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Effects of training in physical fitness and body composition of the brazilian 5-a-side football team

L. F. Castelli Correia de Campos [a,b], A. de Athayde Costa e Silva [a], L. G. Teixeira Fabrício dos Santos [a], L. Trevisan Costa [a], P. C. Montagner [a], J. P. Borin [a], P. Ferreira de Araújo [a] and J. Irineu Gorla [a]

[a] *Physical Education Faculty. Departament of Studies on Adapted Physical Activity. Campinas State University/Unicamp. Campinas, SP, Brazil.*
[b] *Physical Education Faculty. Departament of Sport Science. Campinas State University/Unicamp. Campinas, SP, Brazil.*

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ABSTRACT

Objective. The present study aimed to analyze the effect of 16 weeks of training on the parameters of physical fitness and body composition in athletes of the Brazilian 5-a-side football team.
Method. The sample consisted of six athletes – four outfield players with functional classification B1 and two goalkeepers without visual impairment –, all male, mean age of 27.33 ± 5.5 years. The athletes underwent two evaluations: before and after 16 weeks of training. We measured the levels of cardiorespiratory fitness through the 20m Shuttle Run and the anaerobic parameters through the Rast Test, while the subjects' body composition was assessed by anthropometric technique.
Results. Statistically significant ($p \leq 0.05$) levels were found for VO_{2peak} before (44.7 ± 4.7 ml.(Kg.min)$^{-1}$) and after (50.3 ± 3.2ml.(Kg.min)$^{-1}$), for anaerobic parameters of Medium Power before (442.8 ± 47W) and after (491 ± 72.9W), Low Power before (328.9 ± 26.7W) and after (405.4 ± 79.6W) and for fatigue index before (39.8 ± 10.3%) and after (29.2 ± 12.7%).
Conclusion. The 16 weeks of training were enough to show significant improvements in the components of aerobic and anaerobic fitness of the Brazilian 5-a-side football team players; the same effect was not observed in the indicators of body composition.

Palabras clave:
Entrenamiento.
Rendimiento deportivo.
Consumo máximo de oxígeno.
Deporte paralímpico
Evaluación.

RESUMEN

Efectos del entrenamiento en la aptitud física y composición corporal de atletas de fútbol 5 de la selección brasileña

Objetivo. El presente estudio tiene por objetivo analizar el efecto de 16 semanas de entrenamiento en los parámetros de la condición física y la composición corporal en atletas del equipo de fútbol 5 de la selección brasileña.
Método. La muestra estuvo formada por seis atletas, cuatro jugadores de campo con la clasificación funcional B1 y dos porteros sin discapacidad visual, con una media de edad de 27,3 ± 5,5 años. Los atletas realizaron dos evaluaciones: antes y después de 16 semanas de entrenamiento. Se midieron los niveles de la capacidad cardiorrespiratoria a través de la realización del test de Shuttle Run 20m y las variables anaeróbicas a través del Rast Test, mientras que la medición de la composición corporal de los sujetos se realizó mediante la técnica antropométrica doblemente indirecta.
Resultados. Se observaron diferencias estadísticamente significativas ($p \leq 0,05$) entre los niveles de VO_{2pico} previos (44,7 ± 4,7ml.(kg.min)$^{-1}$) y posteriores al entrenamiento (50,3 ± 3,2ml.(Kg.min)$^{-1}$). Los mismos resultados fueron observados en los valores de potencia media (pre = 442,8 ± 47W, post = 491 ± 72,9W), en la potencia mínima (pre = 328,9 ± 26,7W, post = 405,4 ± 79,6W) y en el índice de fatiga (pre = 39,8 ± 10,3 %, post = 29,2 ± 12,7 %).
Conclusión. Las 16 semanas de entrenamiento fueron suficientes para demostrar mejoras significativas en la condición física de los jugadores del equipo de fútbol 5 de la selección brasileña, sin embargo, no se obtuvieron los mismos efectos en los indicadores de la composición corporal.

Correspondence:
L. F. Castelli Correia de Campos.
Faculdade de Educação Física/UNICAMP.
Av. Erico Verissimo, 701.
Cidade Universitária, CEP. 13083-851
Campinas, SP, Brasil.
E-mail: pfluisfelipe@gmail.com

INTRODUCTION

Visual impairment is a term that refers to the total or partial loss of eyesight related ocular pathologies, leading the individual to a limitation in their visual performance[1]. It is considered as blind the individual who has total lack of vision, or who is unable to recognize a light directed into the eye itself, preventing them from performing any work.

