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Association between Walking and Cardiovascular Risk Factors in University Employees

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Walking is the simplest form of physical activity for the prevention of cardiovascular diseases. The aim of this study was to investigate the association between walking and cardiovascular risk factors in a working adult population. Walking activity was assessed using a pedometer worn over three consecutive days. Anthropometric measurements of height, weight, waist circumference, as well as blood pressure, fasting glucose and lipid concentrations were also determined. In this cross-sectional study, 112 employees (aged 21-65 years, 64% females, Mean±SD BMI: 26.08±4.55 kg m^{-2}) from Universiti Kebangsaan Malaysia Kampus Kuala Lumpur were recruited. On average, participants recorded 7521±3723 steps per day, which was below the recommended target of 10,000 steps per day. About 24 and 33% of employees were categorized as sedentary (<5000 steps/day) and low active (5000-7499 steps day^{-1}), respectively. Only 17% of the participants achieved the recommended 10,000 steps day^{-1}. There were no differences observed in daily walking steps between gender, BMI categories, job categories and age groups. Mean waist circumference for males (92.4±10.67 cm) and females (82.8±10.5 cm) were higher than normal. Other metabolic indices such as blood pressure, glucose and lipid levels appeared to be within normal values. Except for triglycerides, no significant correlation in between the number of steps and other metabolic indices were observed. In conclusion, the level of physical activity in the studied population was categorized as sedentary or low active and generally were not related with adverse risk factors for cardiovascular disease. Notwithstanding, an awareness program to increase the level of physical activity through walking is much encouraged in this population.

Key words: Walking, pedometer, cardiometabolic, physical activity

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INTRODUCTION

Cardiovascular disease presents the leading cause of mortality worldwide (WHO., 2012). In Malaysia, 32% of death nationwide is caused by cardiovascular disease (WHO., 2011). In the report published by the World Health Organization (WHO) in collaboration with the World Heart Federation and the World Stroke Organization (Mendis *et al*., 2011), hypertension, diabetes, high cholesterol and obesity were recognized as the four major cardiometabolic risk factors that are strongly associated with cardiovascular diseases. According to the recent Malaysian National Health and Morbidity Survey (NHMS) 2011, the prevalence of obesity has increased from being 4.4% in 1996 to 15.1% in 2011 (IPH., 2011). The same trend was observed for diabetes, an increase from 8.3-20.8% in the same duration. These statistics are indicative of the rise of cardiovascular risk factors among Malaysian population. Apart from the diseases above, lifestyle and metabolic factors such as Body Mass Index (BMI), abdominal obesity, blood pressure, blood glucose and lipid profile also contribute as risk factors for cardiovascular diseases (Paniagua *et al*., 2008).

Physical activity remains an important part of the management of cardiovascular diseases and favourably affects body composition, blood pressure, glucose tolerance and blood lipid concentrations. According to the report from Malaysian Adult Nutritional Survey (MANS), only 14% of adults performed enough daily physical activity and 74% of the Malaysian adults allocated most of their daily time for sedentary activities (Poh *et al*., 2010). Rapidly advancing technology in transportation, communications, workplaces and home entertainment have significantly contributed to the rise of sedentary behaviour and the elimination of daily physical activities, not only in everyday life, but also in many occupations. In consistent with the wealth of evidence accumulated to date and the public health context of rising chronic diseases, physical inactivity should remain as the top priority of modern public health concerns.

Physical activity can range from the simplest to extensive, complex activities. The simplest and most achievable form of physical activity for everyone is walking. Daily steps can be accumulated by doing household chores and working in the office (Tudor-Locke *et al*., 2011). Walking has been promoted, in part, by the growing popularity of pedometers and pedometer-linked health promotion messages. Many previous studies have indicated that increased walking activity can improve cardiovascular health and lower the risks of coronary heart disease, hypertension, diabetes and obesity (Bertoni *et al*., 2009; Tudor-Locke, 2010). Therefore, this study was conducted to investigate the level of physical activity measured by daily walking steps and its association with cardiovascular risk factors in a population of university employees.

MATERIALS AND METHODS

This cross sectional study was conducted in Universiti Kebangsaan Malaysia, the Kuala Lumpur campus. All subjects were healthy and not suffering from any physical conditions. This study was approved by the Research Ethics Committee of Universiti Kebangsaan Malaysia. Demographic data of subjects were collected by questionnaire.

Walking activity: Subjects were provided with a pedometer, model Yamax Digi-Walker SW200 to measure their daily walking activity for three consecutive days. The accuracy and validity of pedometer has been previously reported (Pavlidou *et al*., 2011). Subjects were required to wear the pedometer during waking hours only and to record their time wearing the device in the morning and time of removal when going to bed in the evening. Daily steps per day were assessed and classified into physical activity indices introduced by Tudor-Locke and Bassett (2004): <5000 steps per day (sedentary), 5000 to 7499 steps per day (low active), 7500-9999 steps per day (somewhat active), 10,000-12,499 steps per day (active) and ≥12,500 steps per day (highly active). Tudor-Locke and Bassett (2004) recommended the target of 10,000 steps per day for healthy adults.

