ORIGINAL ARTICLE

Effect of Physical Activity Intervention on Physical Activity, Body Mass Index, Blood Pressure, Blood Lipid and Fasting Blood Sugar Among Overweight and Obese Military Personnel

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ABSTRACT

Introduction: About 18% of Malaysian Armed Forces (MAF) personnel are diagnosed with either hypertension, diabetes or coronary artery disease, while another 8% are obese. The rising prevalence necessitates intervention. **Methods:** This is a single blinded randomized controlled trial among overweight and obese MAF personnel attending medical checkup in MAF hospital in Kuala Lumpur. An intervention module was developed to increase their physical activity level. Short version of International Physical Activity Questionnaire was used to assess physical activity in metabolic equivalent of task score (METs score), while blood pressure, body mass index (BMI), blood lipid profile and fasting blood sugar measurements were also obtained. These parameters were measured at baseline and again at 6 months. Generalized estimating equations (GEE) statistical test were applied to evaluate the effect of the intervention. **Results:** Response rate was 100%. Most of participants were aged above 40 years, male, from Malay ethnic group, completed secondary education and had monthly income above RM 4000. Most of the respondents were obese and had moderate level of physical activity at baseline. All variables compared between groups at baseline showed no significant difference. At six months, after controlling for covariates, the significant difference was only in METs score. The odds of having high METs score in the intervention group after receiving intervention was nearly 3 times higher than those in the control group, after adjusting for interaction between time and group as well as other covariates (AOR = 2.908, 95% CI 1.323 – 6.391, P=0.008). **Conclusion:** Intervention was effective in increasing physical activity among overweight and obese military personnel.

Keywords: Physical activity intervention, Malaysian Armed Forces, Overweight, Obese

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INTRODUCTION

The National Health and Morbidity Survey Malaysia reported a 13 % rise in prevalence of obesity over a period of two decades (1996-2015) (1). The prevalence of obesity in Malaysia was higher than the world prevalence in 2014 (17.7% vs 13.0%) (1,2). About 4.1% of the working population in Malaysia, specifically those in the government sector, are overweight and obese. This applies to all types of government sectors including uniformed services such as the army (3). As the number of people with obesity amplifies, the country now is facing arise of non-communicable diseases such as diabetes and cardiovascular diseases (1). Military personnels were of no exception to the trend and its consequences. In 2016, the Malaysian Armed Forces (MAF) reported that 8% of their personnel were obese and 18.7% had been diagnosed with either hypertension or diabetes or coronary artery disease (3).

The basic cause of obesity and overweight is a disproportion between calories intake and calories used. Globally, there has been an raised consumption of energy condensed foods that are excessive in fat, while simultaneously there is a decline in physical activity due to the ever more sedentary nature of many tasks and lifestyles including changes in modes of transportation as a result of urbanization. (4). Physical inactivity is known as the fourth leading risk factor of worldwide mortality (5), while physical activity (PA) confers significant benefits on cardiovascular outcomes. Meta-analysis of 21 prospective studies showed risk of cardiovascular disease (CVD) to be contrariwise associated with leisure and occupation physical activity where the risk of cardiovascular disease was lower in men who had higher leisure physical activity (6).

Due to its beneficial effects, international guidelines were developed stating the appropriate amount of PA according to age, weight and gender (7,8). There are three categories of physical activity measured in metabolic equivalent of task score (METs). First is category 3 that is highly active or health enhancing physical activity (HEPA) (scored 3000 or more METs), second is category 2 which is minimally active (scored 600 or more METs) and last is the inactive category (those who do not meet criteria category 2 and 3) (9). Although 66.5% of Malaysians are physically active, 41.1% of them belong in category 2 which is minimally active and only 25.4% are in category 3 which is highly active (1).

