

Physical Activity Pattern and Energy Expenditure of Malaysian Adults: Findings from the Malaysian Adult Nutrition Survey (MANS)

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ABSTRACT

This paper aims to report the physical activity pattern and energy expenditure of adults aged 18 – 59 years in the Malaysian Adults Nutrition Survey (MANS) carried out between October 2002 and December 2003. The survey included 7349 adults representative of Peninsular Malaysia (Northern, Southern, Central and East Coast), as well as Sabah and Sarawak. A total of 6926 adults, comprising 3343 men and 3583 women, completed the physical activity section of the survey. Physical activity data was obtained using a physical activity questionnaire and 24-hour physical activity recall. Basal metabolic rate (BMR) was calculated from Ismail *et al.* (1998) predictive equations; total energy expenditure (TEE) was then estimated through factorial calculations based on time allocated and energy cost of various activities. Physical activity level (PAL) was calculated as the ratio of TEE to BMR. It was found that almost three-quarters of Malaysian adults travelled by passive modes of transportation. Only a third reported having ever-exercised, and an even smaller proportion of the population (14%) had adequate exercise. The population also spent the majority of their time (74% of the day) in sedentary activities, such as sleeping or lying down; doing light intensity activities (15% of the day), and doing moderate to vigorous intensity activities (10% of the day). Mean BMR and TEE was significantly higher amongst men than women, while mean PAL values were similar for men [1.6 (1.6 – 1.7)] and women [1.6 (1.6 – 1.6)]. More men (16%) were categorised as having active PAL compared to women

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(10%), while more women (43%) were categorised as having sedentary PAL compared to their male counterparts (37%). The present study provides the first in-depth report of the physical activity pattern, and national estimates of energy expenditure and physical activity levels of Malaysian adults, and concluded that Malaysian adults are generally sedentary. It is thus important that physical activity be further promoted and integrated into the lives of the population, preferably through various health promotion efforts as well as through the commitment of the authorities in providing a suitable environment for an active lifestyle.

Keywords: Adults, energy expenditure, MANS, physical activity pattern

INTRODUCTION

In recent decades, there has been a shift towards increased obesity and non-communicable diseases as a result of the latest pattern of transition in physical activity, diet and nutritional status in human history (Popkin, 2006). Increased mechanisation at work, during travel, at leisure and in the home has markedly reduced the need for moderate and high intensity activities (Livingstone *et al.*, 2003). This has led to a global phenomenon of physical inactivity occurring in both developed and developing countries (WHO, 2003).

Physical inactivity is a modifiable risk factor for cardiovascular disease and a variety of other chronic diseases, including diabetes mellitus, colon and breast cancer, obesity, hypertension, bone and joint diseases, as well as depression (WHO, 2003). Scientific evidence has accumulated over the last decades to show the wide array of health benefits of physical activity (Vuori, 2001). A decline in daily physical activity levels and insufficient energy expenditure due to a sedentary lifestyle is one of the causes of energy imbalance leading to increasing trends of obesity levels (Saris *et al.*, 2003).

In Malaysia, the pace of industrialisation and urbanisation has been increasing rapidly in the past several decades leading to a more sedentary lifestyle among Malaysians. Although the Ministry of

Health had initiated, in 1991, the Healthy Lifestyle Campaign with different themes over the years, including *Promotion of Exercise and Physical Activity* in the year 1998 (Tee, 1999), adult obesity levels have been escalating (Azmi *et al.* 2009; IPH, 2008), leading to a suggestion of decreasing physical activity levels in conjunction with increasing dietary intakes consequent to rapid socio-economic development and urbanisation.

Several large scale surveys have reported physical activity data of Malaysian adults, including the National Health and Morbidity Survey II (NHMS II) carried out in year 1996 (IPH, 1999), World Health Survey in 2003 (WHO, 2008), Malaysia Non-Communicable Diseases Surveillance-1 (MyNCDS-1) in 2005/2006 (NCD, 2006), and the National Health and Morbidity Survey III (NHMS III) in 2006 (IPH, 2008).

The NHMS II reported that only 11.6% of Malaysian adults surveyed were doing regular physical activity or adequate exercise (IPH, 1999), with twice as many men (16.2%) having adequate exercise as compared to women (7.7%). However, the NHMS II reported only data on exercise and did not discuss physical activity pattern or levels. On the other hand, the NHMS III obtained physical activity data using the International Physical Activity Questionnaire (IPAQ) and reported that 43.7% of adults surveyed were physically inactive, with 35.3% men and 50.5% women being classified as inactive

(IPH, 2008). Physical activity data from the NHMS II and NHMS III were incomparable as different questionnaires were used.

The World Health Survey (WHO, 2008) carried out in year 2003 in Malaysia reported a much lower prevalence of physical inactivity at 19.6% also using the IPAQ to evaluate physical activity. Prevalence of physical inactivity was found to be higher amongst women (23.2%) compared with men (16.0%). However, the MyNCDS-1 using the same questionnaire found a very high prevalence of physical inactivity (60.1%), with 65.1% women and 55.4% men reported as inactive (NCD, 2006).

Although these three surveys discussed above used the same IPAQ to assess physical activity levels, the results from each of these surveys appear to differ widely. None of these large scale surveys reported the pattern of physical activity, nor did they report the energy expenditure of Malaysian adults. Hence, this paper aims to report the daily physical activity pattern and energy expenditure of Malaysian adults from the Malaysian Adult Nutrition Survey (MANS) 2003.

METHODOLOGY

Survey design and sampling

The MANS was a population-household cross-sectional survey designed to produce a nationally representative sample of 18 – 59-year-old population of Malaysia. The survey utilised a stratified random sampling with proportional allocation covering six zones in Malaysia, namely Southern, Central, East Coast, and Northern zones of Peninsular Malaysia, Sabah and Sarawak. The sampling frame comprised Enumeration Blocks and Living Quarters obtained from the Department of Statistics' National Household Sampling Frame. This study was commissioned by the Family Health and Development Division, Ministry of Health, Malaysia. Data collection was carried out between October 2002 and July 2003. The

study design and operation of MANS is fully described in Volume 1 – Methodology, of the MANS Report series (Safiah *et al.*, 2008).

Subjects

A total of 7349 adults corresponding to a total estimated population of 14,178,135 were identified as eligible respondents in this survey. However, only 6926 subjects comprising 3343 men and 3583 women completed the physical activity section of the survey, corresponding to a response rate of 94.2%. Respondents who were physically disabled were excluded from the physical activity study. Informed consent was obtained from respondents prior to their participation in the survey.

The study population comprised 48% men and 52% women. Approximately 53% of the estimated population was from urban areas and 47% was from rural areas. Proportions by zones were 33% from Central region, 19% Southern, 14% East Coast, 13% Northern, 11% Sabah and 10% Sarawak. In this survey, there was 53.8% Malays, 23.0% Chinese, 9.1% Indians, 5.7% Bumiputera Sabah, 5.6% Bumiputera Sarawak, 2.3% other Bumiputera, and 0.4% Orang Asli of Peninsular Malaysia. The highest proportion was from the 20 – 29 years age group (30%), followed by 30 – 39 years (29%), 40 – 49 years (23%), 50 – 59 years (13%) and the smallest proportion from the 18 – 19 years age group (6%). The distribution by BMI status based on WHO (1998) cutoffs was 9% underweight, 50% normal weight, 28% overweight and 13% obese.

Socio-demographic and anthropometric characteristics

A questionnaire (Form A of the MANS questionnaire) was used to obtain information on socio-demography, including sex, age, ethnicity, religion, marital status, educational level, occupation, and monthly household income.

Anthropometric measurements included body weight and height. Body weight was measured to the nearest 0.1 kg using digital weighing scale (SECA Model 880, Germany). Height was measured to the nearest 0.1cm using a SECA bodymeter (Model 208, Germany). Body mass index (BMI) was calculated as weight (in kg) divided by height (in m) squared.

Physical activity assessment

Physical activity was measured using a physical activity questionnaire and 24-hour physical activity recall method (Form C of the MANS questionnaire). The questions on physical activity were divided into two parts namely, Part 1 comprising a brief habitual physical activity questionnaire (Form C1), and Part 2 comprising a 24-hour physical activity recall form (Form C2). The physical activity questionnaire was used to obtain general information on habitual physical activities carried out daily. The 24-hour recall was used to obtain information on daily physical activity pattern and amount of time spent on each activity. Both the questionnaire and recall were administered through face-to-face interview.

Physical activity questionnaire

The physical activity questionnaire (Form C1) was designed to complement the physical activity recall and to provide information on transportation for going to/ from work or school, climbing stairs, and also habitual exercise or sports activities. Transportation includes those that are 'passive' namely public transportation, driving and riding a motorcycle and those that are 'active' namely cycling and walking.

Exercise was defined as physical activity undertaken for the purpose of recreation, sport or health/fitness during the two weeks prior to the interview. A person was considered to have exercised if he/she answered 'Yes' to the question whether he/she had ever carried out any type of exercise

in the last two weeks prior to the interview. A person was considered to have had adequate exercise if he/she had performed any moderate or vigorous intensity exercise for more than 3 times a week, each of which lasted at least 20 minutes (NCCFN, 1999).

