humphreys and Ruseski (2011) offered an interesting finding, revealing that the presence of children in a family is positively associated with participation decisions related to physical activity but is negatively associated with decisions related to the amount of physical activity. It can, therefore, be hypothesised that household commitment may affect physical activity. Because of limitations in the data, the present study uses family size as a proxy for the number of children in a household.

The findings related to gender are quite consistent. Farrell and Shields (2002) found that males display a higher likelihood of participating in physical activity than females. Similar findings were evident in studies conducted by Downward (2007), as well as Eberth and Smith (2010), who focused on the population in Scotland. More interestingly, Humphreys and Ruseski (2007) found that men have a higher likelihood of participating in time-consuming physical activity, whereas women are more likely to engage in time-saving physical activity. In terms of the extensive and intensive margins, Humphreys and Ruseski (2011) found that males are more likely to participate in exercise but generally spend less time on exercise. Furthermore, Meltzer and Jena (2010) and Maruyama and Yin (2012) found that levels of exercise intensity increase with males.

The impact of ethnicity on physical activity has been analysed by Downward (2007) and Downward and Rasciute (2010). They found that the ethnic majority in the UK has a higher probability of participating in physical activity than the ethnic minority. Interestingly, Humphreys and Ruseski (2011) found that individuals who comprise the ethnic majority are more likely to participate in physical activity but spend less time exercising compared with their counterparts who comprise the ethnic minority. In Malaysia, Cheah (2015), Cheah and Rasiah (2017), Cheah and Goh (2017) and Cheah and Tang (2017) all found that there are ethnic differences in health behaviours, such as the use of health screening and alcohol consumption.

It is well documented that education is associated with participation in physical activity. Previous studies have consistently identified a positive relationship between education and physical activity (Downward and Rasciute, 2010; Eberth and Smith, 2010; Humphreys and Ruseski, 2011; Humphreys and Ruseski, 2015). Education promotes participation in physical activity in two ways. First, education enhances the productive and allocative efficiency of health (Grossman, 1972). This is because well-educated individuals are more aware of the benefits of physical activity than less-educated individuals. Second, education lowers the rate of time preference (Van der pol, 2011). Evidence suggests that well-educated individuals are more future-oriented than their less-educated counterparts, and thus are more devoted to efforts to improve their health.

Previous studies have shown that marital status can influence participation in physical activity. In particular, Downward and Rasciute (2010) found marriage reduces the propensity to participate in physical activity. Similar findings were observed in a study conducted by Eberth and Smith (2010). The explanation is straightforward. Since married

individuals need to allocate more time for home activity than their unmarried counterparts, they have less time for physical activity. It can, therefore, be expected that household commitment plays an important role in individuals' decisions to adopt a physically active lifestyle.

The effect of employment status on participation in physical activity has been considered in previous studies. Farrell and Shields (2002) and Eberth and Smith (2010) similarly found that employed individuals are less likely to participate in physical activity than unemployed individuals. This is because of time constraints. Since there is a trade-off between leisure and work, individuals who need to work tend to allocate less time for leisure when compared with their counterparts who are unemployed. Astonishingly, however, the findings of Brown and Roberts (2011) suggest otherwise. Their research revealed that employed individuals are more likely to participate in physical activity than the unemployed.

RESULTS AND DISCUSSION

The characteristics of survey respondents are presented in Table 1. The average times allocated for vigorous and moderate physical activity on a weekly basis are 140.86 and 235.29 minutes, respectively. Respondents earn an average of Ringgit Malaysia (RM) 1653.32 per month. The mean age of all of the respondents is approximately 41 years, while the average family size is four members. Of the total sample, 46.1% are males, and 51.8% are Malays. In terms of education, 26.4%, 47.5% and 26.1% of the respondents have attained tertiary, secondary and primary education levels, respectively. The majority of the respondents are married (68.2%) and are also employed (64.7%).

Table1.Descriptivestatistics

Variable	Definition	Mean	Std. dev.
Continuous			
vig	Time spent in vigorous physical activity per week	140.863	439.906
mod	Time spent in moderate physical activity per week	235.294	457.682
inc	Monthly individual income (in RM)	1653.327	2235.359
age	Age in years	41.179	15.410
fam	Family size	4.405	2.236
Categorical			
male	Gender is male	0.461	0.499
*female**	Gender is female	0.539	0.499
mal	Ethnicity is Malay	0.518	0.500
*nonmal**	Ethnicity is non-Malay (i.e. Chinese, Indians, Others)	0.482	0.500
tert	Highest education level is tertiary	0.264	0.441
sec	Highest education level is secondary	0.475	0.499
*pri**	Highest education level is primary	0.261	0.439
marr	Marital status is married	0.682	0.466
*unmarr**	Marital status is unmarried (i.e. single, divorced, widowed)	0.318	0.466
emp	Being employed full time	0.647	0.478
*unemp**	Being unemployed or employed part time	0.353	0.478

Note: Means and standard deviations reported. RM refers to Ringgit Malaysia. *refers to reference group.
Observations = 10141.
Source: NHMS 2011

The results of the two-part model are presented in Table 2. The hypotheses are tested using a *t*-statistic. The significance level is based on *p*-values of <0.001, <0.05 and <0.10. Likelihood ratio (LR) and F-statistic are used to test the overall significance of the models. The *p*-values of the LR and F-statistic of both vigorous and moderate physical activity models are statistically significant at the one percent level, indicating that all of the explanatory variables are jointly significant in explaining participation and time spent in vigorous and moderate physical activity. Considering the specific explanatory variables, income, age, family size, gender, education and employment status are significantly associated with vigorous physical activity, while income, age, family size, gender, ethnicity, education, marital status and employment status are significantly associated with moderate physical activity.