Exercise either alone or mixed with other lifestyle changes is considered as treatment to reduce hypertension and high cholesterol levels (10). Exercise also reduces the incidence of type 2 diabetes mellitus in high risk groups, increases the metabolic syndrome in general and decreases HbA1c levels in patients with type 2 diabetes (11). There is excellent evidence that physical activity, particularly moderate to vigorous intensity physical activity (MVPA), is helpful in the prevention and treatment of CVD (10,11). In general, exercise is a crucial key modifiable factor to many health benefits. Therefore all clinical and health guidelines should emphasize the role of physical activity.

In view of the increasing percentage of obesity and non-communicable diseases such as diabetes and CVD among military personnels, an intervention to promote physical activity is of priority. The aim of the study is to develop and investigate the effectiveness of an intervention module in improving the physical activity levels among military personnels.

MATERIALS AND METHODS

This study was carried out at Malaysian Armed Forces Hospital under the Military Medicine Department located in Kuala Lumpur. The hospital was chosen because it is the largest and the most well equipped among all Malaysian Armed Forces (MAF) hospitals. Recruitment was initiated by approaching all military personnel who came to Military Medicine Department for their compulsory routine medical checkup, according to the register. The inclusion criteria was those with body mass index (BMI) more than 25.0 kg/m2. Those who are pregnant, handicapped due to service, diagnosed with any heart condition prior to the study and were under medication for hypertension, hyperlipidemia and diabetes were excluded from the study. Overweight or obese military personnel who agreed to take part in this study was randomly assigned by simple balloting to either intervention or control groups. The participants were then proportionately stratified according to the three types of services in the MAF, namely army, navy and air forces. The estimated sample size was 70 respondents per group.

The intervention module was developed through consultation with a group of experts from the Ministry of Health, Universiti Putra Malaysia, Malaysian Armed Forces and Sports and Rehabilitation experts from the MAF. The intervention module fostered a leader and group centric intervention program. It was designed to be incorporated into the existing physical training in the MAF for maximum impact and sustainability. The module consisted of phases. The initiation phase introduces the intervention followed by the health promotion phase which provides health education to improve the knowledge, attitude and practices on physical activity and to lose weight which will hence reduce one of the cardiovascular disease risks. The final phase consists of practical sessions combining cardio and high intensity interval training (HIIT). The sessions are conducted three times per week for six months. Each session requires a minimum of 30 minutes and is carried out by the researcher himself. The control group receives the usual care that has been practiced by the department including medical advice and administration of medication if needed.

The primary outcome in this study is physical activity measured in METS, (other than the intervention session) and the secondary outcome were BMI, blood pressure (systolic and diastolic), blood lipid profiles (cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL) and fasting blood sugar (FBS) taken from records at the hospital. Outcomes were measured at baseline and at six months. METS was measured using International Physical Activity Questionnaire (IPAQ). Data was analyzed using IBM SPSS version 23.0. Descriptive statistic were analyzed using mean (standard deviation, SD) and median (interquartile range, IQR), frequency (n) and percentage (%). Normality of the data was checked using histogram, skewness over standard error of skewness, as well as using Kolmogorov-Smirnov and Shapiro-Wilk normality tests. Parametric tests and non-parametric tests were used accordingly. Multivariate analysis specifically generalized estimating equations (GEE) was used to analyze the effectiveness of the intervention module after adjusting for covariates and interaction between group and time.

This study has obtained ethical approval from UPM Ethics Committee for Human Research, (FPSK (FR16) P014) approval from Director General of Health MAF and the hospital's Ethics Committee. Written consent was taken from all respondents and all data were kept confidential.

RESULTS

A total of 1280 military personnel of MAF were screened for eligibility. Of these, 1140 were excluded. From those excluded, 760 personnel did not meet inclusion criteria, 200 refused to participate and 180 could not be included for other reasons. A total of 140 military personnel were successfully randomized into intervention and control groups with 70 respondents in each group. All of the respondents in both groups completed all time points of intervention and data collection.