24-hour physical activity recall

The 24-hour physical activity recall form (Form C2) was designed in table format in five minute-intervals to obtain information on physical activity and body position during the activity carried out. The recall was carried out via face-to-face interview by trained enumerators, and lasted about 20 – 30 minutes per respondent. Respondents were asked to recall all activities done the day before, starting from 12 midnight the previous day until 12 midnight on the day before the interview. Activities were recorded at 5 minute-intervals to obtain a full 1-day physical activity pattern. Details of activities obtained included the body position during the activity (e.g. reclining, sitting, standing or walking) and a detailed description of the activity (e.g. eating, sewing, typing, or brisk walking). Physical activity data were computed in minutes per day.

The activities were reclassified into three categories of intensity of activities, namely light, moderate, or vigorous-intensity activities as described by Ainsworth *et al.* (2000). In general, an activity carried out at 1.0 to less than 3.0 METs is categorised as light intensity activity (e.g. sitting, bowling); 3.0 to 6.0 METs is categorised as moderate intensity activity (e.g. brisk walking, climbing up stairs, mopping); and more than 6.0 METs is categorised as strenuous or vigorous intensity activity (e.g. running, jogging). A list of activities grouped according to these categories can be found in Volume 6 – Physical Activity of Adults aged 18 – 59 years, of the MANS Report series (Poh *et al.*, 2008).

Energy expenditure and basal metabolic rate

Basal metabolic rate (BMR), defined as the energy expended by an individual who had observed overnight fasting and resting supine, was calculated based on body weight using the predictive equations of Ismail *et al.* (1998) that are sex and age specific.

Total energy expenditure (TEE) was estimated through factorial calculations that combined the time allocated to the physical activities and the energy cost of those activities (FAO/WHO/UNU, 2005). Each physical activity was assigned a score indicating its intensity in terms of BMR multiples adapted from FAO/WHO/UNU (2005) and Ainsworth *et al.* (2000). For example, an individual performing an activity with a 4 BMR rating expends three times the energy required by that same individual sleeping (i.e., 4 x 1BMR) (Bernstein, Costanza & Morabia, 2004). The daily energy expenditure for the *i*th specific physical activity, EE_i , for *i* = 1, 2, 3, ..., 65, for a given study participant was calculated as:

$$EE_i = [\text{BMR multiple for } i\text{th activity}] \times [\text{duration of } i\text{th activity (mins/day)}] \times [\text{participant BMR (kcal/min)}]$$

The daily total energy expenditure (TEE) for each participant was then obtained as the sum of the participant's EE_i , that is: $TEE = (EE_1 + EE_2 + \dots + EE_{65})$.

Physical activity level

Physical activity level (PAL) was calculated as the ratio of TEE to BMR. The population's lifestyle was categorised into sedentary (PAL 1.40 – 1.69), active (PAL 1.70 – 1.99) or vigorous (2.00 – 2.40) according to the classification of FAO/WHO/UNU (2005).

Data analysis

Due to the complex design of the survey, the data analysis had taken into account the

sample weights. A weight to compensate the survey design, non-response and post stratification of stratum, age, sex, and ethnicity was calculated to estimate proportions, means, standard error, and 95% confidence interval (CI).

RESULTS

Mode of transportation

Table 1 shows the proportions of transportation mode used for travelling to and from work according to socio-demographic groups. The majority of Malaysians travelled by passive modes of transportation, which is car [40.8% (CI: 39.1%, 42.6%)] or motorcycle [33.6% (CI: 32.0%, 35.3%)]. Only a small proportion used public transport, such as bus, LRT or commuter [9.2% (CI: 8.1%, 10.4%)]. Proportion of active transportation modes which involves moderate intensity physical activity was low, that is only [2.9% (CI: 2.4%, 3.6%)] cycled and [17.7% (CI: 16.4%, 19.1%)] walked to work.

It can also be observed that the proportion of women using public transport is about three times more than men (16.1% vs. 5.1%). On the other hand, the proportion of men using motorcycle is 2.5 times more than women (43.4% vs. 17.0%). Proportion of women [24.3% (CI: 22.1%, 26.6%)] who walked is also significantly higher than men [13.8% (CI: 12.2%, 15.6%)].

Comparison between urban and rural areas showed that proportion of walking [23.0% (CI: 20.9%, 25.3%) vs 14.1% (CI: 12.5%, 15.9%)] and motorcycling [43.3% (CI: 40.7%, 45.8%) vs 27.2% (CI: 25.2%, 29.4%)] was significantly higher among the rural population, whereas proportion of car / driving [49.0% (CI: 46.5%, 51.5%) vs 28.4% (CI: 26.2%, 30.7%)] and public transport use [10.8% (CI: 9.2%, 12.7%) vs 6.7% (CI: 5.5%, 8.2%)] was significantly higher in their urban counterparts.

Comparing between age groups, proportion of walking [26.9% (CI: 20.5%,

Table 1. Proportion of transportation for traveling to and from work (% , 95%CI)

<i>Socio-demographic groups</i>	<i>Car / Driving</i>	<i>Motorcycle</i>	<i>Public Transport</i>	<i>Cycling</i>	<i>Walking</i>
<i>Sex</i>					
Men	39.4 (37.2-41.7)	43.4 (41.2-45.6)	5.11 (4.0 – 7.0)	2.4 (1.8-3.2)	13.8 (12.2-15.6)
Women	43.2 (40.4-46.0)	17.0 (14.9-19.3)	16.1 (13.9 – 18.5)	3.8 (2.9-5.1)	24.3 (22.1-26.6)
<i>Strata</i>					
Urban	49.0 (46.5-51.5)	27.2 (25.2-29.4)	10.8 (9.2 – 12.7)	2.4 (1.8-3.2)	14.1 (12.5-15.9)
Rural	28.4 (26.2-30.7)	43.3 (40.7-45.8)	6.7 (5.5 – 8.2)	3.7 (2.8-4.9)	23.0 (20.9-25.3)
<i>Zones</i>					
Southern	40.2 (36.4-44.2)	36.0 (32.2-39.9)	11.7 (9.6 – 14.0)	3.0 (1.9-4.6)	14.8 (12.1-17.9)
Central	46.0 (43.0-49.0)	31.0 (28.6-33.6)	12.0 (9.7 – 14.8)	3.0 (2.1-4.2)	10.6 (8.8-12.8)
East Coast	34.3 (29.9-38.9)	41.1 (36.5-46.0)	4.6 (2.7 – 7.6)	2.3 (1.3-3.9)	19.2 (15.1-24.0)
Northern	31.7 (27.7-36.0)	49.7 (45.1-54.2)	6.9 (4.7 – 10.0)	4.1 (2.3-7.2)	10.0 (7.5-13.1)
Sabah	42.9 (37.3-48.6)	11.4 (8.1-16.0)	7.4 (5.2 – 10.6)	0.9 (0.4-2.0)	43.9 (38.4-49.6)
Sarawak	41.9 (35.5-48.6)	25.5 (20.1-31.9)	4.4 (2.8 – 6.8)	3.6 (2.3-5.7)	36.0 (30.6-41.7)
<i>Ethnic Groups</i>					
Malays	35.8 (33.6-38.0)	41.7 (39.5-43.9)	8.6 (7.3 – 10.0)	2.5 (1.9-3.3)	15.5 (13.9-17.2)
Chinese	55.2 (51.5-58.8)	24.4 (21.5-27.5)	9.2 (6.8 – 12.3)	3.2 (2.2-4.7)	11.0 (8.8-13.7)
Indians	31.3 (26.4-36.6)	35.9 (30.9-41.2)	17.5 (12.8 – 23.4)	4.2 (2.1-8.2)	14.7 (10.7-19.7)
Bumiputra Sabah	35.4 (27.9-43.7)	14.3 (9.1-21.9)	8.2 (4.5 – 14.4)	0.9 (0.2-3.2)	48.3 (40.1-56.7)
Bumiputra Sarawak	29.1 (22.7-36.3)	27.3 (21.3-34.2)	5.6 (3.1 – 10.1)	5.5 (3.2-9.5)	47.6 (40.5-54.8)
Other Bumiputra	32.6 (18.4-51.0)	17.3 (6.8-37.3)	5.1 (2.8 – 9.0)	3.2 (1.1-8.9)	44.8 (29.6-60.9)
Others	22.3 (7.0-52.5)	69.7 (42.2-87.9)	NA	NA	12.1 (2.8-39.4)