Table 2. Correlates of income and demographic factors to participation and time spent in vigorous and moderate physical activities

Variables	Vig		Mod	
	Participation	Time spent	Participation	Time spent
constant	-0.543***	328.932***	1.008***	318.100***
	(0.074)	(62.721)	(0.076)	(31.943)
inc	-0.001	-0.011**	-0.001	-0.011***
	(0.001)	(0.005)	(0.001)	(0.003)
age	-0.010***	-1.645	-0.009***	0.113
	(0.001)	(1.022)	(0.001)	(0.492)
fam	0.004	11.422**	-0.014**	6.465**
	(0.006)	(4.961)	(0.006)	(2.657)
male	0.661***	242.249***	-0.414***	10.661
	(0.028)	(23.792)	(0.029)	(12.236)
mal	0.035	-16.212	0.001	-75.502***
	(0.035)	(22.477)	(0.028)	(11.788)
tert	-0.022	-289.876***	0.102**	-105.385***
	(0.045)	(36.651)	(0.046)	(19.147)
sec	-0.011	-165.547***	0.096**	-42.123***
	(0.037)	(30.697)	(0.038)	(15.744)
marr	0.021	18.359	0.315***	18.920
	(0.032)	(27.315)	(0.032)	(13.571)
emp	0.266***	145.948***	0.081**	76.160***
	(0.033)	(62.721)	(0.034)	(13.759)
Elasticity	–	-0.129	–	-0.077
LR	1058.48***	–	399.290***	–
F-statistic	–	30.520***	–	17.420***
Observations	10141	3544	10141	7637

Note: Asymptotic standard errors in parentheses. *** indicate significant at the 1% level, ** at the 5% level and * at the 10% level. LR refers likelihood ratio.
Source: NHMS 2011

Income appears to be associated with time spent in vigorous and moderate physical activity, but it does not explain participation decisions. After controlling for all of the demographic variables, an additional unit of income reduces time spent in vigorous and moderate physical activity by 0.011 minutes per week, which is consistent with the research findings of Downward (2007), Downward and Riordan (2007), Humphreys and Ruseski (2011), and Humphreys and Ruseski (2015) that time spent in physical activity decreases with income. The negative relationship between income and physical activity is also found at the bivariate level[1]. Although the income variable has a small impact on time spent in physical activity, it is highly significant. Hence, policy makers should not neglect this variable. The estimated income elasticity of vigorous and moderate physical activity is noteworthy. The results demonstrate that the income elasticity of time spent in vigorous physical activity is -0.129 and in moderate physical activity is -0.077.

[1] The results of bivariate regression are: $vig = 421.666 - 0.010inc$, $mod = 328.805 - 0.010inc$

In other words, with a one percent increase in income, time spent in vigorous and moderate physical activity is reduced by 0.129% and 0.077%, respectively. This finding leads to the conclusion that time spent in vigorous and moderate physical activity is not sensitive to changes in income.

While the results of the present study demonstrate a negative relationship between income and time spent in vigorous and moderate physical activity, it cannot be concluded that vigorous and moderate physical activity represent inferior goods. Two reasons are noteworthy. First, the effect of income on participation decisions pertaining to physical activity is insignificant, which means that income does not have a negative impact on the extensive margin. If physical activity is an inferior good, it must have a negative relationship between the extensive margin and income. Second, the income effect of a price change is unclear because information on the wage – that is, the price of physical activity – is unavailable. As a result, the direction of movement of the income effect is not identifiable. Nevertheless, the negative income elasticity of physical activity evidenced in the present study can be explained by the fact that higher-income individuals face a higher opportunity cost in terms of time and also find alternative methods of improving health, such as the use of medical care and consumption of health supplements. more affordable, and thus are more likely to substitute these less time-consuming methods for physical activity.

In addition to opportunity cost, other plausible reasons may explain the negative relationship between income and physical activity. First, higher-income individuals are usually healthier and wealthier than lower-income individuals and consequently are less likely to participate in physical activity. Second, because the analysis of the present study does not control for house locality, it may represent the 'third' variable that explains the effect of income on physical activity. This is because high-income earners reside in urban areas, and as a result, they tend to live a hectic and busy lifestyle. If the effect of house locality on physical activity is held constant, the actual relationship between income and physical activity may be clearly identifiable. However, these reasons may be inappropriate because they are not tested in the present study. Hence, an in-depth study should be conducted to supplement existing knowledge regarding those factors that explain why higher-income individuals tend to spend less time in physical activity than lower-income individuals.

