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ORIGINAL ARTICLE

THE EFFECTIVENESS OF FUTSAL AS A GAME-SIMULATED EXERCISE FOR PROMOTING WEIGHT LOSS AND METABOLIC HEALTH IN OVERWEIGHT/OBESE MEN

Nizuwan Azman[1], Nazirah Gulam Mohamed[2], Abdul Rashid Aziz[3], Nor Farah[4] and Ahmad Munir Che Muhamed*[1]

[1]Advanced Medical and Dental Institute, Universiti Sains Malaysia, Penang, Malaysia
[2]Seberang Jaya Hospital, Ministry of Health, Penang, Malaysia
[3]Sport Science and Medicine, Singapore Sport Institute, Sport Singapore, Singapore
[4] Centre for Rehabilitation and Special Needs, Faculty of Health Sciences, Universiti Kebangsaan Malaysia, Kuala Lumpur, Malaysia

ABSTRACT

Small-sided recreational soccer or futsal is associated with near maximal heart rates during training and has been shown to induce favourable metabolic and cardiorespiratory adaptations. It remains unclear, however, whether regular participation in futsal among overweight/obese individuals is effective in improving body composition and metabolic health. The purpose of this study was to determine if futsal can be an alternative method of exercise to promote weight loss and improve metabolic health in overweight/obese men. Eight overweight, untrained male participants (age: 29.5 ± 3.1 years; BMI: 31.2 ± 6.6 kg/m^2) took part in a 12-week intervention consisted of 4-a-side matches, once or twice weekly. Each game lasted for 60 minutes (4 x 10-min) with 3 minutes active rest between each game. All sessions were conducted in a warm-humid outdoor environment. Exercise heart rates, urine specific gravity and ratings of perceived exertion were recorded during each training session. Blood samples were drawn at baseline and post intervention for analysis of fasting blood glucose (FBG), triglycerides (TG), total cholesterol (TC), high density lipoprotein (HDL-C) and low density lipoprotein (LDL-C). Similarly, body composition analysis was analysed pre and post intervention. The average of percentage of exercise heart rates across the 12 weeks of training was at 77.8 ± 4% of heart rate maximum. Body weight did not change significantly following the intervention, however, an average of 4.5% reduction in body fat percentage (p=0.006) was observed. TG levels were increased following the intervention (1.9 ± 0.7 vs. 2.4 ± 1.0 mmol/L), but no changes were detected in FBG (5.5 ± 1.1 vs. 5.6 ± 0.9 mmol/L), CHOL (6.0 ± 1.1 vs. 5.9 ± 1.1 mmol/L), HDL (1.1 ± 0.2 vs. 1.0 ± 0.1 mmol/L) and LDL (4.1 ± 0.8 vs. 3.8 ± 0.9 mmol/L) levels, as well as blood pressure. In conclusion, the 4-a-side futsal intervention over a 12-week period resulted in lower body fat percentage in untrained, overweight/obese men, without significant improvements in metabolic health parameters. Due to the intermittent nature of the game, there is a potential for futsal to produce greater benefits if the intensities were maintained at higher intensities.

Keywords*: physical activity, obesity, body composition, cardiovascular risk factors*

INTRODUCTION

The health benefits from endurance exercise training such as running, cycling and swimming has been well documented[1]. More recently, there is a growing interest in examining the potential health benefits of regular participation in soccer[2,3,4]. Soccer is a high-intensity, intermittent sport characterised by repeated short burst of sprints, multiple turns as well as prolonged slow to medium running[5]. Recreational soccer or futsal is played in a small-sided format such as 3 vs. 3, 4 vs. 4 or 5 vs. 5 using varying field sizes. This small-sided format resembles high intensity interval training (HIIT) as the exercise heart rates are recorded at near maximal heart rate values[6]. Similar to HIIT, health benefits from regular participations in soccer training (12-16 weeks) includes reduction in resting heart rate, improvement in maximal oxygen uptake and ventilation, lowering of fat mass as well as positive changes in blood lipid[7].