Table 1. Continued

<i>Socio-demographic groups</i>	<i>Car / Driving</i>	<i>Motorcycle</i>	<i>Public Transport</i>	<i>Cycling</i>	<i>Walking</i>
<i>Age groups</i>					
18 – 19 years	23.0 (17.4-29.8)	28.2 (22.2-35.2)	27.8 (21.1 – 35.6)	3.6 (1.7-7.5)	26.9 (20.5-34.5)
20 – 29 years	38.3 (35.3-41.5)	37.6 (34.7-40.6)	11.0 (9.2 – 13.0)	2.5 (1.6-3.8)	15.9 (13.9-18.1)
30 – 39 years	46.5 (43.7-49.4)	32.3 (29.6-35.1)	5.1 (4.0 – 6.4)	2.0 (1.3-3.0)	16.1 (14.2-18.2)
40 – 49 years	46.5 (42.8-50.2)	32.9 (29.5-36.4)	5.1 (3.9 – 6.8)	3.4 (2.5-4.7)	15.9 (13.7-18.4)
50 – 59 years	38.9 (33.8-44.3)	32.8 (28.2-37.7)	5.1 (3.3 – 7.9)	4.9 (3.0-7.9)	21.2 (17.1-25.8)
<i>BMI groups</i>					
Underweight	33.7 (28.5-39.3)	30.0 (25.4-35.1)	15.1 (11.0 – 20.3)	4.1 (2.3-7.3)	23.2 (18.8-28.2)
Normal weight	39.8 (37.3-42.3)	33.8 (31.5-36.3)	9.8 (8.2 – 11.7)	3.0 (2.3-4.0)	18.0 (16.1-20.1)
Overweight	44.3 (41.1-47.5)	34.1 (31.0-37.3)	6.6 (4.8 – 9.1)	2.6 (1.7-4.0)	15.5 (13.2-18.1)
Obese	42.2 (37.5-47.0)	37.0 (32.4-41.8)	6.6 (4.8 – 9.0)	2.0 (0.9-4.3)	15.8 (12.7-19.5)
<i>All</i>	40.8 (39.1-42.6)	33.6 (32.0-35.3)	9.2 (8.1-10.4)	2.9 (2.4-3.6)	17.7 (16.4-19.1)

34.5%)] and use of public transport [(27.8% (CI: 21.1%, 35.6%)] was highest among the youngest age group, namely 18 – 19 years old. Proportion of motorcycling was highest among 20 – 29 year olds [37.6% (CI: 34.7%, 40.6%)], whereas driving was highest among 30 – 39 years [46.5% (CI: 43.7%, 49.4%)] and 40 – 49 year olds [46.5% (CI: 42.8%, 50.2%)].

Figure 1 summarises the proportion of transportation use according to ethnic groups. Walking is three times higher among all Bumiputera groups as compared to Malays, Chinese, Indians and others. Proportion of car / driving, motorcycling and public transport are highest among Chinese [55.2% (CI: 51.5%, 58.8%)], others [69.7% (CI: 42.2%, 87.9%)], and Indians [17.5% (CI: 12.8%, 23.4%)], respectively.

Prevalence of exercise

Table 2 shows the prevalence of ever-exercised, which refers to involvement in sports or exercise activities carried out in the two weeks prior to the interview/study. Prevalence of ever-exercised was 31.3% (CI: 29.9%, 32.7%) among the population. Comparison between men and women shows that there were twice as many men [40.0% (CI: 37.9%, 42.1%)] as women [22.3% (CI: 20.6%, 24.2%)] who ever-exercised. Prevalence of ever-exercise was significantly higher among urban [35.7% (CI: 33.8%, 37.8%)] as compared to rural (24.9% (CI: 23.1%, 26.8%) population, and was significantly higher in men from both urban and rural areas as compared to women from both strata.

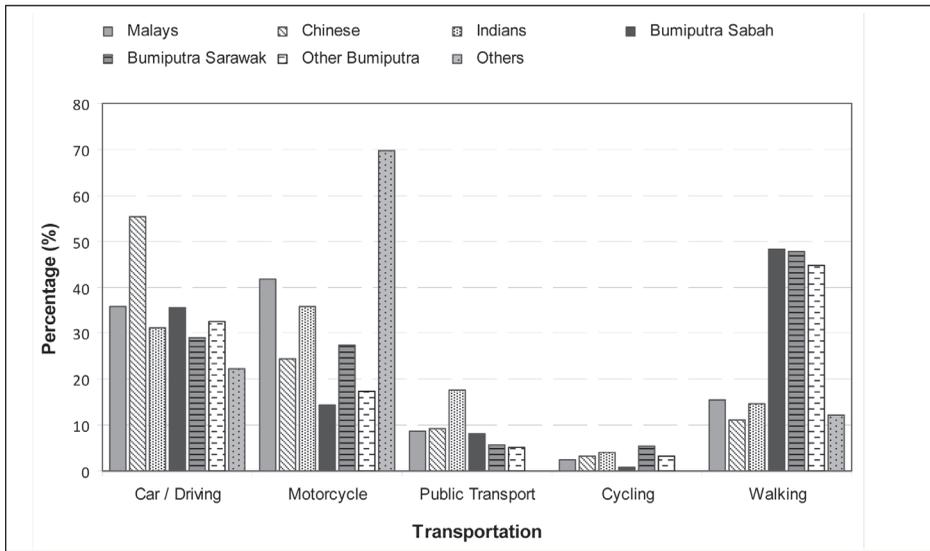


Figure 1. Prevalence of subjects using various types of transportation for travelling to and from work / school by ethnicity

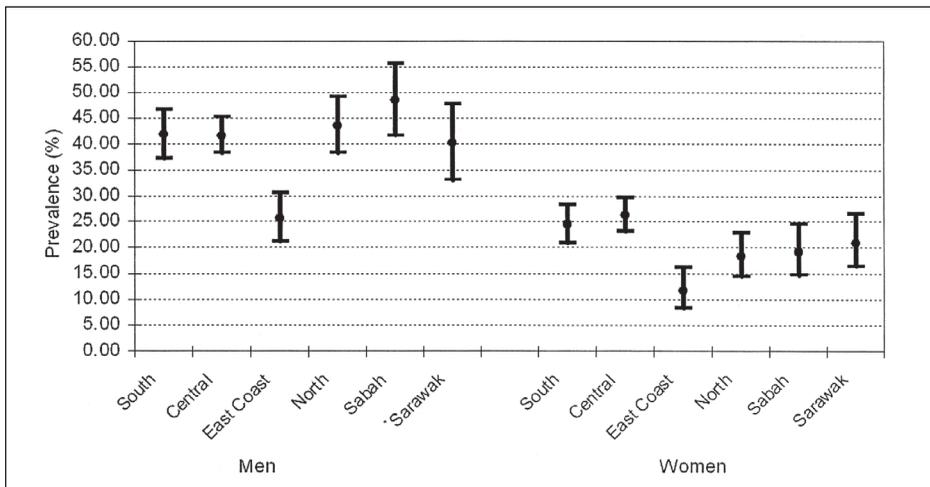


Figure 2. Prevalence of ever-exercise among men and women by Zone

Comparison between Zones showed that East Coast had the lowest prevalence of ever-exercised at [19.0% (CI: 16.1%, 22.4%)] with other Zones having prevalence above 30%. Figure 2 shows that in all Zones, prevalence of women who had ever-exercised was significantly lower than their male counterparts in the respective Zones.

Comparison between age groups showed that prevalence of ever-exercised was highest in the 18 – 19 years age group [39.6% (CI: 33.3%, 46.2%)], lowest in 30 – 39 years [28.3% (CI: 26.1%, 30.6%)] and was slightly higher among the older age groups. Table 3 shows the prevalence of adequate exercise, that is, each exercise or

Table 2. Prevalence of ever-exercised¹ by socio-demographic groups (%; 95%CI)

<i>Socio-demographic groups</i>	<i>Men</i>	<i>Women</i>	<i>All</i>
<i>Strata</i>			
Urban	43.6 (40.7 – 46.6)	27.7 (25.2 – 30.4)	35.7 (33.8 – 37.8)
Rural	34.9 (32.0 – 37.9)	14.7 (12.8 – 16.9)	24.9 (23.1 – 26.8)
<i>Zones</i>			
Southern	41.2 (36.4 – 46.0)	25.2 (21.6 – 29.2)	33.3 (30.2 – 36.5)
Central	41.6 (38.0 – 45.3)	27.3 (24.1 – 30.8)	34.6 (32.1 – 37.1)
East Coast	25.6 (21.2 – 30.6)	12.1 (8.5 – 17.0)	19.0 (16.1 – 22.4)
Northern	43.6 (38.2 – 49.1)	18.4 (14.4 – 23.1)	30.7 (27.2 – 34.4)
Sabah	47.6 (40.9 – 54.4)	21.4 (16.2 – 27.8)	34.5 (29.9 – 39.4)
Sarawak	42.0 (34.1 – 50.3)	20.9 (15.2 – 28.1)	31.4 (26.2 – 37.1)
<i>Ethnicity</i>			
Malays	40.0 (37.3 – 42.7)	17.7 (15.7 – 19.9)	29.1 (27.4 – 31.0)
Chinese	39.0 (34.5 – 43.6)	32.9 (30.0 – 37.0)	36.0 (33.0 – 39.0)
Indians	39.0 (32.5 – 45.9)	23.8 (18.8 – 29.7)	31.2 (26.9 – 35.7)
Bumiputra Sabah	48.2 (38.2 – 58.4)	15.7 (9.5 – 25.0)	30.8 (24.6 – 37.8)
Bumiputra Sarawak	37.0 (28.9 – 25.9)	37.0 (28.9 – 45.9)	23.9 (19.2 – 29.4)
Other Bumiputra	48.7 (31.1 – 66.7)	18.8 (7.4 – 40.3)	34.0 (22.4 – 48.0)
Others	24.2 (5.9 – 62.0)	10.9 (2.6 – 36.2)	15.9 (5.8 – 36.9)
<i>Age groups</i>			
18 – 19 years	53.7 (43.3 – 63.8)	25.7 (18.9 – 34.0)	39.6 (33.3 – 46.2)
20 – 29 years	45.3 (41.7 – 49.1)	20.3 (17.4 – 23.4)	32.9 (30.4 – 35.5)
30 – 39 years	36.4 (33.0 – 40.0)	20.0 (17.4 – 22.8)	28.3 (26.1 – 30.6)
40 – 49 years	34.3 (30.1 – 38.7)	24.6 (20.8 – 28.9)	29.5 (26.7 – 32.6)
50 – 59 years	34.5 (29.3 – 40.2)	25.3 (20.2 – 31.2)	30.0 (26.2 – 34.0)
<i>BMI groups</i>			
Underweight	39.4 (32.7 – 46.6)	21.6 (16.0 – 28.4)	29.9 (25.4 – 34.8)
Normal weight	39.6 (36.6 – 42.8)	24.7 (22.0 – 27.5)	32.7 (30.5 – 34.9)
Overweight	42.0 (38.4 – 45.7)	23.7 (20.4 – 27.3)	33.6 (31.1 – 36.3)
Obese	36.1 (30.2 – 42.4)	16.5 (13.0 – 20.7)	24.4 (21.2 – 27.9)
<i>All</i>	40.0 (37.9 – 42.1)	22.3 (20.6 – 24.2)	31.3 (29.9 – 32.7)