The findings pertaining to income have two important implications. First, because the effect of income on physical activity is not large, the promotion of participation in physical activity through increases in individual income may not be a viable public policy. It is apparent that monetary incentive is not the solution to encourage physical activity among the population. Therefore, to promote and increase the prevalence of physical activity in Malaysia, future policies should look beyond monetary factors and consider other non-financial strategies, such as providing the public with additional physical education and introducing more sports campaigns. Second, providing financial support or altering income tax rates may not result in significant changes in the prevalence of physically active adults. This is especially true in light of the fact that the degree of sensitivity regarding time spent in physical activity relative to changes in income is extremely low.

In an effort to develop effective intervention measures, policy makers should also pay attention to other factors that determine physical activity. These include age, family size, gender, ethnicity, education, marital status and employment status. The results of the present

study demonstrate that age diminishes participation in both vigorous and moderate physical activity. These findings are to some degree consistent with the findings evidenced by Downward and Riordan (2007) and Downward and Rasciute (2010). The findings are attributable to the fact that as individuals grow older, they tend to decline physically and thus are less able to participate in physical activity.

To some extent in contrast with the findings of Humphreys and Ruseski (2011), family size is negatively associated with participation in moderate physical activity but is positively associated with time spent in vigorous and moderate physical activity. If family size is an appropriate proxy for the presence of children in a household, this finding confirms the hypothesis that household commitment plays a significant role in determining participation decisions and decisions related to time spent in physical activity. Plausible factors to explain this outcome are unclear and should be further substantiated by an in-depth qualitative study that specifically focuses on the relationship between family structure and physical activity.

The finding on gender is noteworthy. Compared to females, males are more likely to participate and spend more time in vigorous physical activity, but are less likely to participate in moderate physical activity. This evidence confirms the findings of Meltzer and Jena (2010) and Maruyama and Yin (2012), which demonstrate that males are more vigorous than females. The fact of the matter is that men have less time for physical activity due to their higher job position. As a result, they need to reduce the time allocated for physical activity by increasing the intensity level. In order to acquire a better understanding of the effect of gender on physical activity, future studies may want to control for a job characteristic variable.

Consistent with the findings of Downward (2007), Downward and Rasciute (2010) and Humphreys and Ruseski (2011), ethnicity is found to be significantly associated with participation in physical activity. Specifically, Malays, that is, the ethnic majority in Malaysia, spend less time in moderate physical activity than non-Malays. Contributing factors may be related to religion and culture. An important implication of this finding is that an intervention directed towards promoting participation in physical activity among Malays may hold promise.

It is interesting to note that well-educated individuals are more likely to participate in moderate physical activity but spend less time in both vigorous and moderate physical activity than less-educated individuals. This finding is not entirely consistent with the findings of previous studies (Downward and Rasciute, 2010; Eberth and Smith, 2010; Humphreys and Ruseski, 2011; Humphreys and Ruseski, 2015). Because well-educated individuals are knowledgeable about and efficient at preserving their health, they are able to reap health benefits without spending a lot of time in physical activity. They are also wealthier than their less-educated counterparts (Arshad, 2016).

The findings of the present study demonstrate that married individuals are more likely to participate in moderate physical activity than unmarried individuals, which is in contrast to the findings of Downward and Rasciute (2010) and Eberth and Smith (2010). One plausible reason for this outcome is that married individuals tend to carry more responsibilities related to caring for their family and consequently are more willing to make efforts to improve their health.

The findings regarding employment status appear to contradict those of Farrell and Shields (2002) and Eberth and Smith (2010). The present study finds that employed individuals are more likely to participate in vigorous and moderate physical activity, and to also spend more time exercising than their unemployed counterparts. A likely reason is that employed individuals are exposed to workplace health promotional programmes and thus are more aware of the benefits of physical activity. As argued by Moy *et al.* (2006), workplace health promotion programmes advocate a healthy lifestyle and result in better health outcomes. This finding leads to the conclusion that time constraints may not affect individuals' propensity to participate and spend time in physical activity if individuals recognize and understand the importance of being physically active.

CONCLUSION

The present study examines the income elasticity of physical activity, with a focus on the developing country of Malaysia. To generate accurate estimates, we control for demographic factors when estimating the results. The results suggest that although time spent in vigorous and moderate physical activity diminishes with income, this variable is not sensitive to changes in income. This could be a new finding and also a direction for future research. Since the scope of the present study concentrates on adults, the results do not reflect the behaviours of the elderly. Another suggestion for future studies would be to explore this segment of the population when data is available. Due to the limited availability of data, the present study fails to control for health variables, such as the presence of chronic diseases and modifiable health risk factors. Another limitation of the present study is that the substitution effect and the income effect from a change in wage are not identifiable because of data limitations. These shortcomings should be taken into account in future research

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