With regard to the prevalence of this particular condition, WHO estimated that, in 2002, the world had at least 40 million people under this condition and it is estimated that by 2020 that number will reach 76 million due to the lack of actions to prevent blindness[2,3]. Among the main features inherent to visual impairment there are: the difficulty of dynamic and static balance, poor posture, deficient motor coordination, impaired mobility and gait and inappropriate muscle tone, resulting in less ability to perform tasks[4].

In this context, sport can be used as a method to reduce and overcome these disadvantages. Five-a-side football is one of the Paralympic modalities for people with visual impairment. Its practice began in the mid-1920s in specialized schools and institutes for the blind in Spain[5]. In Brazil, there are reports of this practice since the 1950s, also in specialized schools and institutes[6,7].

This method is practiced by athletes with visual classification B1, following the official rules proposed by the International Blind Sport Association - IBSA. However, the rules are based on conventional Futsal with some adjustments to provide greater dynamism in the sport, for example: side barriers, balls bearings and goalkeepers without visual impairment (IBSA, 2012). Furthermore, it is believed that the game features are also similar to the conventional futsal, such as the intense physiological, metabolic and bone-muscle use, with manifestations of different volumes and strengths by position[8].

However, there are no known studies evaluating the effects of training on the physical fitness and body composition of 5-a-side football athletes. Thus, the aim of this study was to analyze the effect of 16 weeks of training on motor and anthropometric variables in athletes of the Brazilian 5-a-side football team.

METHODS

Sample

This study presents a longitudinal design and quasi-experimental nature, as the study design is related to the manipulation of at least one independent variable to observe its effect and relationship with other dependent variants on intact groups (groups formed before the intervention)[9,10].

The sample, selected for convenience, was composed of six male athletes of the Brazilian 5-a-side football team with mean age of 27.33 ± 5.5 years. From them, 4 were outfield players diagnosed with congenital glaucoma and categorized as B1, in accordance with the ophthalmologic classification of IBSA[5], and 2 goalkeepers were without visual impairment. Athletes have practiced the modality for over 5 years and integrate the major national teams in this sport. As exclusion criteria, any athlete who presented clinical evidence of cardiac or orthopedic changes would be excluded from the sample (table 1).

The study followed the guidelines and regulations governing research on humans (law 196/96). Thus, after being clarified the purpose of the research and the procedures to which athletes would be submitted, all of them signed an informed consent form approved by the research ethics committee of the School of Medical Sciences of UNICAMP, protocol 550/2011.

Training regime

The athletes underwent 16 weeks of training, a preparatory period (general and specific), consisting of 10 weekly sessions - five sessions in the morning and five sessions in the afternoon - with an average duration of approximately 60 minutes in the morning and 90 minutes in the afternoon, amounting an average working week of 12.5 hours, amounting a volume of 12,000 minutes in 160 sessions. And, during the training program, the athletes did not participate in any sports competition and the frequency of athletes regarding the training sessions was above 90%. All trainings had the standard procedure of performing first stretching and then overall muscle warming and ultimately the training session pre-established by the coaching staff.

Regarding the content of the training, due to the possibility of the preparation of athletes with a more extensive calendar than that commonly experienced in conventional collective modalities, we opted for the traditional Matveev's method[11]. According to the author, the preparatory period comprises the phases: general and specific. Thus, the training was planned in two stages: in the first one (the general phase), the athletes were subjected to predominantly aerobic and muscle strength exercises, providing the necessary adjustments to conduct specific training. And the second one (the specific phase) was prepared with increasing stimulus intensity and a significant decrease in the volume of training, closer to the reality experienced during official games, focusing on interval aerobic work and speed drills with active recovery.

Body composition

We collected the anthropometric variables of: body mass (BM), in digital scale, brand PLENA, model Acqua®, with reading of 100g; body height,

Table 1
Characterization of subjects

Subjects	Age (years)	Position	IT (years)	Cause	Height (m)	BM1 (Kg)	BM2 (Kg)
A	22	Goalkeeper	–	–	1.84	82	82.3
B	35	Goalkeeper	–	–	1.77	87.3	84.6
C	28	Winger	Congenital	Glaucoma	1.61	69	67.5
D	29	Defender	Congenital	Glaucoma	1.71	70.8	73.4
E	30	Pivot	Congenital	Glaucoma	1.75	82	83.4
F	20	Winger	Congenital	Glaucoma	1.64	69	65.8
Mean	27.33	–	–	–	1.72	76.68	76.17
SD	5.50	–	–	–	0.09	8.02	8.38

IT: injury time; BM: bBody mass before and after the test.