¹ Involvement in sports or exercise activities in the two weeks prior to the interview

sports activity was performed at least three sessions a week, and at least 20 minutes per session. The prevalence of adequate exercise among Malaysians is 14.2% (CI: 13.2%, 15.3%). There were twice as many men [18.9% (CI: 17.3%, 20.6%)] as women [9.4% (CI: 8.2%, 10.8%)] who had adequate exercise.

Prevalence of adequate exercise was significantly higher among urban [15.7% (CI: 14.3%, 17.3%)] as compared to rural [12.0% (CI: 10.7%, 13.5%)] population. Figure 3

shows that prevalence of rural women who had adequate exercise was significantly lower than urban, whereas there was no such difference between urban and rural men.

Comparison between zones showed that Sabah [18.6% (CI: 14.9%, 22.9%)] had the highest prevalence of adequate exercise, and the East Coast [8.5% (CI: 6.5%, 11.0%)] had the lowest. The East Coast had significantly lower prevalence of adequate exercise than all the other Zones except the Southern Zone.

Table 3. Prevalence of adequate exercise¹ by socio-demographic groups (%; 95%CI)

<i>Socio-demographic groups</i>	<i>Men</i>	<i>Women</i>	<i>All</i>
<i>Strata</i>			
Urban	19.0 (16.8 – 21.3)	12.4 (10.6 – 14.6)	15.7 (14.3 – 17.3)
Rural	18.8 (16.5 – 21.2)	5.2 (4.1 – 6.6)	12.0 (10.7 – 13.5)
<i>Zones</i>			
Southern	15.4 (12.1 – 19.3)	8.4 (6.1 – 11.4)	11.9 (9.8 – 14.4)
Central	19.1 (16.7 – 21.8)	13.4 (11.0 – 16.3)	16.3 (14.6 – 18.2)
East Coast	12.0 (8.9 – 16.1)	4.8 (2.8 – 7.9)	8.5 (6.5 – 11.0)
Northern	24.1 (19.5 – 29.3)	13.4 (11.0 – 16.3)	15.3 (12.5 – 18.6)
Sabah	27.6 (21.6 – 34.6)	9.6 (6.2 – 14.4)	18.6 (14.9 – 22.9)
Sarawak	20.5 (14.8 – 27.8)	7.5 (4.9 – 11.3)	14.0 (10.7 – 18.1)
<i>Ethnicity</i>			
Malays	19.5 (17.4 – 21.8)	4.9 (3.8 – 6.2)	12.4 (11.1 – 13.8)
Chinese	15.5 (12.6 – 19.0)	18.4 (15.3 – 22.1)	17.0 (14.8 – 19.4)
Indians	21.4 (16.6 – 27.1)	11.0 (7.4 – 16.0)	16.0 (12.9 – 19.7)
Bumiputra Sabah	30.2 (21.6 – 40.4)	5.9 (2.7 – 12.5)	17.2 (12.5 – 23.2)
Bumiputra Sarawak	19.2 (13.3 – 26.8)	5.8 (3.1 – 10.4)	12.4 (9.1 – 16.8)
Other Bumiputra	19.3 (10.1 – 33.9)	3.6 (1.6 – 7.7)	11.6 (6.7 – 19.4)
Others	24.2 (5.9 – 62.0)	NA	9.2 (2.2 – 30.9)
<i>Age groups</i>			
18 – 19 years	29.9 (21.7 – 39.5)	9.2 (5.4 – 15.5)	19.4 (14.7 – 25.2)
20 – 29 years	21.3 (18.5 – 24.3)	7.7 (5.9 – 10.1)	14.6 (12.8 – 16.5)
30 – 39 years	15.4 (13.0 – 18.1)	6.6 (5.1 – 8.4)	11.0 (9.6 – 12.6)
40 – 49 years	15.4 (12.7 – 18.5)	12.2 (9.7 – 15.3)	13.9 (11.9 – 16.0)
50 – 59 years	18.1 (14.0 – 23.0)	14.2 (10.1 – 19.7)	16.2 (13.2 – 19.7)
<i>BMI groups</i>			
Underweight	15.4 (11.2 – 20.7)	7.5 (4.1 – 13.1)	11.1 (8.3 – 14.8)
Normal weight	18.5 (16.3 – 21.0)	10.0 (8.1 – 12.1)	14.5 (13.0 – 16.2)
Overweight	21.4 (18.5 – 24.7)	12.5 (10.0 – 15.5)	17.3 (15.3 – 19.6)
Obese	15.1 (11.3 – 19.8)	5.9 (3.9 – 8.9)	9.6 (7.6 – 12.1)
<i>All</i>	18.9 (17.3 – 20.6)	9.4 (8.2 – 10.8)	14.2 (13.2 – 15.3)

¹ Involvement in sports or exercise activities for at least 3 times a week, at least 20 minutes each session.

In all Zones, prevalence of women who had adequate exercise was significantly lower than men in the respective Zones.

Comparison between age groups shows that prevalence of adequate exercise was highest at 18 – 19 years old [19.4% (CI: 14.7%, 25.2%)], lowest at 30 – 39 years [11.0% (CI: 9.6%, 12.6%)] and higher again among the older age groups. Women in all age groups had a significantly lower prevalence of

adequate exercise as compared to their male counterparts in the same age groups.

Physical activity pattern

Table 4 shows the mean time spent on each type of physical activity based on body position as reported by the respondents. Physical activities based on body position are reported as sleeping and lying down, sitting, standing, walking, personal-care

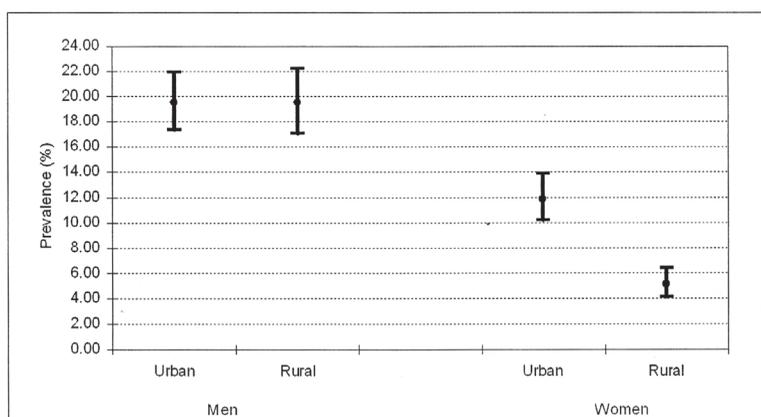


Figure 3. Prevalence of adequate exercise (at least 3 times a week for 20 minutes or more each time) for men and women by Strata

Table 4. Physical activity pattern of Malaysian men and women (mean minutes, 95% CI)

Activities	Men (N= 6,998,660)	Women (N= 6,869,291)	All (N=13,867,950)
Sleeping and lying down	472.1 (466.5-477.6)	482.4 (477.9-486.8)	477.2 (473.6-480.7)
Sitting	613.7 (605.6-621.9)	559.3 (552.9-565.7)	586.8 (581.5-592.1)
Standing	147.7 (142.1-153.3)	193.9 (188.5-199.4)	170.6 (166.6-174.6)
Walking	133.6 (130.1-137.1)	141.5 (138.5-144.5)	137.5 (135.2-139.8)
Personal care activities	49.7 (48.7-50.6)	51.4 (50.4-52.3)	50.5 (49.8-51.2)
Climbing up and down stairs	2.3 (2.0-2.7)	1.9 (1.7-2.2)	2.1 (1.9-2.3)
Sports activities ¹	11.4 (10.2-12.7)	4.3 (3.6-5.0)	7.9 (7.2-8.6)
Other activities ²	9.4 (7.5-11.2)	5.3 (4.7-5.9)	7.4 (6.4-8.4)

¹ Includes running, cycling, and all sports related activities

² Includes squatting, bending, carrying load, climbing, diving, and rowing

activities, climbing stairs, sports activities (including running, cycling, and all sports-related activities), and other activities (including squatting, bending, carrying load, climbing, diving and rowing).

