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Assessing Physical Activity Levels of Elderly Malays Living in Semi-Rural Areas Using Tri-Axial Accelerometer

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ABSTRACT

Background: Population-based physical activity (PA) data are lacking in multicultural South East Asia. Malaysian elderly Malays, for example, are occupied daily with religious and community activities. Those living in rural areas also have a distinctively different lifestyle in terms of walking habits and leisure-time activities, compared to people from urban areas. **Methods:** A cross-sectional study was conducted with 146 community-dwelling Malay adults aged 60 to 85 years (mean (SD) = 67.6 (6.4) years) living in semi-rural areas in Seberang Perai Utara, Penang, Malaysia. Each participant was interviewed using a questionnaire for their socio-economic background and self-reported PA levels. Then, the participants were invited to wear an accelerometer (ActiGraph GT3X or GT3X+) during their waking hours for seven consecutive days. **Results:** Daily activity patterns of the participants were dominated by sedentary time (7.9 (SD 2.1) hours/day; 52% of wear time) and light intensity activity (7.0 (1.9) hours/day; 46% of wear time). The participants spent 24 (SD 30) minutes daily in 'health enhancing' (i.e. moderate-vigorous intensity) activities. Men spent significantly more time in higher intensity acti-vities than women. Average daily step count was more than 10,000 (mean = 12,542 [4,857]) steps/day. **Conclusion:** Based on the accelerometer counts, these elderly Malay participants were assessed to be sedentary for most of the time during the day, though their daily step count exceeded 10,000 on average. Community-living older adults, especially women,should be encouraged to increase their physical activity levels.

Key words: Malaysian, older adults, physical activity assessment, tri-axial, vector magnitude

INTRODUCTION

The number of aging people in the population is increasing, especially in developed countries. This is due to advances in public healthcare, social and economic factors, and lower fertility and mortality rates. According to the United Nations, an estimated 737 million individuals in the world were aged 60 or over in 2009, and the number was projected to increase to 2 billion

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by the year 2050 (Department of Economics and Social Affairs, 2012). In Malaysia, according to the Department of Statistics, 6.3% of the total population, or 1.4 million people, were 60 years or older in the year 2000 (Department of Statistics Malaysia, 2005). This has increased to 1.7 million (6.6% of the total population) in 2005 and by 2020, this number was expected to grow to more than 3.4 million (UNESCAP, 2011).

In Malaysia, the older population is not equally distributed across the states. Higher proportions of older populations are concentrated in rural areas (Wan-Ibrahim & Zainab, 2014). This is because people who migrated to urban areas were originally from the rural areas and when reaching retirement age, chose to move back to their original towns or villages. In addition, many never migrated in the first place, leading to a high concentration of older population in the rural or semi-rural areas (Wan-Ibrahim & Zainab, 2014).

Limited information exists describing the levels of physical activity among older people in Malaysia (Chan *et al.*, 2014; Molanorouzi, Khoo, & Morris, 2015). According to national studies on Malaysian adults in 2010 (Poh *et al*., 2010) and 2014 (Chan *et al*., 2014), the Malays had the lowest and the second lowest prevalence, respectively, of meeting the physical activity recommendations compared with other ethnic groups.

There are lifestyle differences between the elderly living in rural and urban areas, particularly in terms of occupational and social activities (Thompson, 2004). In Seberang Perai Utara, Penang, for example, the main occupations are in agriculture (paddy growing, rubber tapping and various types of farm work s), and various voluntary activities. The elderly living in villages are also actively involved in tightly-knit social networks, where people get together and work on mutual projects such as a kenduri (feast to celebrate a special occasion), cleaning the village's mosque or common hall, or for religious obligations such as praying together (Thompson, 2004). Furthermore, due to poor road networks within villages, the main mode of transportation is by walking or cycling for the majority of people. We hypothesised that the physical activity levels of older Malays living in rural or semi-rural areas would be relatively high, reflecting these lifestyles.

Because of recall and response challenges, using accelerometers to assess physical activity eliminates the biases that come with questionnaires, especially for older adults. Several studies have shown that responses to questionnaire items may be affected by impaired cognitive ability, slow information processing speed, and fluctuation in mood and anxiety (Washburn, 2000; Heesch *et al.*, 2010).

