Sport Sci Health (2016) 12:63–67
DOI 10.1007/s11332-015-0254-9

ORIGINAL ARTICLE

Metabolic profile is not associated with body composition parameters in recreational female futsal players

Metabolic profile and recreational female futsal players

Eduardo Zapaterra Campos[2] · **José Gerosa-Neto**[2] · **Fábio Santos Lira**[2] · **Camila Buonani**[1]

Received: 14 October 2015 / Accepted: 9 December 2015 / Published online: 5 January 2016

Abstract
Objective To investigate the association between body composition parameters and the metabolic profile of recreational female futsal players.
Methods 11 recreational female futsal players (21.2 ± 1.4 years, 163.2 ± 4.0 cm and 61.3 ± 17.6 kg) participated in this study. The assessment of body composition was performed using Dual Energy X-ray Absorptiometry, and the following body composition variables were evaluated: total body mass (TBM); body mass index (BMI); total body fat; relative total body fat; upper body fat (UBF); relative upper body fat (RUBF); lean mass (LM); lower limb muscle mass (LLMM). In addition, an evaluation of the metabolic profile was conducted: triacylgrycerol (TAG), total cholesterol (TC), low-density lipoprotein cholesterol (LDL-c), high-density lipoprotein cholesterol (HDL-c) and plasma concentrations of glucose (Glu). For the statistical analysis, descriptive analysis and the Pearson test were used to verify association between metabolic profile and body composition. The significance level was 5 %. Results: No significant association was found between TAG, HDL-c, and TC/HDL-c to body composition variables, while LDL-c had a tendency to associate with TBM ($r = 0.54$; $p = 0.08$) as well as Glu to BMI ($r = -0.56$; $p = 0.07$), and TBM ($r = -0.59$; $p = 0.05$). Significant association was found between Glu and LM ($r = -0.73$; $p < 0.01$) and TC with LLMM ($r = 0.59$; $p = 0.055$).
Conclusion No significant association was found between the metabolic profile and body fat indices, which may be explained by the relatively low levels of TAG, TC, and LDL-c.

Keywords Lean mass, fat mass · LDL-c · Total cholesterol

✉ Fábio Santos Lira
fabiolira@fct.unesp.br

[1] Soccer Research Group, Department of Physical Education, Universidade Estadual Paulista, Presidente Prudente, São Paulo, Brazil

[2] Exercise and Immunometabolism Research Group, Department of Physical Education, Universidade Estadual Paulista, UNESP, Rua Roberto Simonsen, 305, Presidente Prudente, São Paulo 19060-900, Brazil

Introduction

The lipid profile describes the level of lipids in the blood, with low-density lipoprotein (LDL-c), high-density lipoprotein (HDL-c), triacylgrycerol (TAG), and total cholesterol (TC) being the most commonly reported [1, 2]. LDL-c, TAG, and TC are usually associated with risk of cardiovascular disease, and mortality [3], while HDL-c has been considered a cardio protective index due to its capacity to transport excess cholesterol to the liver for excretion [4].

Exercise training improves the lipid profile, reducing the risk of cardiovascular diseases [5]. In sedentary populations, physical activity induces positive changes in LDL-c, TAG and TC [6]. Reductions of 0.6 mmol/L of TC can decrease the incidence of ischaemic heart disease by 54 % [7]. The mechanisms underlying the improvements of lipid profile after exercise is still unclear, but exercise enhances the ability of muscles to use lipids (i.e., saving glycogen) and reducing plasma levels [2, 8]. Furthermore, the mechanism includes increases in lecithin-cholesterol acyl-trans (LCAT), which is the enzyme responsible for ester transfer to HDL cholesterol [9]. However, it seems that the alterations in blood lipid concentration is dependent on energy expenditure, and the higher activity levels and intensity are, the higher is the improvements in HDL-c, TC, and LDL-c concentration [2].

Both low and high intensity running and cycling exercises have been shown to produce beneficial adjustments to lipid profiles [10–12]. Furthermore, team sport training also presented improvements in concentration of TC, TAG, LDL-c, and HDL-c [13–15]. Some studies have already observed that soccer players under regular training present higher levels of HDL-c [4, 16], and lower levels of LDL-c and TC [17] than match-related sedentary subjects.