While there are a growing number of research findings indicating various positive health effects of recreational soccer, little is known if overweight and obese individuals are able to similarly gain these health benefits. Recommendation by the American College of Sports Medicine (ACSM) stated that physical activity (PA) of 150 to 250 min·wk^{-1} with an equivalent energy of ~1200 to 2000 kcal is sufficient to prevent weight gain greater than 3% in most adults and result in modest weight loss[8]. Unfortunately, the physical strain associated with continuous running exercises represents a major challenge for the overweight and obese populations, thus requiring an alternative form of activity in order to promote weight loss. Considering that nearly one out of four Malaysian adults was considered sedentary[9], small-sided games like futsal may provide an alternative exercise modality for prevention of excess weight gain and development of cardiovascular risk factors. To date, there is limited evidence to indicate whether small-sided futsal is an effective form of exercise to promote weight loss and improve metabolic health in the obese population. Due to its high-intensity intermittent characteristic of the sport, under the physiological point of view, we hypothesized that futsal would be a suitable exercise modality to promote weight loss and induce favourable metabolic responses in sedentary, overweight/obese male adults.

METHODS

Subjects

Eight overweight/obese adult men, aged between 27-33 years (29.5 ± 3.1 yrs) with a body mass, body mass index, body fat percentage and maximal oxygen uptake (VO_2max) of 87.0 ± 19.5 kg, 31.2 ± 6.6 kg/m^2, 35.9 ± 6.3% and 37.9 ± 0.6 ml/min/kg, respectively, volunteered for this study. The participants did not participate in any exercise programs within the last 12 months. Each participant was medically screened prior to their involvement in the study. Participants who were certified healthy with no chronic health issues as well as not taking any prescribed medications were accepted to this study. Participants were required to maintain their usual food and fluid intake throughout the intervention. Prior to the first day of futsal intervention, each participant signed the informed consent form. This study was approved by the Universiti Sains Malaysia Human Ethics Committee (FWA Reg. No: 00007718; IRB Reg. No: 00004494) and registered with the National Medical and Research Register (NMRR-14-944-22045).

Familiarisation

Participants completed two familiarisation sessions during which all the experimental procedures were explained to them. Participants then completed a multi-stage Yo-Yo Intermittent Recovery Test Level (YYIRT) developed by Bangsbo and his colleagues (1995)[10] to predict their maximal oxygen consumption, calculated using the formula: VO_2max (mL/min/kg) = distance (m) × 0.0084 + 36.4. Participants also completed two 10-min blocks game to prepare themselves for the actual training intervention.

Futsal Training Intervention

The training intervention involved a 4-a-side format on a 15 x 30 m natural grass pitch twice a week for 12 weeks. Each training intervention was separated over a-72 hour period. The training intervention was carried out between the hours of 17:00 to 18:30 with the recorded temperature and humidity of 29.8 ± 1.2^{0}C and 74.1 ± 7.3% relative humidity, respectively. Each training session consisted of four, 10-min blocks game with a 3-minute rest in between each game. The training session was initiated with a 5- min of structured low intensity warm up and ended with a 5-min of structured cool down. During each training session, players were randomly selected for both teams. This was to avoid participants playing the same team members across the 12 weeks. In addition, goal scores were recorded for the purpose to motivation players. During each training session verbal encouragement was provided for the participants to actively engaged in the game and to keep players moving throughout the entire period of the game. At each rest intervals, players were encouraged to drink plain water that was provided.

Exercise Heart Rates and Hydration Status

Heart rate (HR) during exercise was continuously recorded telemetrically with a short-range transmitter-receiver (Polar RS 400, Polar Electro, Kempele, Finland) throughout the training for each session. The recorded exercise HR was used to determine the exercise intensity of the training session based on the percentage of maximum exercise heart rates (% HRmax). At the completion of each training session, subjects rated their subjective rating of perceived exertion using Borg CR10 scale[11] of 0-10. Participants' hydration status was determined via urine specific gravity (USG) measured using a refractometer (Atago Co. Ltd, PAL-10S, Tokyo, Japan) before and after each training session. The environmental condition during each training session was recorded using whirling hygrometer (H2001, Paint Test equipment, Cheshire, England).

Anthropometric Measurement

Height, weight, and body fat percentage were measured before the first training session in week 1 and a day after the last training session in week 12. Participants' height was measured using height and weight scale (Seca 213, Seca, Hamburg, Germany) to the nearest 0.1 cm. Body mass index was calculated using the weight/height squared formula (kg/m^2). Meanwhile, body fat percentage was assessed using air displacement plethysmography (Bod Pod 2007A, COSMED, Rome, Italy).

Metabolic Health Measurement

Blood pressure measurements and venous blood were collected before the first training session in week 1 and a day after the last training session in week 12. Resting blood pressure was recorded using by an automatic blood pressure monitor (HEM-709; OMRON, Illinois, USA) after a 10-min rest. Venous blood was sampled in the morning following a 12-hour fast. Blood samples (4ml) were collected into a 2 ml vacutainer containing sodium fluoride and a 2 ml vacutainer with serum separator. The analysis of blood specimens were performed on an automated biochemical analyser for fasting blood glucose (FBG), triglycerides (TG), total cholesterol (TC), high density lipoprotein (HDL-C), and low density lipoprotein (LDL-C) levels.