The main aim of this study was to measure PA levels in a sample of older Malay adults living in semi-rural areas using triaxial accelerometers,and to provide information on movement intensity and duration (Butte, Ekelund & Westerterp, 2012). The feasibility of using an accelerometer in this demographic group was also determined by their compliance to meeting the minimum wear-time and wear-days.

METHODS

Recruitment of participants

One hundred and forty-six older Malay Muslim adults aged 60 to 85 years were recruited from the Seberang Perai Utara district of Penang, Malaysia, which consists of 16 sub-districts. The sample size was calculated using Sample Size Calculator for Estimating Mean (Naing, Winn & Rusli, 2006) with the standard deviation (count per minute in vertical axis, VT) obtained from a previous study by Davis & Fox (2007). The final sample size required was 146 participants.

A cross-sectional study design with multi-stage sampling was used. In the first stage, simple random sampling (using the RAND function in Microsoft Excel©) of the sub-districts was employed (4 sub-districts were chosen out of 16). Stratified random sampling of the participants by population size was employed in the second stage. The population size of each sub-district was taken from the 2010 Population and Housing Census of Malaysia, obtained from the Department of Statistics, Malaysia (2010). Potential participants were approached by a liaison person appointed from each sub-district. Participation was on a voluntary basis and whether they met the inclusion criteria.

Interested participants were briefed about the purpose, procedures, benefits, risks, and possible discomforts of the study. The inclusion criteria were as follows: (1) aged 60 to 85 years; (2) able to walk without assistance from another person; (3) of Malay ethnicity; (4) willing to wear an accelerometer for 7 consecutive days; and (5) permanent resident of Seberang Perai Utara district. Prior to screening the participants for inclusion in the study, ethical approval was obtained from the Human Research Ethics Committee, Universiti Sains Malaysia (FWA Reg. No: 00007718; IRB Reg. No: 00004494).

Procedures

The timing of monitor wear was arranged to avoid periods in which an individual's activity behaviour differed from their typical 7 day routine (e.g., holidays, vacations, scheduled surgery, and sudden illness). If they reported having non-typical activity during the assessment week, they were asked to wear the meter again when their activity returned to normal. Participants were visited twice at their home or were asked to gather at a public centre near their homes (one day to distribute, and another day to collect the accelerometer). On the accelerometer distribution day, before obtaining informed consent, the procedures and purposes of the study were explained in detail to the participants. Then, after consent form was signed by the participants or a family member by proxy, each participant was administered a one-on-one interview by a trained interviewer lasting approximately 30 minutes. The interview, which was conducted in the Malay language, included questions about age, sex, marital status, educational status, monthly income and self-reported PA level.

Self-reported PA was assessed to best describe their usual pattern of daily PA, with options as follows: (1) Inactive or little activity other than usual daily activities; (2) Regularly, (5 days per week or more) participates in physical activities requiring low levels of exertion that result in slight increases in breathing and heart rate for at least 10 min at a time; (3) Participates in aerobic exercises such as brisk walking, jogging or running, cycling, swimming, or vigorous sports at a comfortable pace or other activities requiring similar levels of exertion for 20 to 60 min per week; (4) Participates in aerobic exercises such as brisk walking, jogging, or running at a comfortable pace, or other activities requiring similar levels of exertion for 1 to 3 h per week; and (5) Participates in aerobic exercises such as brisk walking, jogging, or running at a comfortable pace, or other activities requiring similar levels of exertion for over 3 h per week.

After that, participants were asked to empty their pockets and take off their shoes before height and weight were measured. Height was measured to the nearest 0.1 cm using a portable stadiometer (SECA 217, Hamburg, Germany), and weight was measured to the nearest 0.1 kg using a body composition monitor (HBF-362, Omron Healthcare Co. Ltd., Kyoto, Japan). Body Mass Index was calculated as weight(kg)/height2(m)2 and defined as: <18.5kg/m2 (underweight), 18.5–24.9 kg/m2 (normal), 25.0–29.9 kg/m2 (overweight); or ≥30.0 kg/m2 (obese) (WHO Expert Consultation, 2004).