Beside its benefits on metabolic profile, professional soccer training also promotes a reduction in fat mass in women [18]. Although the majority of studies examined male professional soccer players, and few studies evaluated female soccer players, no studies have investigated the metabolic profile of recreational female futsal players, who have specific metabolic loads [19]. Furthermore, body composition exhibits a greater correlation to their metabolic profile, especially body fat, and increased body fat is associated with dyslipidemia while reduced body fat leads to an anti-atherogenic profile.

Together with the metabolic profile, body composition can be also considered a protective index in reducing the risk of cardiovascular diseases. However, for recreational female futsal players it is not known whether body composition is associated with the metabolic profile. Thus, the aim of this study was to investigate the association between body composition parameters and the metabolic profiles of recreational female futsal players. Our hypothesis was that a significant association would be found between metabolic profile and body composition.

Methods

Sample

This study has a cross-sectional design and was carried out in 2014 and 2015 at the University Estadual Paulista (UNESP), Presidente Prudente, SP, Brazil. 11 recreational female futsal players (21.2 ± 1.4 years, 163.18 ± 4.0 cm and 61.3 ± 17.6 kg) participated of this study. These athletes were participating in a league composed of 20 teams and the match schedule extended over 11 months of the year, which did not allow for a lot of interruptions, and trained two times per week (week volume: 180 min/week), composed by specific futsal training. Therefore, the data for this study were obtained during the pre-season.

To participate in this study, the following inclusion criteria were adopted: (1) to be playing futsal for at least a year; (2) to be between the ages of 18 and 25 on the date of the evaluation; (3) to perform all evaluations; (4) to sign the informed consent form necessary for participation in the study. To avoid circadian variation, the blood samples were collected in the same time of day [20].

From an ethical point of view, the related program was approved by the Ethics Research Group of the university (n ° 31023314.2.0000.5402). All participants were fully informed about the nature and demands of the study, as well as the known health risks. They completed a health history questionnaire and were informed that they could withdraw from the study at any time. All participants signed a written consent form (Protocol no 31023314.2.0000.5402/2015).

Instruments and procedures

Anthropometry and body composition

Body weight was measured using an electronic Filizola-brand scale. Height was measured using a Sanny-brand fixed stadiometer. The values of height and weight were used to calculate body mass index (BMI) [weight (kg)/ height (m)^2].

For analysis of body composition, a dual energy X-ray absorptiometry (DXA) (General Electric Medical Systems, Lunar DPX MD, Madison, WI, USA) device brand was used with software version 4.7. The DXA body composition was estimated by dividing the body into three anatomical compartments: fat-free mass, fat mass and bone mineral density (BMD). Results are expressed in grams of lean mass, fat and body fat percentage. This technique also allows the estimation of total and segmental body composition. Thus, we estimated the total body composition and that of lower limbs. All evaluations were performed in the competitive pre-season.

To calculate the technical error of measurement in the DXA, two whole body evaluations were performed, by the same evaluator, on two consecutive days with 12 female subjects. From the results obtained, the error was estimated as follows: 1.48 % for total body fat; 1.38 % for trunk fat; 2.06 % for total lean body mass. Test–re-test intraclass correlation coefficient (ICC) of DXA also showed to be reliable (ICC between 0.91 and 0.99 for the variables used in this study).

Metabolic profile

The blood samples (20 mL) were immediately allocated into vacutainer tubes (Becton–Dickinson, BD, Juiz de Fora, MG, Brazil) containing EDTA for plasma separation and into dry vacutainer tubes for serum separation. The tubes were centrifuged at 3000 rpm for 15 min at 4 °C. Plasma and serum samples were stored at −80 °C until analysis. To eliminate inter-assay variance, all samples were analyzed in identical runs, resulting in an intra-assay variance of <7 %. For each sample, the plasma concentrations of glucose (Glu), TAG, HDL-c and TC were assessed by colorimetric assay using commercial kits (labtest®, São Paulo, Brazil). The Friedewald (1972) formula was used to calculate LDL-c concentration.

Statistical analysis

For the statistical analysis, the Kolmogorov–Smirnov test was used for verifying normality of the data set. After the descriptive analysis for the sample characterization, the Pearson test was used to verify association between metabolic profiles and body composition. All analyses were performed using BioEstat software (version 5.0). The significance level was 5 %.