Statistical Analysis
The data collected throughout the 12 weeks intervention training were analysed using IBM Statistical Package for Social Sciences 22 (IBM SPSS, Chicago, Ill., USA) software. Since subjects' statistics normal distribution was violated, the non-parametric analysis was used; Wilcoxon Signed Rank test was used to determine the pre-post intervention period and the Mann-Whitney two tailed test to determine the comparison between two independent variables. All the significance level was set at $p < 0.05$. All values are presented as means ± SD unless otherwise indicated.

RESULTS

Participants' Physiological Responses
All participants completed the study with an adherence rate to the exercise intervention of 100%. Mean training frequency over the 12-week intervention were 1.3 sessions per week resulting in 20 sessions in total. Mean ratings of perceived of exertion using the Borg CR10 scale were 4.3 ± 0.5. Mean exercise heart rates were 155.3 ± 7.8 bpm corresponding to 77.8% of heart rate maximum (HRmax). Mean urine specific gravity values were 1.023 ± 0.002, indicative of mild dehyration. Body composition, cardiorespiratory fitness and metabolic health outcomes of the participants at baseline and post intervention are summarised in Table 1.

Body Composition Outcomes
Mean body weight was -2.5% lower following 12 weeks but the change was not significant compared to baseline. However, mean percentage of body fat showed a significant -4.5% reduction (p = 0.006) following the intervention.

Cardiorespiratory Fitness and Metabolic Health Outcomes
The cardiorespiratory fitness of the participants were categorised as fair. No improvement was observed in the cardiorespiratory fitness following the 12-week intervention although there was a 9% increase in distance covered in the YYIRT compared to baseline. Levels of FBG, TC, HDL-C and LDL-C did not change, however triglycerides increased (p = 0.021) following the intervention. Similarly, no significant changes were noted for systolic, diastolic and mean blood pressures.

DISCUSSION

The aim of this study was to investigate the effectiveness of a 12-week recreational futsal intervention in promoting weight loss and improving metabolic health parameters in overweight/obese male individuals. Our findings demonstrated that 4-a-side futsal game performed 1-2 sessions per week over the period of 12 weeks resulted in a significant reduction (-4.5%) in percentage of body fat in the absence of a concomitant body weight loss and improvement in metabolic health parameters.

To the best of our knowledge, there is a lack of published data regarding the benefits of playing futsal in improving metabolic health in obese individuals, despite its popularity here in Malaysia. Recent exercise recommendations are now moving from continuous, aerobic-based training to incorporating varied exercise intensities within a single exercise bout, i.e. high intensity intervals interspersed with low intensity movements[12], which lends credence to the use of soccer-based exercise modes. It has been demonstrated that small-sided games like futsal or recreational soccer can lead to comparable if not better improvements in body composition, aerobic capacity, and glucose homeostasis compared to traditional aerobic training[3,4,7].

The present study showed that the 12-week futsal intervention resulted in insignificant weight loss (-2.2 kg) in our participants. On the contrary, the intervention led to an overall ~5% reduction in percentage of body fat. Indeed, changes in body weight due to physical activity interventions were generally small, unless the prescription for exercise-induced energy expenditure was substantial[13]. Further examination revealed that only two out of the eight participants managed to lose at least 5% of the baseline body weight while the rest were considered as 'non-responders', *i.e.* those who maintained or gained excess weight in response to an intervention[14]. A systematic review by Caudwell et al. (2014)[15] have shown that most physical activity interventions produced individual variability in weight loss, between 0.6 – 4.4 kg in short- to medium-term interventions. The extent of weight loss in physical activity interventions are driven by a number of factors such as combined diet and exercise interventions, exercise-induced energy expenditure, and the often ignored compensatory eating[14,15].