Recent accelerometer models have assessed accelerations in three axes (Sasaki *et al.*, 2011). This study aimed to use measurements from all three axes of a tri-axial accelerometer to provide a better assessment of activities. Participants were asked to wear a GT3X or GT3X+ accelerometer (ActiGraphTM, Pensacola, FL, USA) fixed on a waistband, in line with the right hip. The accelerometers were small enough to be unobtrusive (dimensions: 3.8 cm × 3.7 cm × 1.8 cm) and expected to produce little interference with normal activities. The device was set to assess acceleration in the vertical (VT), anterior-posterior (AP), and medio-lateral (ML) axes, using the low frequency extension (LFE) filter. The final activity count was presented as a composite vector magnitude of these three axes (VM), calculated as the square root of the sum of squares of counts per minute from all three axes (Butte *et al.*, 2012). The LFE option increased the sensitivity to very low amplitude activities, which effectively improved performance in the low frequency range of the device. This option is useful when measuring accelerometer data for participants who move slowly or take very light steps, such as the elderly.

Participants were asked to wear the accelerometer for 7 consecutive days, starting from the moment they woke up until they went to bed at night; during that time they could remove it only for water activities such as swimming, showering, and bathing. They were advised to wear the device during daily prayers, if possible. Visual instructions (a written manual with pictures showing the correct way to wear the accelerometer) was given to the participants, together with an ActiGraph-generated Excel chart showing an example of a valid (e.g. 12 h wear time) and non-valid (e.g. 5 h wear time) day.

A daily log bookwas also provided, in which participants were asked to record the times they put the accelerometer on in the morning and took it off at night, and any time the monitor was taken off during the day, including the reason for doing so. For participants who were illiterate, a family member was allowed to fill out the log book for them. For the GT3X model, activities were set to record at a sample rate of 1 sec epochs; counts per min (cpm) were obtained later by summing the 1 sec epoch data for 60 sec intervals. For the GT3X+, raw data were summed in 60 sec intervals, in order to have comparable data from both monitors. All accelerometers were initialised and downloaded on the same computer (Dell Inc, Texas, United States) in order to ensure time and date matching.

Data management

Data were collected from May 2013 to March 2014. For inclusion in data analysis, each participant must have worn the monitor for a minimum of 10 h per day, for at least 3 days, including at least one weekend day (Davis & Fox, 2007). Participants who did not comply were asked to wear it again. Non-wear time was filtered from the raw data using a semi-automated algorithm in the Actilife 6.5.2 software that looked for periods of ≥90 min of consecutive vector magnitude (VM) zero counts without interruptions (Peeters *et al.*, 2013).

Activity intensity categories used in this study were the ones described by Sasaki, John & Freedson (2011) for moderate (VM 2690–6166 cpm), vigorous (VM 6167–9642 cpm) and very vigorous (VM>9642 cpm) activity and the one described by Farias, Brown & Peeters (2013)for sedentary time (VM<200 cpm). Counts between VM 200 and<2690 per min were defined as light intensity.To allow comparison with other studies in which single or bi-axial accelerometers were used, vertical axis (VT) data was reported in addition to the composite VM data for average activity counts per min. The range used for VT was as described by Copeland & Esliger (2009)(light = VT 51–1040 cpm), and has been shown to be appropriate for older adults. The number of minutes/hour per day at different intensities were determined by summing all minutes where the count met the criterion for that intensity, divided by the number of valid days.

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics 20 for Windows (IBM Corporation, Somers, NY, USA). Accelerometer data were filtered to only include readings from 5 am to 11pm each day for standardisation purposes. Descriptive data are presented as proportions, means, standard deviations (SD), and 95% confidence intervals(CI) where appropriate. The Shapiro-Wilks test was used to test for normality. Differences between sexes were analysed using an independent *t*-test or Mann-Whitney U Test, after testing for assumptions. Differences in parameters between weekdays and weekend were analysed using the Wilcoxon signed rank test. The level of significance for all analyses was $p<0.05$.