Cardiovascular risk factors: Biomarkers of cardiovascular risk included indicators of overweight (i.e., body mass index, waist circumference), blood pressure, plasma levels of fasting glucose, total cholesterol, High-Density Lipoprotein Cholesterol (HDL-C), Low-Density Lipoprotein Cholesterol (LDL-C) and triglycerides. Weight was measured to the nearest 0.5 kg, wearing light clothes and no shoes using a digital scale (SECA; London, UK). The BMI was calculated as weight (kilograms) divided by height (meters) squared. Waist circumference, a measure of abdominal obesity; was taken midway between the lowest rib margin and the iliac crest. Abdominal obesity, a risk factor for cardiometabolic disease, is determined according to the International Diabetes Federation cut-points for Asian population, i.e., waist circumference >90 cm in men and >80 cm in women (Alberti *et al*., 2006). Arterial blood pressure were measured using a digital OMRON HEM-7111 sphygmomanometer, in sitting position and

after 5 min rest. Two measurements were taken and the mean of these values was used. Fasting blood samples were drawn in the morning and analysed with enzymatic colorimetric method performed on the Biosystems Semiautomatic Analyser BTS-350 (Biosystems S.A., Barcelona, Spain).

Statistical analyses: Analyses were performed using the Statistical Package for the Social Sciences (IBM©, SPSS Version 19.0). All data was inspected normality. Mean differences between groups were tested using independent t-test and one-way ANOVA. Correlation between variables were determined using Pearson's correlation coefficient. Statistical significance was accepted at $p<0.05$. Results were presented as Mean±Standard Deviation (SD).

RESULTS

Table 1 showed the characteristics of the 112 subjects involved in the study. A majority of the participants were Malay (97%) and working as non-academic staff (71%). Mean age of the study population was 39.9±9.4 years. About 72% of them were classified as overweight/obese.

The levels of physical activity achieved by the subjects of the study, measured using pedometer, are shown in Table 2. The subjects recorded an average of 7521±3707 steps per day, which was lower from the target of 10,000 steps per day set by Tudor-Locke and Bassett (2004). The majority of employees (57%) were classified as sedentary and low active, while only 18% of the sample achieved the target of 10,000 steps per day. Table 3 showed the differences in mean daily steps according to demographic variables. There was no significance difference in the number of daily steps between gender, job, age groups, mode of transport and BMI categories.

Cardiovascular risk factors measured as Body Mass Index (BMI), waist circumference, blood pressure, plasma levels of fasting glucose, total cholesterol, HDL-C, LDL-C and triglycerides are shown in Table 4. Mean waist circumference for both males (92.4±10.6 cm) and females (82.8±10.5 cm) were slightly above normal. All other metabolic indices were within normal values.

The results of Pearson correlation for the association between daily steps and cardiovascular risk factors are shown in Table 5. There was a positive correlation between daily steps and triglycerides. No significant associations were observed for other risk factors. In addition, waist circumference, systolic and diastolic blood pressures and fasting glucose showed positive correlation with age.

Table 1: Subjects' characteristics (n = 112)

Parameters	N	%
Gender		
Male	38	34
Female	74	66
Job categories		
Academic staff	32	29
Non-academic staff	80	71
Race		
Malay	109	97
Chinese	1	1
Indian	2	2
Age (years)		
20-29	45	40
30-39	35	31
40-49	18	16
50-59	14	13
Mode of transportation to work		
Car	74	66
Motocycle	26	23
Public transport	3	3
On foot	9	8
BMI (kg m^{-2})		
Normal	31	28
Overweight	39	35
Obese	42	38
Waist circumference (male)		
Normal (≤90 cm)	19	50
Risk (>90 cm)	19	50
Waist circumference (female)		
Normal (≤80 cm)	31	42
Risk (>80 cm)	43	58

BMI: Body mass index

Table 2: Physical activity classifications based on steps per day

Physical activity levels	Percentage
Sedentary (<5000 steps/day)	24
Low active (5000-7499 steps/day)	33
Somewhat active (7500-9999 steps/day)	26
Active (10000-12499 steps/day)	13
Very active (>12500 steps/day)	4

Table 3: Mean differences in steps per day according to demographic variables

Variables	Mean±SD	F	p value
Gender			
Male	7890±4976	0.991	>0.05
Female	7322±2818		
Job categories			
Academic staff	6712±2599	0.093	>0.05
Non-academic staff	7882±4069		
Age groups (years)			
<40	7333±2570	2.202	>0.05
≥40	7975±5600		
Mode of transportation to work			
With transport	7617±3802	-0.88	>0.05
Without transport	8750±2178		
BMI (kg m^{-2})			
Normal	7396±2260	0.22	>0.05
Overweight	7984±4277		
Obese	7682±4038		