Results

The subjects' body compositions are presented on Table 1.

The subjects' metabolic profiles are presented on Table 2.

No association was found between TAG, HDL-c, and TC/HDL-c to body composition variables, while LDL-c had a tendency to associate with TBM ($r = 0.54$, CI 95 % −0.39 to 5.36; $p = 0.08$) as well as Glu with BMI ($r = -0.56$, CI 95 % −5.20 to 0.25; $p = 0.07$), and TBM ($r = -0.59$, CI 95 % −1.72 to 0.01; $p = 0.05$). Significant association was found between Glu and LM (CI 95 % −2.75 to −0.47) (Fig. 1), and TC with LLMM (Fig. 2).

Discussion

The aim of this study was to associate the metabolic profile with the body composition of recreational female futsal players. The main findings of the present study were that lean mass was inversely related to Glu concentration, and LLMM has a positive association to TC. Moreover, TBM had a tendency to correlate with LDL-c and Glu concentration.

Table 1 Mean, standard deviation (SD), and 95 % confidence interval (CI 95 %) of body composition of female futsal players ($n = 11$)

	Mean	SD	CI 95 %
TBM (kg)	58.39	5.28	54.84–61.94
BMI (kg/m^2)	22.01	1.72	20.85–23.16
TBF (kg)	16.84	3.78	14.30–19.38
RBF (a.u.)	28.67	4.68	25.52–31.82
UBF (kg)	7.78	1.89	6.51–9.05
RUBF (a.u.)	29.89	5.83	25.97–33.81
LM (kg)	38.94	3.42	36.64–41.24
LLMM (kg)	7.08	0.69	6.61–7.54

TBM total body mass, *BMI* body mass index, *TBF* total body fat, *RBF* relative total body fat, *UBF* upper body fat, *RUBF* relative upper body fat, *LM* lean mass, *LLMM* lower limb muscle mass, *a.u.* arbitrary unit

Table 2 Mean, standard deviation (SD), and 95 % confidence interval (CI 95 %) of metabolic profiles of female futsal players ($n = 11$)

	Mean	SD	CI 95 %
TC (mg/dL)	144.93	15.82	134.30–155.54
TAG (mg/dL)	119.11	17.39	107.45–130.80
HDL (mg/dL)	46.25	12.97	37.53–54.97
LDL (mg/dL)	74.86	24.05	58.70–91.02
TC/HDL (a.u.)	3.30	0.71	2.82–3.78
Glu (mg/dL)	83.07	7.56	77.97–88.15

TC total cholesterol, *TAG* triacylglicerol, *HDL* high-density lipoprotein, *LDL* low-density lipoprotein, *Glu* glucose

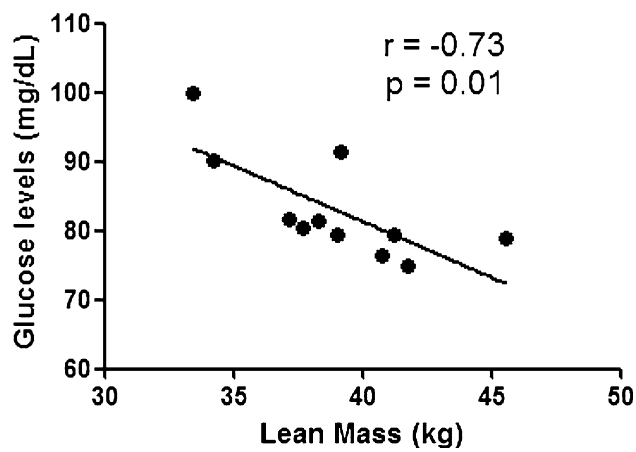

Fig. 1 Relationship between glucose and lean mass of recreational female futsal players