RESULTS

One hundred and forty-six community-dwelling older Malay Muslim adults (mean age (SD) = 67.6 (6.4) years; 60% [n=87] women) participated in the study. Their demographic characteristics are shown by age group in Table 1. The participants tended to be overweight, married, inactive, had no formal education or at primary level educated, and had low monthly income (no income/ no fixed income/ <USD150.00).

All participants wore the accelerometer for 10 or more hours per day, for at least 3 days. The accelerometer data are shown in Table 2. The mean (SD) number of days with valid activity recording was 6.5 (1.2) days, with a mean daily accelerometer wear time of 15.3 (1.3) h per day. Average PA in cpm for VT and VM are also shown in Table 2. Both values (VT 226.7 (97.7) cpm and VM 558.5 (223.5) cpm) were in the light intensity category with no significant sex-differences. Although daily activity cpm were in the light intensity range, step counts per day were indicative of highactivity levels (12,542 (4,857) steps) (Tudor-Locke & Bassett, 2004)(See Table 2).

Daily accelerometer VM time in various activity intensities indicated that participants spent 52% of their time at sedentary, and a further 46% of daily wear time at light intensity activity levels. Participants spent on average 24 min per day in moderate-to-vigorous PA (MVPA), with only one bout of 10-min or more sustained activity at this level per day.

Independent *t*-test analyses (VM) showed that women spent significantly more time in light intensity activity each day than men ($p<0.05$, see Table 2). A Mann-Whitney U test showed that men accumulated significantly more time in moderate PA per day than women ($p<0.05$).

A comparison of weekday and weekend day activity patterns is shown in Figure 1. There was no significant sex-difference in sedentary time on weekdays and weekend days. Women spent significantly more time in light intensity PA (7.2 (1.9) h) than men on week days (6.5 (2.0) h; $p<0.05$) and on weekend days (women = 7.2 (2.3) hours; men = 6.5 (2.2) h, $p<0.01$). However, men spent significantly more time in moderate intensity PA (0.6 (0.8) h) than women (0.34 (0.34) h, $p<0.05$), but only on week days.

DISCUSSION

This study describes accelerometer-determined PA patterns among older Malay Muslim adults living in semi-rural areas in Seberang Perai Utara, Penang, Malaysia. Using the latest model of Actigraph accelerometer, the tri-axial accelerometer, we categorised the PA intensity using cut-points for VM (a composite vector of all three axes) instead of just VT (only the vertical axis). In this sample population, during an average 15.3 h per day of wear time, 52% of time was spent in sedentary, 46% in light activity and only 2.6% in moder-

Table 1. Demographic characteristics by age groups

	Age (years)			
Variables	*60-69*	*70-79*	*80-85*	*Total*
Participants,n (%)	92	47	7	146 (100)
Sex				
Men, n (%)	39	19	1	59 (40)
Women,n (%)	53	28	6	87 (60)
Mean BMI*(SD)	27.0 (4.7)	23.9 (4.9)	21.8 (4.5)	25.8 (5.0)
Underweight,n (%) <18.5 kg/m2	3	8	2	13 (9)
Normal,n (%) 18.5 – 24.9 kg/m2	23	17	3	43 (29)
Overweight,n (%) 25.0 – 29.9 kg/m2	43	18	2	63 (43)
Obese,n (%) ≥30.0 kg/m2	23	4	0	27 (19)
Marital status				
Single, divorced or widowed,n (%)	18	23	5	46 (32)
Married,n (%)	74	24	2	100 (68)
Educational status				
No formal Education,n (%)	13	13	3	29 (20)
Primary school,n (%)	58	33	4	95 (65)
Secondary school, n (%)	16	1	0	17 (12)
Tertiary education, n (%)	5	0	0	5 (3)
Monthly income status**				
No income, n (%)	23	16	3	42 (29)
No fixed income, n (%)	21	12	3	36 (25)
<USD150.00, n (%)	9	5	1	15 (10)
USD150.00-USD912.00, n (%)	38	13	0	51 (35)
≥USD913.00,n (%)	1	1	0	2 (1)
Self-rated level of physical activity				
Inactive,n (%)	52	33	6	91 (62)
Participate in PA 10 mins at a time per week, n (%)	28	12	1	41 (28)
Participate in aerobic exercises 20 to 60 mins per week, n (%)	4	1	0	5 (3)
Participate in aerobic exercises 1 to 3 hours per week, n (%)	3	1	0	4 (3)
Participate in aerobic exercises over 3 hours per week, n (%)	5	0	0	5 (3)