Table I and Table II show the comparison of respondents' characteristics at baseline. In both groups, the higher percentages were of those in age group of more than 40 years old, male, Malay ethnicity, finished education at secondary level and monthly income of RM4000 and above. At baseline, most were in moderate level physical activity and obesity category. The METS score, BMI, blood lipid profile and fasting blood sugar compared at baseline showed no significant differences.

Table III shows comparison of changes in physical activity level and BMI category post intervention. The high level activity increased about 50% (from 20% to 73%) in the intervention group contrasted to about 3% in control group (from 37 %to 40%). As for the BMI category about 24% in the intervention group managed to get into normal weight category compared to only 11% in the control group.

Table IV shows there is significant difference in the changes between intervention and control group METs score, BMI, cholesterol and HDL level from baseline to 6 months post intervention, however after controlling for covariates, comparison was only significant for METs score (Table V). The odds of having higher METS score after receiving intervention was nearly 3 times more as compared to control group, after adjusting for interaction between time and group as well as gender, education and age group (AOR = 2.908, 95% CI 1.323 – 6.391, P=0.008).

DISCUSSION

Participation rate was 100% in this study. This was expected due to the nature of being a military personnel, one always had high sense of voluntarism when asked to participate or perform tasks (3). Group comparisons at baseline were not significant for all variables. This could indicate that the randomization was carried out appropriately to ensure equalization of confounders between the two groups. The result showed that the intervention module improved the odds of higher physical activity by 3 times compared to those in control group. It can be concluded after adjusting for covariates, the physical activity intervention module was helpful in increasing physical activity (activity other than the intervention session) among respondents in the intervention group contrasted to those in control group.

Table I: Comparison of respondents' characteristics between intervention (n=70) and control group (n=70) at baseline

Variables	Groups, n (%)		Median (IQR)	χ^2	df	*P*- value
	Intervention	Control				
Age (Years)			43.5(17)	1.060	1	0.391
Less than 40	32(45.7)	26(37.1)				
More than 40	38(54.3)	44(62.9)				
Gender				2.719	1	0.142
Male	44(62.9)	53(75.7)				
Female	26(37.1)	17(24.3)				
Ethnicity				3.294	1	0.348
Malay	64(91.4)	59(84.3)				
Chinese	1(1.4%)	3(4.3)				
Indian	0	2(2.9)				
Others	5(7.1)	6(8.6)				
Education level				9.492	2	0.09
Secondary	40(57.1)	31(44.3)				
Diploma/Degree	29(41.4)	28(40.0)				
Post Graduate	1(1.4)	11(15.7)				
Income level (RM)			5000 (4950)	6.047	1	0.366
Less than 4000	25(35.7)	20(28.6)				
4000 and above	45(64.3)	50(71.4)				
PA level				5.082	2	0.079
Low	13(18.6)	11(15.7)				
Moderate	43(61.4)	33(47.1)				
High	14(20.0)	26(37.1)				
BMI category				0.741	1	0.39
Overweight	26(37.1)	31(44.3)				
Obese	44(62.9)	39(55.7)				

* Significant at <0.05

Table II: Comparison of METs score, BMI, blood pressure, blood lipid profile and fasting blood sugar between intervention (n=70) and control group (n=70) at baseline

Variables	Mean (SD)		U	*t*	*P*-value
	Intervention	Control			
METs score	2000 (1681)	2415 (2821)	2091.0		0.135
BMI	30.63 (3.08)	30.50 (3.41)		0.239	0.811
Blood pressure					
Systolic BP [a]	132.5 (18) [b]	131 (22) [b]	2227.5		0.352
Diastolic BP	82.47 (7.38)	81.56 6.22)		0.793	0.429
Blood lipid profile					
Cholesterol	5.50 (1.2)	5.32 (1.06)		0.911	0.364
LDL	3.43 (1.13)	3.4 (1.15)		0.192	0.848
HDL [a]	1.2 (0.5) [b]	1.16 (0.34) [b]	2298.0		0.526
Fasting blood sugar	5.53 (1.74)	5.57 (1.4)		-0.154	0.878