BMI: Body mass index

Table 4: Mean values for cardiovascular risk factors

Risk factors	Mean±SD
Weight (kg)	66.90±13.7
BMI (kg m^{-2})	26.20±4.6
Waist circumference (cm)	
Male	92.40±10.6
Females	82.80±10.5
Systolic blood pressure (mm Hg)	121.00±15.2
Diastolic blood pressure (mm Hg)	75.00±11.2
Glucose (mmol L^{-1})	4.99±1.42
Total cholesterol (mmol L^{-1})	4.89±1.35
Triglyceride (mmol L^{-1})	1.18±0.50
HDL (mmol L^{-1})	1.15±0.43
LDL (mmol L^{-1})	3.19±1.22

BMI: Body mass index, HDL: High density lipoprotein, LDL: Low density lipoprotein

Table 5: Correlation between cardiovascular risk factors with daily steps and age

Risk factors	Steps per day (R)	Age (r)
BMI (kg m^{-2})	-0.04	0.16
Waist circumference (cm)	-0.05	0.24*
Systolic blood pressure (mmHg)	0.03	0.46*
Diastolic blood pressure (mmHg)	-0.02	0.36*
Glucose (mmol L^{-1})	0.04	0.19*
Cholesterol (mmol L^{-1})	0.14	0.11
Triglyceride (mmol L^{-1})	0.18*	0.16
HDL (mmol L^{-1})	-0.12	-0.06
LDL (mmol L^{-1})	0.16	0.12

*p<0.05, BMT: Body mass index

DISCUSSION

The '10,000 steps/day' is the recommended estimate of daily activity for apparently healthy adults and numerous studies have documented the health benefits of attaining such levels (Tudor-Locke and Bassett, 2004). In the present study, the level of physical activity of the majority of the employees was classified as generally low and only 17% achieved the recommended target of 10,000 steps/day.

These findings showed that the number of steps achieved daily were not different between male and females workers, as well as between academic and non-academic staff. The lack of physical activity among the university employees was not entirely supervising. Most of the subjects commuted to work in their private cars, reducing the chance of engaging in walking activity by commuting with public transport. Furthermore, technological advances e.g. the usage of computers mean that many adults are now working in sedentary environments (Ryan *et al*., 2011; Parry and Straker, 2013; Owen *et al*., 2011). Evidence also suggests that individuals who sit for long periods of their working day do not compensate by increasing their physical activity levels and/or reducing their sitting time during leisure time (Clemes *et al*., 2014; Chau *et al*., 2012). A systematic review of 32 empirical studies suggests that relatively healthy adults take between 7000-13,000 steps/day (Bravata *et al*., 2007). On the other hand, unfavorable indicators of body composition and cardiometabolic risk have been consistently associated with taking <5000 steps/day (Tudor-Locke *et al*., 2013). As, most working adults these days spend most of their waking time at work and commuting to and from work, it is an ideal environment for occupational behaviour change interventions to increase physical activity and promote cardiometabolic health.

We did not find significant differences in accumulated steps/day between the BMI categories. Previous evidence has shown that people meeting the 10,000 steps/day target are more frequently classified as normal weight and those individuals with values less than 5000 steps/day are more frequently classified as obese (Dwyer *et al*., 2007; Tudor-Locke *et al*., 2001). Perhaps due to the majority of the study subjects being overweight/obese and were generally sedentary or low active that no differences were observed.

In general, our study showed that accumulated steps/day were not associated with cardiovascular risk factors, except with triglycerides. There was a positive correlation observed between steps/day and triglycerides, which was contradictory with previous findings. For instance, Sisson *et al*. (2010) demonstrated that in a study of 1446 adults, those who took more steps/day tended to have lower waist circumference, higher HDL levels and lower levels of triglycerides. It is possible that our finding was of such because we did not take into account other factors that may have affected triglyceride levels such as food intake, number of cigarettes smoked per day and psychological stresses (Steinmetz *et al*., 1979). Apart from the triglycerides data, we also did not find an association between steps/day and HDL levels and this could be partly due to the fact that the HDL levels of the studied population were generally on the low end of the normal range.

The main limitation of our study was that it was limited to those employees willing to participate in the study. This created a selection bias, as the employees agreeing to participate may be different from the non-participating employees. The volunteer sample in this study may not have been representative of the entire workforce. Also, this study was cross-sectional and these types of studies are weak for evaluation of relations between variables. Further research could explore walking activity framed within the context of during working hours and outside working hours separately. Additionally, evaluating walking intensity (e.g., 100 steps/min) and duration of intensity-based steps rather than volume alone will add to the current understanding of the dose-response effects of walking.

CONCLUSION

The findings of this present study is important in highlighting the undesirable levels of physical activity

among university employees, which generally were low active. Coupled with the high prevalence of overweight/obesity in the sampled population, these people could benefit from occupational health interventions to promote workplace physical activity and reduce sedentary behaviour.

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