*BMI = body mass index, SD = standard deviation
**Malaysian Ringgit to US Dollar is based on currency exchange rate on 31st August 2013

Table 2. Anthropometrics and accelerometer variables for the total sample and by sex

Variable	*Total (n = 146) Mean (SD)*	*Men (n = 59) Mean (SD)*	*Women (n = 87) Mean (SD)*	*p-value*	*Mean difference (Men-Women)*	*95% CI*
Height (cm)	154.3 (8.9)	162.6 (5.7)	148.6 (5.6)	<0.001***	14.0	12.11 to 15.91
Weight (kg)	61.1 (13.6)	66.5 (14.1)	57.5 (12.0)	<0.001***	9.0	4.69 to 13.26
BMI (kg/m2)	25.8 (5.0)	25.2 (4.8)	26.1 (5.2)	0.284	-0.9	-2.58 to 0.76
Valid wear days	6.5 (1.2)	6.5 (1.0) (MR = 71.68)	6.5 (1.3) (MR = 74.7)	0.643[φ]	0.0	NA
Valid wear time (hours per day)	15.3 (1.3)	15.2 (1.5)	15.3 (1.2)	0.710	–0.1	–0.521 to 0.355
VT activity per minute (counts)	226.7 (97.7)	224.9 (105.7) (MR = 71.49)	227.9 (92.4) (MR = 74.86)	0.637[φ]	–3.0	NA
VM activity per minute (counts)	558.5 (223.5)	555.5 (247.9) (MR = 71.60)	560.5 (206.9) (MR = 74.79)	0.655[φ]	–5.0	NA
Steps (counts per day)	12542.0 (4857.0)	12938.0 (5014.0)	12273.0 (4758.0)	0.419	665.0	–955.99 to 2286.17
Time being sedentary[a] (hours per day)	7.9 (2.1)	8.2 (2.1)	7.7 (2.1)	0.158	0.5	–0.197 to 1.200
Time in light intensity[a] PA (hours per day)	7.0 (1.9)	6.5 (1.9)	7.3 (1.9)	0.016*	–0.8	–1.404 to –0.148
Time in moderate intensity[a] PA (hours per day)	0.4 (0.5)	0.5 (0.7) (MR = 82.5)	0.3 (0.3) (MR = 67.3)	0.033*[φ]	0.2	NA
Time in vigorous intensity[a] PA (hours per day)	0.0032 (0.0061)	0.0022 (0.0030) (MR = 71.49)	0.0039 (0.0076) (MR = 74.86)	0.610[φ]	–0.0017	NA
Bouts of ≥ 10 mins MVPA per day	1.0 (2.2)	1.8 (4.0) (MR = 79.8)	0.7 (2.1) MR = 69.23)	0.055[φ]	1.1	NA

CI = confidence interval; MR = mean rank; MVPA = moderate to vigorous physical activity; NA = not available; PA = physical activity; SD = standard deviation; VT = vertical axis; VM = vector magnitude; φ = analysed using the Mann-Whitney U test; the rest of the data were analysed using independent *t*-tests; * = statistically significant between sexes ($p<0.05$); *** = statistically significant between sexes ($p<0.001$); [a] = using VM cut-off points of <200 cpm = sedentary, 200–<2690 cpm = light, 2690–6166 cpm = moderate, 6167–9642 cpm = vigorous.