* Significant at <0.05
[a] Mann-Whitney U test
[b] Median (IQR)

Table III: Changes in physical activity (PA) level and Body Mass Index (BMI) category from baseline to 6 months post intervention in intervention and control group

	Baseline		6 month post intervention		*P*- value
	Intervention n(%)	Control n n(%)	Intervention n(%)	Control n(%)	
PA level					<0.001*
Low	13(18.6)	11(15.7)	0(0)	3(4.3)	
Moderate	43(61.4)	33(47.2)	19(27.1)	39(55.7)	
High	14(20.0)	26(37.1)	51(72.9)	28(40)	
BMI category					<0.001*
Normal weight	0(0)	0(0)	17(24.3)	8(11.4)	
Overweight	26(37.1)	31(44.3)	46(65.7)	38(54.3)	
Obese	44(62.9)	39(55.7)	7(10)	24(34.3)	

* Significant at <0.05

The intervention module showed an impact on PA level where none of the respondents in the intervention group remained in category 1 (physically inactive) at the end of this study. This finding was similar to a study in 2010 where after given physical activity intervention, a higher self-reported physical activity level was found to be significant in a community intervention program in rural Southwestern Oklahoma (12).

Health education and promotion at the early stage of the intervention phase could have also contributed to boost respondents' self-motivation to become healthier. The findings of this are in line with a review of 26 school based physical activity intervention studies which showed health promotion combined with

Table IV Physical activity (PA) (METSs Score), Body Mass Index (BMI), blood pressure (systolic and diastolic), cholesterol, LDL, HDL and FBS changes from baseline to 6 months post intervention between intervention (n=70) and control group (n=70)

Variables	Median (IQR)/Mean (SD)		*P*-value
	Baseline	6 months post intervention	
METs score			<0.001*[a]
Intervention	2000(1681)	4472(1677)	
Control	2415(2821)	2515(2286)	
BMI			0.005*
Intervention	30.63(3.08)	27.2(2.50)	
Control	30.63(3.08)	28.63(3.33)	
Systolic			0.247 [a]
Intervention	132.5(18)	123.0(14)	
Control	131.0(22)	125.0(10)	
Diastolic			0.246 [a]
Intervention	82.47(7.38)	77.86(8.172)	
Control	81.56(6.22)	79.94(7.822)	
Cholesterol			0.016*
Intervention	5.50(1.20)	5.04(1.00)	
Control	5.32(1.06)	5.49(1.14)	
LDL			0.864
Intervention	3.43(1.13)	3.36(1.13)	
Control	3.40(1.15)	3.40(1.16)	
HDL			0.001* [a]
Intervention	1.20(0.50)	1.55(0.80)	
Control	1.16(0.34)	1.30(0.48)	
FBS			0.257
Intervention	5.53(1.74)	5.56(1.07)	
Control	5.57(1.4)	5.33(1.28)	

* Significant at <0.05
[a]Mann-Whitney U test

exercise program increased PA level (13). The repetitive activity for almost six months could have an impact on respondents' behaviour towards healthy lifestyle, hence the increment of PA level amongst them. This is similar to an intervention study of four months aerobic physical activity to estimate a 30 year CVD mortality risk by using risk calculator among adults with elevated c-reactive protein which showed significant different of increased METs (14).