Table 1: *Body Composition, Cardiorespiratory Fitness and Metabolic Health Outcomes Pre- and Post-Intervention (n=8)*

Outcome Parameters	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	p value
Body Composition			
Body weight (kg)	87.0 ± 19.5	84.7 ± 18.0	0.363
BMI (kg/m^2)	31.2 ± 6.6	30.4 ± 5.9	0.368
Body fat percentage (%)	35.9 ± 6.2	34.3 ± 6.0	**0.006**
Metabolic Health Parameters			
Systolic blood pressure (mmHg)	131 ± 14	131 ± 13	0.868
Diastolic blood pressure (mmHg)	76 ± 13	85 ± 9	0.052
Mean arterial pressure (mmHg)	94 ± 13	100 ± 9	0.051
Fasting blood glucose (mmol/l)	5.5 ± 1.1	5.6 ± 0.9	0.948
Triglycerides (mmol/l)	1.9 ± 0.7	2.4 ± 1.0	**0.021**
Total cholesterol (mmol/l)	6.0 ± 1.1	5.9 ± 1.1	0.593
HDL-cholesterol (mmol/l)	1.1 ± 0.2	1.0 ± 0.2	0.219
LDL-cholesterol (mmol/l)	4.1 ± 0.8	3.8 ± 0.9	0.392
Total cholesterol/HDL ratio	5.5 ± 0.7	5.7 ± 0.9	0.339
Cardiorespiratory Fitness (YY1RT)			
Level	11.3 ± 1.1	11.8 ± 0.5	0.303
Distance (m)	180.0 ± 77.1	195.0 ± 45.0	0.593
Max HR (bpm)	176 ± 3	165 ± 12	0.110
% Max HR	92.5 ± 6.3	86.5 ± 12.4	0.109
Predicted VO_2max (ml/kg/min)	37.9 ± 0.6	38.0 ± 0.4	0.584

Our participants were asked to continue on their usual diet during the study period to better study the effect of a single type of intervention, however the lack of dietary intervention in the study could very well explain for the variable weight loss observed in the study. The 'responders' could be particularly motivated to change both their exercise and diet habits and may have decreased their caloric intake on their own, compared to the non-responders. Furthermore, the beneficial effects of an exercise intervention should not restrict to changes in body weight but should also take into account other aspects of body composition such as percentage of body fat and waist circumference.

The reduction in percentage of body fat observed in this study is consistent with the findings of Vasconcellos et al. (2015)[16], who recently reported similar percentage of reduction (~2%) in body fat following 12 weeks of recreational soccer in obese adolescents. Given the known benefits of decreasing body fat percentage with improved insulin resistance[17] especially in the obese, the reduction of body fat percentage in this study was encouraging even in the absence of substantial amount of weight loss. A number of studies have shown that high intensity exercise of intermittent nature are more effective at reducing subcutaneous and abdominal fat loss than other types of exercises[18], therefore supporting the potential of futsal training in improving body composition.

With regards to metabolic health parameters, no changes were observed in fasting blood lipids and glucose in the study, with the exception of increased triglycerides following the intervention. This finding was somewhat surprising, since it has been shown that systematic soccer training seemed to improve blood lipids when compared with sedentary women[19]. On the other hand, Beato et al. (2017)[20] recently showed that 12 weeks of recreational soccer training (1 session weekly) in overweight males did not lead to any improvements in blood lipids. It is likely that the low training frequency utilised in the study (1-2 sessions weekly) might contribute to the lack of changes seen in the lipid profile. Moreover, changes in body composition seems to influence lipid responses to training, since improvements in total cholesterol, triglycerides and HDL-C, have been observed in obese subjects who lost at least 5% of body weight[16]. Cross-sectional and longitudinal exercise studies have supported these findings, showing that unless exercise is accompanied by substantial weight loss, body composition changes (especially loss of intra-abdominal adiposity), and/or dietary changes, cholesterol levels typically do not change[21,22]. It has also been suggested that exercise needs to be of sufficient intensity to produce changes in HDL-C, and that obesity may also blunt the exercise response of HDL-C[21]. Contrary to our expectation, triglycerides levels were increased following the intervention. Compared to cholesterol, levels of plasma triglycerides are highly dependent on recent meal intakes and the rate of lipoprotein clearance, therefore this increase could either indicate a higher-than-normal fat intake prior to the last blood sampling or the possibility of an adverse response to exercise as has been demonstrated in some studies[23]. We also recognise that a combination of exercise and diet is always required for beneficial modifications in serum lipids and lipoproteins.