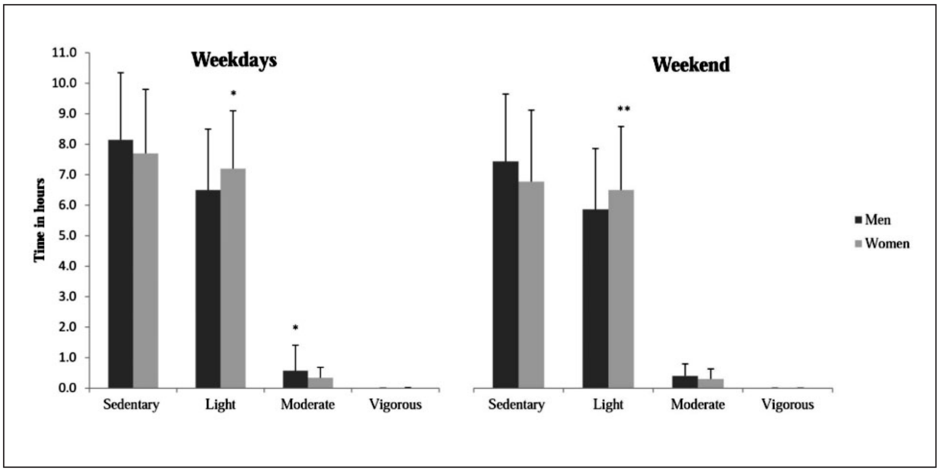

Figure 1. Time in PA of different intensity (in hours per day) by sex on weekdays and weekend days
* Sex-difference $p<0.05$; ** $p<0.01$

ate intensity activities. Women spent more time in light intensity activities than men, but men spent more time in moderate intensity activities than women. There were, however, no differences in time spent in sedentary activities. The compliance data showed that accelerometers are an acceptable method of activity assessment in this population of older Malay adults, because on average, participants provided valid data for 6.5 (1.2) days, with high daily wear times.

Previous studies using self-reported measures have shown that older Malay adults are generally physically inactive (Poh *et al.*, 2010; Amal *et al.*, 2011). To some extent, the present accelerometer study confirmed this, but in comparison with other accelerometer studies, the results indicate that this population group may be as active, or more active than other groups of older adults.For example, the overall activity counts on the vertical axis (VT) were similar to findings from a Norwegian population study of older adults (65–85 years)(Hansen *et al.*, 2012) and in a European study (≥70 years) (Davis & Fox, 2007), both of which reported VT counts in the 200 and 300 range, albeit the countries have significantly different climates compared to the present study population.

Sedentary time in the present study was the largest component of waking hours, at 52% (7.9 (2.1) h per day). This is however, much lower than was reported in two population-based Norwegian studies at 62% (Hansen *et al.*, 2012) and 66% (Lohne-Seiler *et al.*, 2014), respectively) and in an Icelandic study at 75% (Arnardottir *et al.,* 2013). Nevertheless, caution must be used when making comparisons due to differences in the cut-points used to define what constitutes as sedentary behaviour. For example, the western studies mentioned above used a classification of VT<100 cpm to describe sedentary behaviour, whereas the present study used VM<200 cpm. As pointed out by Sasaki *et al.* (2011), VM and VT cut-points are not comparable, as one measures acceleration in composite three axes, and the other, only in the vertical axis.

In an Australian study, Farias *et al.* (2013) found that a VM cut-point for sedentary behaviour in older adults (<200 cpm) in free-living environments, equates with a VT equivalent of<25 cpm. These differences suggest that the proportion of sedentary behaviour in the present study would have been higher, and the proportion of light intensity activity would have been lower, had VT <100 cpm been used as the cut-point. Nonetheless, when compared with older adults in an Australian study using the same model of accelerometer (Actigraph GT3X tri-axial accelerometer), sedentary time in the present study was still lower (VM 7.9 (2.1) h/day vs. VM 9.7 (2.6) h/day). Moreover, when compared with the number of step counts reported in two previous Norwegian studies (Hansen *et al.*, 2012; Lohne-Seiler *et al.*, 2014), the present study's participants accumulated higher counts (12,542 steps/day vs. <10,000 steps/day), indicating a more active lifestyle.

People living in warmer climates have reported a high temperature and humidity as barriers to outside PA, compared with relatively higher PA levels reported for people living in cooler climates (Brown, 2010). However, the present study's population (where people live in a high temperature and humidity environment) were found to be relatively active. The reason might be due to factors other than the weather. Although their self-reported PA level was 'inactive' or minimally active (90%, Table 1), many participants reported doing unpaid activities such as child care (of grandchildren), voluntary work or religious activities (walking to the mosque and/or praying five times a day), which are activities at light intensity.