The impact of the intervention in this study on the reduction of BMI level within the intervention group was noteworthy. This is supported by a systematic review and meta-analysis of 66 studies which reported that analysis of the success of different exercise interventions in reducing body mass (15). However, in this study, comparing the changes between groups after controlling for covariates showed no statistical significance. This could be due to other known modifiable factors which were not included in this intervention such as dietary intervention. A systematic review of 43 studies which included 3476 participants show that intervention which includes diet would maximize the impact on BMI changes (16) and dietary monitoring was found to be an

Table V: Physical activity (PA) (METSs Score), Body Mass Index (BMI), blood pressure (systolic and diastolic), cholesterol, LDL, HDL and FBS changes from baseline to 6 months post intervention between intervention (n=70) and control group (n=70) after controlling for covariates

Variable	β	SE	Wald	Adjusted Odds Ratio	95% CI		*P* value
					Lower	Upper	
PA level							
Control [a]				1			
Intervention	1.068	0.402	7.061	2.908	1.323	6.391	0.008*
BMI							
Control [a]				1			
Intervention	-0.45	0.475	0.9	0.637	0.251	1.617	0.343
Systolic							
Control [a]				1			
Intervention	-0.343	1.587	0.047	0.710	0.032	15.929	0.829
Diastolic							
Control [a]				1			
Intervention	-0.331	0.973	0.116	0.718	0.107	4.837	0.734
Cholesterol							
Control [a]				1			
Intervention	-0.019	0.123	0.025	0.981	0.771	1.247	0.875
LDL							
Control [a]				1			
Intervention	0.033	0.129	0.067	1.034	0.803	1.332	0.796
HDL							
Control [a]				1			
Intervention	0.063	0.0564	1.227	1.065	0.953	1.189	0.268
FBS							
Control [a]				1			
Intervention	0.094	0.182	0.266	1.01	0.769	1.571	0.606

*Significant at $P<0.05$, [a] Reference group

significant factor of successful weight loss (17). This is also the finding of another study among 439 overweight and obese postmenopausal women in Seattle which showed that diet and exercise interventions had favourable effects on weight loss once given alone but the maximum effects were obtained in combining both (18).

The intervention module in this study was found to be not significant in improving blood pressure readings among the respondents. This current finding contradicts the finding of a systematic review and meta-analysis of seven studies conducted among Brazil's adult populations which showed that physical activity significantly decreases blood pressure among adults in Brazil (19). Again, the difference could be due to other influencing factors which are not studied such life style. A study done among 28235 respondents in Finland showed that lifestyle such as leisure physical activity, alcohol and sodium intake influences blood pressure in both hypertensive and non-hypertensive individuals (20). Even the variability of exercise regimes brings about the question such as 'the quantity of exercise needed to lower blood pressure' which up to this date is still uncertain. A study in Japan among 207 healthy subjects in five groups of exercise intervention showed that although there were reduction in blood pressure in the exercise group but there were no clear associations between exercise frequency per week and the magnitude of BP decrease with exercise training (21).

In this study, the intervention was also not effective in improving full lipid profile and fasting blood sugar. This is contrary to two reviews; one is a review of twelve studies representing up to 28 groups and 859 respondents which showed that exercise improves blood lipid except for HDL-C (22) and in another systematic review of 27 randomized control trials reported a reduction in HbA1c levels (23). The differences could be due to other factors which are not studied such as smoking status (24), total and type of fat intake (25).

The strength of this study is in its design which is randomized controlled trial. However, since all respondents were from the same centre there was risk of contamination of intervention to the control group. Nevertheless, researchers are optimistic that the intervention contamination was minimized by arranging different follow up days for respondents in intervention and control groups and the duration of intervention was limited to only 6 months. Most of the outcomes measured in this study were objective (body mass index, blood pressure and blood lipid profile) except physical activity which were measured in METS using IPAQ questionnaire. A study on validity Malay version IPAQ reported that due to its subjectivity, IPAQ generates underestimation in terms of METS and overestimation in categorizing physical activity level, thus suggesting the use objective instrument such as accelerometer in future studies (26). Nonetheless, the practical sessions of structured exercise program implemented in this study was designed by combining most of the available physical training regime in the MAF to encourage sustainability.

CONCLUSION

The result of this intervention program is encouraging in increasing physical activity among military personnel in MAF. However it was not statistically significant for other outcomes such as BMI, blood pressure, blood lipid profile and FBS. Nevertheless, these results could be extended to MAF to be considered as one of its research driven policy.

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