Malaysian adults spent most of their time in the sitting position (mean 586.8 minutes, or 40.8% of the day), followed by sleeping or lying down position (477.2 minutes, or 33.1% of the day), standing (170.6 minutes, or 11.8% of the day), walking (137.5

minutes, or 9.5% of the day), personal-care activities (50.5 minutes, or 3.5% of the day). Heavy intensity activities, such as stair-climbing (2.1 minutes, or 0.1% of the day) and sports (7.9 minutes, or 0.6% of the day), as well as other activities (7.4 minutes, or 0.5% of the day), are minimal.

Figure 4 shows the comparison of physical activity pattern between men and women. Generally, the physical activity pattern of both men and women are similar.

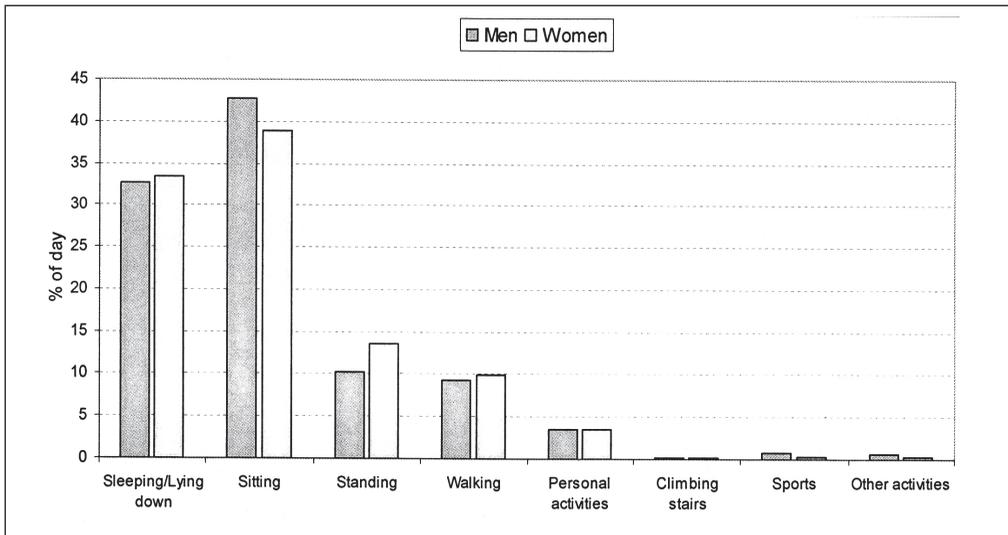


Figure 4. Physical activity pattern depicted as percentage of day by sex

However, significant differences can be seen between the sexes. On average, men spent significantly more time sitting [613.7 (605.6, 621.9) minutes] vs [559.3 (552.9, 565.7) minutes], involved in sports [11.4 (10.2, 12.7) minutes vs 4.3 (3.6, 5.0) minutes], and other activities [9.4 (7.5, 11.2) minutes] vs [5.3 (4.7, 5.9) minutes] as compared to their female counterparts. On the other hand, women spent significantly more time sleeping and lying down [482.4 (477.9, 486.8) minutes] vs 472.1 (466.5, 477.6) minutes], standing [193.9 (188.5, 199.4) minutes] vs [147.7 (142.1, 153.3) minutes], and walking [141.5 (138.5, 144.5) minutes] vs [133.6 (130.1, 137.1) minutes] as compared to their male counterparts. There were no significant differences between men and women for personal care activities and stair-climbing.

Table 5 describes the daily physical activity pattern of working and non-working men and women. Generally, non-working men and women spent more time sleeping, resting, watching television, and on recreation, as well as doing housework compared with their working counterparts; while the opposite is true for time spent working.

Figure 5 presents the physical activity pattern as percentage of a day (24 hours). Non-working women and men spent approximately 33 and 34% of a day, respectively, (or about 8 hours a day or more) sleeping compared to only 31% (approximately 7 and a half hours) among working adults. The amount of time spent resting was also higher among non-working adults, on average 9% of a day (slightly more than 2 hours), compared with working women and men at 7 and 8%, respectively (or about 1 hour 50 minutes). On the other hand, working adults spent more than 20% of a day (approximately 5 hours or more) at work compared with only 2 and 4% (1 hour or less) among non-working women and men, respectively.

Non-working adults spent more time on housework and childcare activities than those working (Figure 5). However, the differences between the sexes were larger, whereby working men spent only 2% of their time (approximately 30 minutes) and non-working men only 3% (approximately 40 minutes) of their time on housework and childcare activities. At 11% of the day (approximately 2.5 hours), working women

Table 5. Daily physical activity pattern of working and non-working Malaysian men and women (mean, 95% CI)

Activities (N=5,736,959)	Men		Women	
	Working (N=1,014,463)	Non-working (N=2,875,522)	Working (N=3,877,146)	Non-working
Sleeping	453.2 (447.7 - 458.8)	491.3 (474.5 - 508.2)	451.1 (444.3-458.0)	477.3 (472.0-482.7)
Resting	109.7 (105.4 - 114.0)	131.1 (116.6 - 145.7)	102.5 (96.4-108.5)	129.0 (122.8-135.1)
Working	319.5 (309.4 - 329.6)	64.0 (44.7 - 83.2)	289.8 (277.3-302.4)	28.5 (21.4-35.7)
Housework	21.3 (19.2 - 23.3)	38.0 (28.6 - 47.4)	129.3 (122.2-136.4)	233.3 (225.3-241.4)
Village-type activities	10.6 (8.7 - 12.5)	16.6 (10.2 - 23.0)	5.1 (3.4-6.8)	7.8 (6.1-9.4)
Childcare activities	8.1 (6.9 - 9.2)	5.5 (1.7 - 9.3)	25.8 (22.4-29.1)	65.4 (59.8-71.0)
Personal care activities	49.9 (48.9 - 50.9)	48.7 (45.2 - 52.1)	54.6 (53.0-56.1)	49.0 (47.7-50.3)
Praying	15.3 (14.3 - 16.4)	18.5(15.2 - 21.7)	16.4 (15.0-17.8)	18.7 (17.2-20.2)
Religious activities	6.5 (4.1 - 9.0)	9.4 (5.4 - 13.3)	4.7 (3.2-6.2)	8.2 (5.8-10.6)
Social activities	53.0 (49.0 - 57.0)	76.7 (65.5 - 87.9)	28.7 (25.3-32.0)	33.6 (30.0-37.2)
Transportation-related activities	84.4 (80.9 - 87.8)	71.4 (59.0 - 83.8)	56.0 (52.2-59.8)	32.5 (29.3-35.7)
Moving about	49.3 (48.2 - 50.5)	56.0 (50.0 - 61.9)	49.4 (47.8-51.1)	48.1 (46.7-49.6)
Watching television	138.3 (132.8 - 143.8)	214.7 (188.9 - 240.5)	123.9 (117.2-130.6)	189.8 (182.1-197.5)
Recreational activities	21.5 (19.1 - 23.9)	50.0 (39.1 - 60.8)	18.5 (15.5-21.6)	21.7 (18.8-24.5)
Light-intensity sports activities	1.0 (0.7 - 1.4)	1.8 (0.5 - 3.1)	0.6 (0.3-0.9)	0.9 (0.5-1.3)
Moderate-intensity sports activities	3.3 (2.3 - 4.3)	6.2 (3.6 - 8.8)	1.1 (0.5-1.7)	1.3 (0.6-1.9)
Heavy-intensity sports activities	3.5 (2.8 - 4.2)	9.2 (6.1 - 12.4)	0.9 (0.4-1.4)	1.0 (0.6-1.4)
Eating	71.2 (69.5 - 72.8)	66.8 (62.3 - 71.4)	63.2 (61.3-65.2)	66.3 (64.6-68.0)
Errands-related activities	4.3 (3.4 - 5.3)	3.4 (1.4 - 5.5)	2.2 (1.6-2.8)	2.2 (1.5-2.8)
Miscellaneous activities	16.0 (13.9 - 18.1)	60.3 (39.9 - 80.6)	16.2 (12.2-20.1)	25.5 (20.6-30.4)

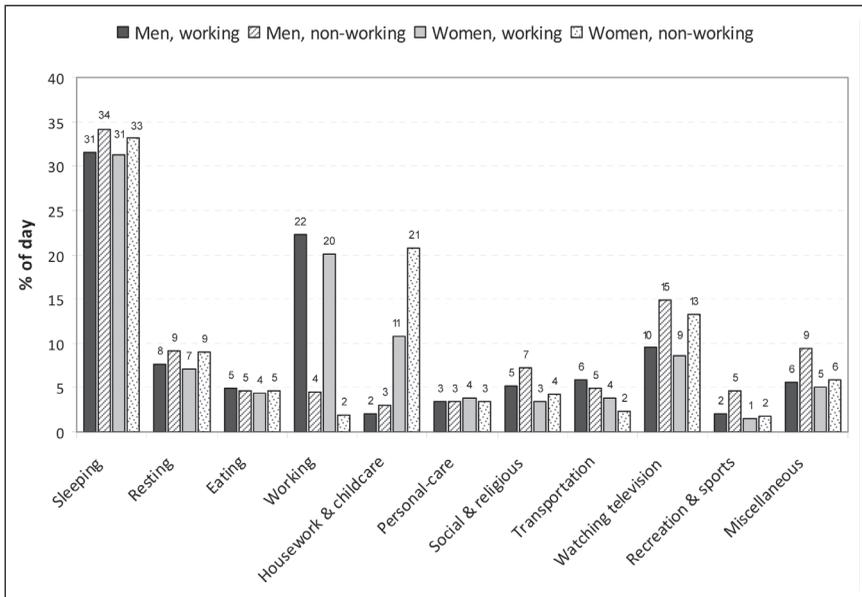


Figure 5. Physical activity pattern depicted as percentage of day among working and non-working adults

spent more than triple the amount of time doing housework and childcare activities compared to men. Non-working women spent the most time on these activities at almost double that of working women, that is on average 21% of the day (almost 5 hours).