The men in this study accumulated more minutes of moderate activity than the women. Similar differences were reported in European (Davis & Fox, 2007), Norwegian (Lohne-Seiler *et al.*, 2014) studies, and in an Icelandic (Arnardottir *et al.*, 2013) studies. In contrast, the women spent more time in light intensity activity, a finding that is also common (Davis & Fox, 2007; Lohne-Seiler *et al.,* 2014; Arnardottir *et al.*, 2013) and might reflect the fact that women, regardless of age, do the majority of housework tasks, which are typically light intensity (Abidin, 2015). Overall, there were few differences in activity patterns on week days and weekends between the sexes (Figure 1). The men were involved in higher levels of moderate intensity activity on week days, which is consistent with the fact that most reported earning income from jobs such as working at a farm or rubber tapping on week days (Abidin, 2015).

According to the definitions of step counts presented by Tudor-Locke and Bassett (2004), these older Malay people would be categorised as 'highly active', with an average daily step count of 12,542 steps/day. This high step count may reflect the fact that this district is populated by clusters of villages and walking is the typical mode of transport. The majority of participants cited the leisure activity of 'walking' (53.8%) as 'often' (done between 5-7 days, each lasting less than 1 h) during the week, and this is not included in the household chores and other activities (Abidin, 2015).

Another explanation may be that the LFE option used in the present study increased the sensitivity of the accelerometer to ambulation (i.e., walking), and overcounted the number of steps. In a comparison study of older and newer generations of ActiGraph accelerometers with the normal filter and the LFE option, the GT3X+ with the latter option recorded significantly more steps (+3597 steps per day; $p<0.001$) than the uniaxial Actigraph accelerometer 7164 (Cain *et al.,* 2013). However, according to Hansen *et al.* (2012), the high sensitivity of accelerometers to ambulatory activities is a strength in community-dwelling older population studies in which walking is the most frequently performed PA.

Accelerometers may provide a more accurate measure of PA than self-reported methods, and our findings suggest that they are acceptable for use in older Malay participants. On average, men in this sample group were able to accumulate 30 min of moderate intensity activity per day, meeting the PA recommendation for older adults (Chodzko-Zajko *et al.*, 2009), as opposed to only 18 min by women. This is higher than the population in the Better Ageing Project in 2007, in which men only accumulated 23.8 min of moderate intensity activity per day, and women, 16.7 min (Davis & Fox, 2007). The difference in lifestyles might be one of the factors to explain the differences in their PA levels. With evidence that this sample of older Malay population is relatively active, we might be able to rule out 'inactivity' as one of the reasons for poor health. However, more studies, preferably longitudinal and cause-effect studies, are needed to confirm this claim.

Strengths and limitations

The major strength of this study was the use of tri-axial accelerometers to assess PA levels. Objective assessment is the most appropriate way to measure PA in a multi-cultural country such as Malaysia because difficulties in interpretation and understanding when working with people from different ethnicities and educational backgrounds, limits the use of questionnaires (Poh *et al.*, 2010). The objective assessment method is also advantageous for studying people who are not literate. Malaysia is a relatively young country, and older citizens usually have none or only primary level education. Some participants encountered in this study could not read. Those who could read preferred the questions to be asked verbally, rather than completing the questionnaires themselves. Reasons given were poor eyesight or simply not being in the mood.

Limitations of this study include a low number of older-old people(≥80 years old), disproportionate number of males to females, and the inability of the accelerometers to detect certain movement patterns, such as upper body movements during activities like heavy carrying. Accelerometers are also limited in their ability to detect non-ambulatory activities such as cycling (Chen & Basset, 2005) six participants reported using a bicycle, but only intermittently.

CONCLUSION

The levels of physical activity in a sample of elderly Malays was assessed using tri-axial accelerometers. Although sedentary time was quite high, among the women, time spent in moderate intensity activity was also high, with walking count exceeding 10,000 steps daily.

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