The lack of significant change in fasting blood glucose in the study was also consistent with previous studies involving futsal or recreational soccer training[16,20]. This may be linked to the glucose median levels, which were within the normal range in our participants. It was very likely that changes would be evident if the participants were hyperglycemic as metabolic adaptations to exercise training were much greater in diabetic or pre-diabetic compared to normoglycemic individuals[24]. Recreational soccer has been associated with a reduction in blood pressure in hypertensive subjects[25,26], however this was not demonstrated in the present study. The finding was somewhat unexpected as our subjects were considered as pre-hypertensive[27]. This could be partly explained by the lack of significant weight loss in our participants, as evidence has shown that larger changes in blood pressure are associated with larger reductions in body weight in hypertensive and non-hypertensive obese[28,29]. It was reported that in obese subjects with elevated cardiovascular risk, systolic and diastolic blood pressures decreased by approximately 3 and 2 mm Hg, respectively, after a ≥5% weight loss, with modest and variable reductions seen with <5% weight loss[29].

In contrast to a previous meta-analysis report on the improvement of cardiorespiratory fitness through recreational soccer[30], we did not observe any changes in the predicted VO_2max values following the 12-week futsal training. Previous studies cited at least an increase of ½ MET (i.e. 1.75 ml/kg/min) in cardiorespiratory fitness to elicit a minimum meaningful improvement corresponding to reduction in risk mortality[31]. It is well-known that the health benefits of physical activity follow a dose-response relationship[32], therefore the discrepancy in the findings between the current and previous studies may be justified by the different doses of training utilised. Our study utilised a protocol of an hour of training per week that probably has a smaller effect than previous studies with 2 - 3 hours training per week[16,33], which could have partly contributed to the lack of improvements seen in cardiorespiratory fitness and metabolic parameters in the study. In addition to training volume, training intensity is also important in determining the beneficial changes in cardiorespiratory fitness and body composition following an exercise intervention, especially in the obese population[12].

Futsal games are usually conducted in a five-a-side format on pitch dimensions of 15 x 30 m or 40 x 20 m[5]. Although the game is intermittent in nature, involving multiple turns, sprints and jumps in multiple directions interspersed with low-intensity recovery periods, futsal is also characterised by long periods of standing or walking, which is considered to have minimal or no influence on physical fitness[7]. The intensity of futsal games therefore can be manipulated by the modification of game variables such as the number of players, the pitch area, the game format and duration. In small-sided futsal games, the exercise heart rates can exceed 80% of maximum heart rate (HRmax), with mean values of 85-90% HRmax per match and such intensities are similar to those observed in elite soccer games and high intensity interval training[5]. On this basis, the present study was conducted using a 4-a-side format, as the reduction in the number of players increases the intensity of the game, due to the larger ratio of area covered per player[34]. Analysis of exercise heart rates in the present study revealed that the mean heart rates during training were corresponding to 78% of HRmax. This was in contrast to similar 4-a-side futsal studies by Barbero-Alvarez et al. (2008)[35] and Duarte et al. (2017)[34] which had reported mean exercise heart rates corresponding to 90% and 82% of HRmax respectively. On the other hand, the % HRmax recorded in the study was comparable to that of the study by Castagna et al. (2007)[36] which recorded a value of 74% of during a 5-a-side futsal match. It may be possible that the lack of cardiorespiratory fitness and excess body weight in the participants were the limiting factors contributing to their capabilities in maintaining the games at higher intensities, and thus, could not fully benefit from intervention. Therefore, the above data suggests that in addition to the low training volume, the intensity of the futsal training conducted in this study were not sufficient to elicit significant improvements in body weight and metabolic health parameters as compared to previous studies with higher training volumes and intensities.

The present study is primarily limited by the small sample size and absence of comparison with a control group, therefore the analysis was based on pre- and post-intervention comparisons rather than on a comparison between randomized groups. It could be argued that the finding of this study is not meant to quantify general performance within a population but merely to document the existence of an effect. Although we do not deny that having a larger sample size would increase the power of the study, we were still able to detect differences in body fat in our relatively small sample size. Secondly, the present study only investigated overweight males and therefore these results may not be generalised for females or other clinical populations. On the basis of our preliminary findings for the potential of HIIT in promoting body fat loss, future studies involving futsal should look into increasing the sample size as well as training volume or intensity by decreasing the number of players per side to achieve greater benefits in metabolic health.

CONCLUSION

In conclusion, our findings demonstrated that ~1 hour of futsal training per week for 12 weeks were able to reduce percentage of body fat in the absence of significant body weight loss and improvement in metabolic health parameters. Given that futsal is a popular sport, relatively inexpensive, socially and culturally acceptable, and easy to learn, it has the potential to be an effective exercise modality for the prevention and management of cardiovascular risk factors as well as improving general health among the obese populations in Malaysia if more frequent training and higher intensities were adopted.

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