Another difference between working and non-working adults is the amount of time spent watching television. Non-working women and men spent 13 and 15% of a day, respectively, (between 3 and 3.5 hours) watching television, while their working counterparts watched television for only 9 and 10%, respectively, (slightly more than 2 hours) on average in a day.

Energy expenditure and physical activity level

Tables 6 and 7 presents the basal metabolic rate (BMR), total energy expenditure (TEE) and physical activity level (PAL) that were calculated based on body weight and physical activity of Malaysian men and women. Mean BMR of men [1439 (1432, 1446) kcal/day] was higher than that of

women [1243 (1236, 1250) kcal/day]. Similarly, mean TEE of men [2360 (2341, 2379) kcal/day] was also higher than among women [1989 (1972, 2006) kcal/day]. However, mean PAL is similar for both men [1.6 (1.6 – 1.7)] and women [1.6 (1.6 – 1.6)] and is not significantly different.

A comparison between rural and urban areas showed no significant differences in the mean values of BMR, TEE and PAL of both men and women, with the exception of BMR whereby urban men had significantly higher BMR as compared with their rural counterparts. This is due to urban men having higher body weights as compared with rural men.

Comparing among ethnicities, it can be seen that the mean BMR of Malays, Chinese and Indians are significantly higher than that of all the Bumiputera and other ethnicities. However, mean TEE did not differ between ethnicities, and hence PAL was similar for all ethnic groups.

Comparison among age groups showed that mean BMR and TEE of the 18 – 19 year

Table 6. Total energy expenditure (TEE) and physical activity level (PAL) of Malaysian men (mean, 95%CI)

Socio-demographic Groups	N	Body weight (kg)	BMR (kcal/day)	TEE (kcal/day)	PAL
Strata					
Urban	4,103,785	67.5 (66.7-68.3)	1453 (1443-1463)	2373 (2348-2399)	1.6 (1.6-1.6)
Rural	2,894,875	64.7 (63.8-65.5)	1420(1410-1430)	2341 (2312-2371)	1.6 (1.6-1.7)
Zones					
Southern	1,311,591	67.9 (66.5-69.2)	1459 (1443-1475)	2397 (2348-2446)	1.6 (1.6-1.7)
Central	2,477,002	67.6 (66.5-68.7)	1455(1441-1469)	2353 (2320-2385)	1.6 (1.6-1.6)
East Coast	1,016,620	64.5 (62.9-66.2)	1417 (1397-1436)	2288 (2240-2337)	1.6 (1.6-1.6)
Northern	985,369	66.1 (64.8-67.5)	1436 (1420-1451)	2388 (2337-2439)	1.7 (1.6-1.7)
Sabah	573,195	64.0 (62.5-65.5)	1409 (1392-1425)	2331 (2284-2377)	1.7 (1.6-1.7)
Sarawak	634,882	63.5 (61.7-65.4)	1406 (1384-1427)	2411 (2340-2482)	1.7 (1.7-1.8)
Ethnicity					
Malays	3,646,295	66.3 (65.5-67.2)	1440 (1429-1450)	2356 (2331-2382)	1.6 (1.6-1.7)
Chinese	2,041,430	68.1 (67.1-69.2)	1460 (1448-1472)	2387 (2351-2423)	1.6 (1.6-1.7)
Indians	546,004	67.2 (65.2-69.3)	1449 (1424-1474)	2415 (2328-2501)	1.7 (1.6-1.7)
Other Bumiputera	202,521	60.7 (57.1-64.4)	1373 (1331-1415)	2221 (2101-2341)	1.6 (1.6-1.7)
Sabah Bumiputera	257,242	61.6 (59.4-63.7)	1384 (1360-1408)	2262 (2193-2332)	1.6 (1.6-1.7)
Sarawak Bumiputera	290,611	60.3 (58.1-62.5)	1368 (1343-1392)	2314 (2237-2391)	1.7 (1.6-1.7)
Others	14,556	58.5 (54.1-62.8)	1346 (1301-1392)	2129 (1879-2379)	1.6 (1.4-1.7)
Age groups					
18 – 19 years	679,000	59.2 (55.5-62.8)	1370 (1322-1417)	2186 (2101-2271)	1.6 (1.5-1.7)
20 – 29 years	2,058,002	65.2 (64.2-66.3)	1450 (1436-1463)	2364 (2325-2404)	1.6 (1.6-1.7)
30 – 39 years	1,798,823	68.3 (67.4-69.2)	1448 (1439-1457)	2415 (2384-2446)	1.7 (1.6-1.7)
40 – 49 years	1,499,258	68.3 (67.3-69.2)	1448 (1438-1458)	2402 (2368-2437)	1.7 (1.6-1.7)
50 – 59 years	963,577	67.1 (65.8-68.5)	1436 (1422-1450)	2306 (2263-2349)	1.6 (1.6-1.6)
BMI groups					
Underweight	626,365	48.1 (47.4-48.8)	1230 (1221-1239)	1933 (1876-1990)	1.6 (1.5-1.6)
Normal weight	3,713,307	60.4 (60.0-60.8)	1373 (1368-1378)	2272 (2250-2294)	1.7 (1.6-1.7)
Overweight	2,011,977	75.0 (74.5-75.5)	1535 (1530-1541)	2529 (2497-2561)	1.6 (1.6-1.7)
Obese	636,972	91.1 (89.3-93.0)	1725 (1698-1752)	2763 (2701-2825)	1.6 (1.6-1.6)
All	6,998,660	66.3 (65.7-66.9)	1439 (1432-1446)	2360 (2341-2379)	1.6 (1.6-1.7)

Table 7: Total energy expenditure (TEE) and physical activity level (PAL) of Malaysian women (mean, 95%CI)

Socio-demographic Groups	N	Body weight (kg)	BMR (kcal/day)	TEE (kcal/day)	PAL
Strata					
Urban	4,011,825	57.9 (57.3-58.3)	1243 (1234-1252)	1982 (1961-2005)	1.6 (1.6-1.6)
Rural	2,857,466	58.1 (57.3-58.9)	1244 (1234-1255)	1997 (1971-2023)	1.6 (1.6-1.6)
Zones					
Southern	1,281,257	59.7 (58.5-60.8)	1267 (1252-1282)	2045 (2008-2082)	1.6 (1.6-1.6)
Central	2,369,306	58.2 (57.3-59.2)	1245 (1232-1257)	1982 (1951-2013)	1.6 (1.6-1.6)
East Coast	966,863	56.9 (55.5-58.3)	1230 (1211-1248)	1963 (1917-2009)	1.6 (1.6-1.6)
Northern	1,035,887	58.9 (57.6-60.2)	1256 (1238-1273)	1971 (1931-2011)	1.6 (1.6-1.7)
Sabah	576,341	54.7 (53.2-56.3)	1202 (1182-1223)	1928 (1885-1971)	1.6 (1.6-1.6)
Sarawak	639,637	56.8 (55.3-58.2)	1228 (1209-1247)	2025 (1972-2077)	1.6 (1.6-1.7)
Ethnicity					
Malays	3,444,664	59.4 (58.6-60.1)	1260 (1250-1269)	2025 (2002-2048)	1.6 (1.6-1.6)
Chinese	2,029,221	56.7 (55.8-57.6)	1229 (1217-1241)	1933 (1901-1965)	1.6 (1.6-1.6)
Indians	583,719	60.2 (58.6-61.8)	1270 (1249-1291)	2039 (1984-2093)	1.6 (1.6-1.6)
Other Bumiputera	196,784	53.9 (50.7-57.1)	1194 (1152-1237)	1959 (1815-2103)	1.6 (1.5-1.8)
Sabah Bumiputera	296,822	52.1 (50.1-54.1)	1166 (1139-1194)	1886 (1826-1945)	1.6 (1.6-1.7)
Sarawak Bumiputera	294,336	55.6 (53.7-57.4)	1210 (1186-1234)	1971 (1909-2033)	1.6 (1.6-1.7)
Others	23,744	55.4 (50.6-60.2)	1210 (1141-1279)	2076 (1906-2245)	1.7 (1.6-1.8)
Age groups					
18 – 19 years	697,865	51.8 (49.8-53.9)	1139 (1112-1165)	1749 (1676-1823)	1.5 (1.5-1.6)
20 – 29 years	2,016,402	56.4 (55.4-57.3)	1197 (1184-1209)	1890 (1860-1920)	1.6 (1.6-1.6)
30 – 39 years	1,769,524	59.0 (58.1-59.8)	1272 (1261-1283)	2075 (2050-2101)	1.6 (1.6-1.6)
40 – 49 years	1,438,022	60.8 (59.7-61.8)	1295 (1282-1309)	2122 (2092-2153)	1.6 (1.6-1.7)
50 – 59 years	947,478	60.0 (58.6-61.4)	1286 (1268-1303)	2011 (1973-2049)	1.6 (1.5-1.6)
BMI groups					
Underweight	721,446	41.3 (40.6-42.1)	1018 (1008-1029)	1600 (1560-1641)	1.6 (1.5-1.6)
Normal weight	3,238,194	52.1 (51.8-52.5)	1167 (1162-1171)	1867 (1850-1885)	1.6 (1.6-1.6)
Overweight	1,695,343	64.1 (63.6-64.6)	1327 (1321-1333)	2138 (2110-2165)	1.6 (1.6-1.6)
Obese	945,860	79.2 (78.0-80.3)	1521 (1507-1536)	2456 (2407-2504)	1.6 (1.6-1.6)
All	6,869,291	58.0 (57.5-58.5)	1243 (1236-1250)	1989 (1972-2006)	1.6 (1.6-1.6)

olds were significantly lower than all other age groups. However, the mean PAL of all age groups was similar and showed no significant difference.