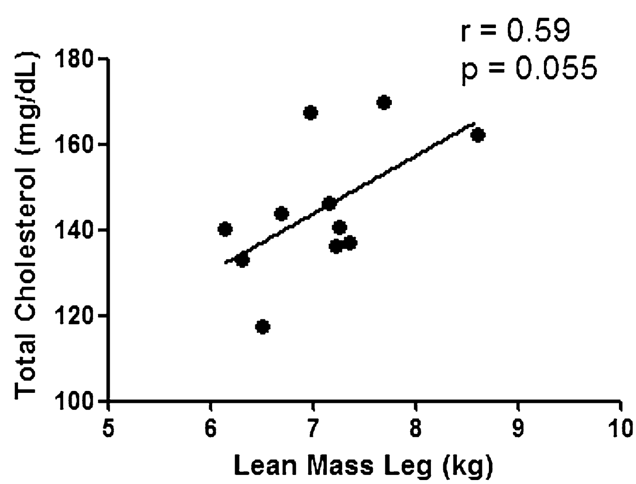

Fig. 2 Relationship between total cholesterol and lower limb lean mass of recreational female futsal players

To our knowledge, this is the first study to present the detailed body composition characteristics of recreation female futsal players. The present study BMI was higher than Angoorani's et al. [21] study (20.4 ± 1.4 kg/m^2), which analyzed Iranian professional futsal players; however, it was similar to Milanez's et al. [22] study. Thus, it seems that the players' professional level may not influence BMI indices since no difference was found between professional and recreational female futsal players which have low training frequency (two times per week, and 180 min/week). On the other hand, the BMI cannot be assumed to be a trustworthy index for body composition. Ruiz et al. [23] have analyzed the TBF of professional female futsal players (16.9 ± 4.4 kg) and no difference was observed in comparison to the present findings. However, the present study presents lower LM compared with Ruiz's et al. [23] study (42.3 ± 4.5 kg), and lower LM than studies investigating sedentary women [24]. Bangsbo et al. [25] showed that recreational soccer training was effective in reducing FM and increasing LLMM in sedentary young women, while running training did not change either LLMM or FM. Since no study verified segmental body composition for female futsal players, no comparison can be conducted. However, although female futsal players have already been studied, no study has investigated the effects of recreational training on their metabolic profile.

Studies have evidenced that lipid profiles are related to the risk of cardiovascular disease [26], furthermore, systematic soccer training seems to improve the lipid profile of women soccer players when compared with sedentary women [27]. Randers et al. [27] have studied the effects of 16 weeks of soccer training (two sessions per week) on young women and verified that only TAG decreased with training, while LDL-c, HDL-c did not change after training. On the other hand, Stasiulis et al. [28] have shown that 8 weeks of aerobic training (three sessions per week) were able to improve the lipid profile in sedentary female subjects. It is likely that training frequency might determine the training outcomes seen in the lipid profile; moreover, the pre-training body composition seems to influence the HDL-c and LDL-c response to training, since improvements in LDL-c, TC, and TAG have been observed in overweight women and not in normal or underweight subjects [29]. This may be explained by the relationship between the improvement in lipid profiles and in the decrease in FM [30], which agrees with LeMura's et al. [24] study, where the aerobic training group increased HDL-c and decreased TAG concentration, and FM, while resistance training and cross training group has not shown modifications on lipid profile.

Katzmarzyk et al. [30] have observed correlations between changes to TBF and improvements in the LDL-c and TC profiles in sedentary women. The present study did not submit the recreational futsal players to a training intervention, limiting the comparison with others. Although LDL-c tends to correlate to TBM ($r = 0.54$; $p = 0.08$), and the last is associated with TBF ($r = 0.72$; $p < 0.05$), no metabolic profile indices were associated with body fat composition, but they were associated with lean mass variables. The negative association between Glu and LM suggests that for recreational female futsal players, the LM might be a protective index against high blood glucose levels. Nevertheless, other studies may be done to determine whether modifications in LM result in improvements to the glucose concentration profile. The positive association between TC and LLMM was unexpected, since TC is usually associated with body fat indices. None of the female athletes presented levels of TC above the OMS recommendation; thus, the association between TC and LLLM was observed in subjects with accepted range of cholesterol concentration. Thus, it is likely that body fat would have association with TC in subjects with above threshold levels of lipid profile.

This study is limited by the small sample size and absence of comparison with a control group. Furthermore, since no training intervention was performed, it is difficult to state the beneficial of lean mass on metabolic profile for recreational futsal players.

In summary this study is the first to investigate the relation between body composition and metabolic profile for recreational female futsal players. No association was found between metabolic profile and body fat indices, which may be explained by the relatively low levels of TAG, TC, and LDL-c. Other studies should be conducted to determine the influence of body composition on changes to the metabolic profiles of recreational female futsal players.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

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