Among BMI groups, the mean BMR and TEE increased significantly with each BMI category. This is expected as the basis of calculation of BMR and consequently of TEE is body weight dependent. Nonetheless, the PAL of the BMI groups did not show such a trend.

Table 8 shows the proportion of Malaysian adults with sedentary, moderately active and active lifestyle based on PAL. The majority of Malaysians adults are either sedentary [39.7% (CI: 38.2%, 41.1%)] or moderately active [47.6% (CI: 46.1%, 49.0%)], while only a small proportion are active [12.8% (CI: 11.9%, 13.8%)].

Comparison between strata shows that the proportions of urban adults in each PAL category are very similar to those of rural adults. However, comparison between the sexes in Figure 6 shows that the proportion of men (15.7%) who were active was higher than their female counterparts (9.8%), while the opposite is true of a sedentary lifestyle (women 42.6% versus men 36.7%).

Comparison between zones (Table 8) shows that Sarawak had the highest proportion of active adults [18.0% (CI: 14.3%, 22.3%)], while the East Coast has the lowest [9.9% (CI: 7.8%, 12.3%)]. On the other hand, the Northern region had the highest proportion of sedentary adults [44.3% (CI: 40.6%, 48.0%)], while Sarawak had the lowest [31.1% (CI: 26.3%, 36.3%)].

Comparison among ethnicity, age grouping and BMI grouping did not show any significant differences or any clear trends in physical activity levels.

DISCUSSION

In this survey, we found that the majority of Malaysian adults were generally physically inactive in almost all aspects studied,

including mode of transportation and exercise habits, as well as physical activity patterns.

Passive transportation mode was prevalent amongst the adult population. Almost 75% travelled to and from work or school by passive transportation, namely driving a car or riding a motorcycle. Only a small proportion (21%) used active transportation, namely walking and cycling. Our results are similar to the situation in Canada where more than 80% of the population travelled by passive transportation using car, truck or van (Statistics Canada, 2006). Similarly, in the United States, the proportion of walking trips is low (8.6%) compared to other travel modes, such as use of personal vehicles (86.6%) (DOT/BTS, 2003). In addition, Saelens, Sallis & Frank (2003) reported that walking and biking trips were consistently higher in high-walkable neighbourhoods as compared to those for low-walkable neighbourhoods. This shows that the built environment is an important aspect in determining the mode of transportation chosen by a population. Although this study does not provide data on the built environment of our Malaysian neighbourhoods, it can be observed that with very few exceptions, most neighbourhoods do not have walking or cycling paths to encourage higher physical activity amongst its community.

There is growing concern that the modern society may have 'engineered' physical activity out of the people's daily lives by building neighbourhoods so that it is difficult, and in many cases dangerous, to walk or cycle around (Jackson & Kochtitzky, 2002). This is particularly worrying as declines in active transport are known to have contributed to overweight and obesity. In China, a country that has recently evolved from wide-spread use of active transportation (bicycling) to passive transportation (cars, buses and motorcycles), it was found that this change in transportation mode has

Table 8. Proportion of sedentary, moderately active and vigorous lifestyles of Malaysian adults (% , 95%CI)

<i>Socio-demographic groups</i>	<i>Sedentary</i> (PAL 1.40 – 1.69)	<i>Moderately active</i> (PAL 1.70 – 1.99)	<i>Active</i> (PAL 2.00 – 2.40)
<i>Sex</i>			
Men	36.7 (34.6-38.9)	47.6 (45.5-49.7)	15.7 (14.3-17.2)
Women	42.6 (40.7-44.7)	47.6 (45.6-49.6)	9.8 (8.6-11.1)
<i>Strata</i>			
Urban	40.3 (38.3-42.3)	47.2 (45.2-49.2)	12.6 (11.3-13.9)
Rural	38.8 (36.7-40.9)	48.1 (46.0-50.2)	13.1 (11.8-14.6)
<i>Zones</i>			
Southern	38.2 (35.1-41.5)	49.1 (45.9-52.3)	12.7 (10.6-15.1)
Central	41.0 (38.5-43.5)	46.7 (44.3-49.2)	12.2 (10.7-13.9)
East Coast	40.4 (36.4-44.4)	49.8 (45.9-53.7)	9.9 (7.8-12.3)
Northern	44.3 (40.6-48.0)	40.9 (37.3-44.6)	14.8 (12.4-17.5)
Sabah	37.4 (32.8-42.1)	51.6 (46.7-56.4)	11.1 (8.5-14.3)
Sarawak	31.1 (26.3-36.3)	50.9 (45.6-56.3)	18.0 (14.3-22.3)
<i>Ethnicity</i>			
Malays	39.6 (37.7-41.5)	47.4 (45.5-49.3)	13.0 (11.8-14.4)
Chinese	40.8 (37.9-43.8)	48.0 (45.1-51.0)	11.2 (9.6-13.0)
Indians	39.0 (34.4-43.7)	44.2 (39.4-49.0)	16.8 (13.3-21.1)
Sabah natives	36.1 (34.7-59.6)	55.8 (27.6-51.2)	8.1 (7.4-25.9)
Sarawak natives	33.3 (29.6-43.2)	50.2 (48.8-62.6)	16.4 (5.2-12.4)
Other natives	47.0 (27.7-39.5)	38.8 (43.9-56.6)	14.3 (12.4-21.4)
Others	23.2 (10.0-44.9)	61.1 (39.1-79.4)	15.7 (5.8-36.1)
<i>Age groups</i>			
18 – 19 years	48.9 (42.4-55.5)	39.3 (33.1-45.9)	11.7 (8.4-16.1)
20 – 29 years	42.5 (39.9-45.1)	46.1 (43.5-48.6)	11.5 (9.9-13.2)
30 – 39 years	34.4 (32.0-36.8)	51.3 (48.8-53.8)	14.3 (12.7-16.1)
40 – 49 years	33.3 (30.4-36.3)	52.5 (49.4-55.5)	14.2 (12.2-16.6)
50 – 59 years	46.6 (42.6-50.6)	42.2 (38.2-46.2)	11.3 (9.0-14.0)
<i>BMI groups</i>			
Underweight	47.5 (42.4-52.6)	41.5 (36.7-46.5)	11.0 (8.5-14.2)
Normal weight	37.3 (35.3-39.3)	49.4 (47.3-51.5)	13.3 (12.0-14.8)
Overweight	38.3 (35.7-41.1)	48.6 (45.8-51.4)	13.1 (11.3-15.1)
Obese	42.4 (38.3-46.5)	44.5 (40.6-48.5)	13.1 (10.8-15.9)
<i>All</i>	39.7 (38.2-41.1)	47.6 (46.1-49.0)	12.8 (11.9-13.8)

contributed to a doubling of the risk of becoming overweight or obese (Bell, Ge & Popkin, 2002).

Exercise prevalence is also low amongst Malaysian adults. Only a third of the adults reported having ever-exercised within the two weeks prior to being interviewed for the survey. The proportion of women (22%) who had ever-exercised was about half that of

men (40%). These results differ from that reported in the NHMS II survey, where the proportions of ever-exercised were less divergent between men (38%) and women (25%) (IPH, 1999).

Of concern is the very small proportion of Malaysian adults (14.2%) who had adequate exercise. Again, the proportion of women (9%) who had adequate exercise was

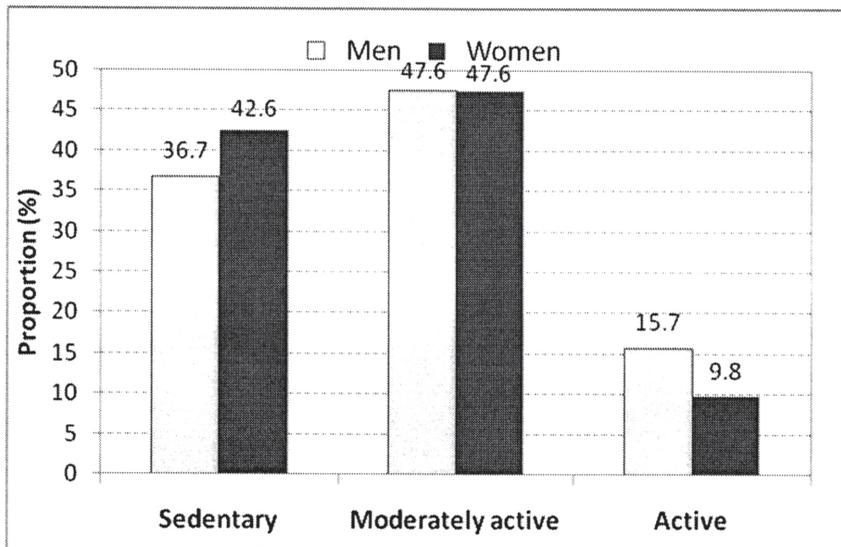


Figure 6. Proportion of Malaysian adults according to physical activity level (Sedentary: PAL = 1.40 – 1.69; Moderately active: PAL = 1.70 – 1.99; Active: PAL = 2.00 – 2.40)

only half that of men (19%). In comparison, NHMS II reported a prevalence of 12% of the population having adequate exercise, with 8% women and 16% men. However, it must be noted that these percentages are not directly comparable as the definition of adequate exercise used in this survey was “at least 3 times a week for 20 minutes each session”, whereas that used in the NHMS survey was “at least 3 times a week for 15 minutes each session”. In comparison, the 2004 National Health Survey in Singapore (Bhalla *et al.*, 2006) found that 25% of their adult population had regular exercise, which was defined exactly the same as for adequate exercise in MANS survey. Comparison with previous surveys in Singapore found that prevalence of regular exercise had been increasing from 14% in the year 1992, to 17% in 1998, and to the current 25% in year 2004 (Bhalla *et al.*, 2006). Similar to our findings, there were more Singaporean men (29%) who had regular exercise as compared to their female counterparts (20%).

It is also observed in this survey that the urban Malaysian population (16%) had a

higher proportion having adequate exercise as compared to their rural counterparts (12%). Other surveys have also reported that levels of leisure-time physical activity were higher among those with higher education and income (de Almeida *et al.*, 1999). Livingstone *et al.* (2003) explained that this variance may be attributed to occupational activity, which is not studied in many surveys, whereby lower income and lower educated subjects may have been misclassified due to their lack of interest in being active during leisure time as they already have physically demanding jobs. This is reflected in the study of Mbalilaki *et al.* (2007) who reported that most individuals living in rural areas work in agriculture and are involved in heavy physical activities, while most of urban inhabitants have sedentary work and more leisure-time activities.

Sedentary activities appear to be most prevalent amongst adult Malaysians. This survey found that the Malaysian adult population spent most of their time in sedentary activities such as sitting (41% of the day) and sleeping or lying down (33% of

the day). Time spent on light intensity activities, including standing and personal care activities, amounted to only approximately 15% of the day; while moderate to vigorous intensity activities, such as walking, stair climbing and sports, took up only about 10% of the day. In comparison, Malaysian soldiers spent only 21.3% of the day sitting (Ismail, Isa & Janudin, 1996). However, they reported a similar amount of time sleeping/lying down (31.6% of the day). Similarly, Malaysian sportsmen spent approximately 34.5% of the day sleeping, and only 24.0% of the day sitting (Ismail, Wan Nudri & Zawiah, 1995). This shows that the Malaysian adult population were generally more inactive compared to their counterparts in the armed forces and sports.

There appears to be some differences in the way the working and non-working population spent their time. On average, working people spent less time sleeping as compared to their non-working counterparts. As expected, working people spent a greater proportion of the day at work, while those without full time employment spent more time watching television. Non-working women also spent a significantly greater proportion of their day on housework and childcare activities as compared to their working counterparts.

In Great Britain, average sleeping time is 8.46 hours (35.3% of the day), with women spending on average slightly more time sleeping than men (Allender *et al.*, 2006). In a study of middle-aged adults in the US (Lauderdale *et al.*, 2006), it was found that objectively measured sleep duration using wrist actigraphy averages 6.13 hours per day (25.5% of the day), whereas self-reported sleep duration was longer, at 6.65 hours (27.7% of the day) during weekdays and 7.26 hours (30.3% of the day) on weekends. Comparatively, our Malaysian adult population spent more time sleeping than those in the US study, but less than adults in Great Britain.

The 2005 Health Survey in Great Britain found that the amount of time spent watching television was 148 minutes per day (2 hours and 28 minutes, or 10.3% of the day), with men watching on average 24 minutes more television than women. Time spent on household chores and childcare activities averages 193 minutes (3 hours and 13 minutes, or 13.4% of the day), with men spending only half the time that women do on these activities (Allender *et al.*, 2006). It would appear that our Malaysian population spent more time watching television as well as on household chores and child care activities as compared to their British counterparts. However, this finding could be due to the fact that approximately 30% of our Malaysian subjects were housewives. Nevertheless, the pattern of men spending half the time doing household chores and childcare activities as compared to women holds true for both populations.

Total energy expenditure (TEE) of the Malaysian adult population was estimated from calculations of basal metabolic rate (BMR) based on body weight, and self-reported physical activity recall. The overall energy expenditure values are in similar ranges to those reported by Walsh *et al.* (2004) in their study comparing self-reported energy expenditure versus that measured objectively by doubly-labelled water (DLW) in women. The mean TEE of overweight women in the present study was 2138 kcal/day, while that reported by Walsh *et al.* (2004) using DLW technique among women in the same weight category was 2234 kcal/day. However, Walsh *et al.* (2004) found that the TEE estimated from self-reported questionnaire among their subjects' was overestimated when compared with that measured using DLW technique. Another study by Conway *et al.* (2002) among men also found that TEE estimated from physical activity recall was higher than that measured by DLW technique. Although self-reported physical activity may not be the best method to assess energy expenditure, the

method has been used in many surveys (Steffen *et al.*, 2006). Moreover, studies have shown that energy expenditure estimated from self-reported physical activity has good agreement with that obtained from DLW and accelerometry techniques at the population group level (Corder *et al.*, 2009).

The overall physical activity level of both Malaysian men and women at mean PAL 1.6 is considered sedentary. However, when the population was categorised into PAL groups, it was found that almost half the population (47.6%) was moderately active. There were more men categorised as active compared to women, and more women categorised as sedentary as compared to their male counterparts. Another study by Paul, Novotny & Rumpler (2004) using DLW technique in healthy adults in the US also showed that men (1.64 ± 0.19) and women (1.69 ± 0.19) had similar PAL levels as that found in our study. A study in Siberia (Snodgrass *et al.*, 2006), on the other hand, found that women (1.50 ± 0.20) had significantly lower PAL than men (1.68 ± 0.33). On the other hand, Tooze *et al.*, (2007) reported that their sample of middle-aged women in Washington DC had significantly higher PAL (1.75 ± 0.02) compared to their male counterparts (1.69 ± 0.01). Nevertheless, the average PAL levels of these various studies revolve around the sedentary to moderate levels of physical activity as in our Malaysian population.

Overall, the results from most surveys revealed that men are more active than women (Livingstone *et al.*, 2003). A nationally representative survey in every member state of the European Union found that women participated less and for shorter periods of time in leisure-time physical activity (de Almeida *et al.*, 1999). Halldin *et al.* (2007) also reported that men were more vigorously active than women during leisure time. It is important to note, however, that although most reports concluded that men are more active than women, this difference is usually in the context of participation in

sports and other leisure activities, particularly those that are of vigorous intensity (Livingstone *et al.*, 2003), and may not reflect whole day physical activity levels.

The findings from this survey also found that men were more involved in vigorous intensity physical activities, including exercise and sports, as compared to women. We also found that according to PAL values, more men were categorised as active while more women were categorised as sedentary. This survey shows that Malaysian men are comparatively more active than Malaysian women. However, on the whole, both sexes are still considered generally sedentary, from the point of view of their overall physical activity levels, as well as in the sedentary physical activities that the population engages in.

One of the limitations of this study is the use of the recall method to assess physical activity. As discussed previously, self-report methods are usually affected by various factors, including lack of cooperation and inability to recall every activity that was performed. Also, the factorial method was used to calculate total energy expenditure, and this method is constrained by insufficient data on energy cost of various types of physical activity. Hence, estimates had to be made using the closest value, which would affect the overall energy expenditure. Nevertheless this problem is not unique to this particular study, but occurs for all studies that employs this methodology. Although the most accurate is the doubly-labelled water (DLW) technique, it is not possible to employ this highly expensive method in population studies.

CONCLUSION

Generally, the Malaysian adult population is considered sedentary. Participation in exercise is low, and only minimal time is spent on vigorous intensity activities, such as sports and stair-climbing. Choice of

transportation also tended towards the passive modes of transportation. There are differences in the way Malaysian working and non-working men and women, from rural and urban areas spent their time. These differences could be due to the differing nature of the occupations of men and women, as well as to the differing lifestyle of urban and rural populations.

We stress the importance of further promoting physical activity as part of a healthy lifestyle for the Malaysian population, as an active lifestyle will improve physical fitness and health as well as reduce the incidence of obesity amongst the population. Various health promotion efforts should include a physical activity component, and most importantly the authorities need to be committed towards providing a built environment that is suitable for an active lifestyle.

The present survey is the first to provide an in-depth glimpse of the physical activity pattern of Malaysian adults. It is also the first to provide national estimates of energy expenditure and physical activity levels of Malaysian adults. Future studies are needed to explore the associations between physical activity, nutritional status and chronic diseases among the Malaysian population. Other factors influencing physical activity pattern such as the built environment, as well as barriers and enhancers to a more physically active lifestyle should also be studied. It is also recommended that physical activity be maintained as a component for future national surveys and national nutrition surveillance in order to further understand the activity patterns of Malaysians, and to track the changes in physical activity levels over the years.

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