Table 2
Behavior of the anthropometric variables and body composition indicators before and after 16 weeks of training

	Before			After			Δ%
	Max.	Min.	Mean	Max.	Min.	Mean	
BMI (Kg/m²)	27.87	24.2	26 ± 1.32	27.2	24.3	25.69 ± 1.37	–1.19
%BF	25.74	12.36	16.84 ± 4.97	21.96	10.92	15.96 ± 4.54	–5.22
FM (Kg)	22.47	8.53	13.28 ± 5.25	18.58	7.37	12.46 ± 4.75	–6.17
FFM (Kg)	67.62	60.25	63.81 ± 3.23	69.7	60.13	64.87 ± 3.67	1.66
Endomorphy	6.5	3.7	4.7 ± 1.04	6.2	3.2	4.7 ± 1.17	–
Mesomorphy	6.5	3.8	5.1 ± 0.95	6.5	3.7	5.1 ± 0.93	–
Ectomorphy	2.4	0.5	1.15 ± 0.67	2.4	0.7	1.25 ± 0.60	8.7

BMI: body mass index; %BF: body fat percentage; FM: fat mass; FFM: free-fat mass; Min.: minimum; Max.: maximum; Δ%: percentage difference between the moments before and after. *statistical difference $p \leq 0.05$.

by wall mounted stadiometer (WCS) with reading scale of 0.1 cm; thickness of seven skinfolds (chest, middle axillary, triceps, subscapular, abdominal, suprailiac and thigh) with the use of skinfold Harpenden® (Harpenden Instruments, Marsden, UK); and breadths of the humerus and femur with the 15 cm caliper Cardiomed® with 0.1 cm precision.

From these data, we calculated the body density of athletes using the equation proposed by Jackson and Pollock[12] of 7 skinfolds and the estimated of body fat percentage (%BF) from the equation proposed by Siri[13]. The somatotype profile of the athletes was performed according to the method and procedures proposed by Hebbelinck et al.[14] and Carter[15]. We also calculated the values of fat mass (FM), by calculating FM = (%BF x BM)/100 and fat-free mass (FFM) by subtracting the BM by FM.

To minimize the standard error in the measurement of measures, all of them were performed by the same evaluator with extensive experience in the measurement procedure.

Physical fitness

The physical fitness variables were obtained through the Shuttle Run test validated for adult males[16]. For the test, the athlete was initially oriented on the procedure to be performed. The test was developed in field with synthetic grass and 40 x 20m in size (same training site of the team). The path was defined in 20m where the athlete should go through with the speed pre-set by beep, which showed increased velocity parallel to the increase in the number of stages completed[17,18]. The test was stopped when the athlete could not reach the line marked at the end of the path 2 consecutive times before the beep. The peak oxygen consumption (VO_{2peak}) was obtained by the equation y = -24.4 + 6. (stage)[17,18]. Anaerobic Power (AP) was assessed using the Rast Test, whose protocol and validity was prepared by Zacharogiannis, Paradisis, Tziortzis[19]. The Fatigue Index (Rast Test) was calculated by adding the total time of sprints performed with the value of maximum and minimum power (FI = (Pmax-Pmin)/total time of 6 sprints)[19].

In both tests, familiarization occurred during the training process, in which the protocols were performed where appropriate during the training sessions. As adjustment for people with visual impairments, we assigned two investigators distanced approximately five meters from the ends of the paths in order to guide the athlete through beep, allowing the athlete to straightforward perform the trajectory and to avoid any overexertion after completing the predetermined route.

Data analysis

Initially, we performed the descriptive statistics of mean, standard deviation, minimum, maximum and percentage difference between moments, anthropometric variables, body composition and physical fitness. Then, we verified the normality of the data by the Shapiro-Wilk test and the coefficient of skewness and kurtosis for greater reliability. To analyze the difference between the moments, we used the Wilcoxon test due to the small sample size.

The procedures were performed using the statistical package R-plus®2.11, with a significance level of $p \leq 0.05$.

RESULTS

The anthropometric values are shown in table 2. We observed that there was no significant difference ($p \leq 0.05$) between the absolute values of body mass compared before (77.08 ± 7.73 kg) and after (76.16 ± 8.38 kg) tests. The same behavior was observed in relation to the BMI values, which initially were 26 ± 1.32 Kg/m² and afterwards 25.69 ± 1.37Kg/m².

Regarding the components of body composition, there were no statistically significant differences for the mean values of body fat percentage before (16.84 ± 4.97%) and after (15.96 ± 4.54%) and fat-free mass before (63.81 ± 3.23Kg) and after (64.87 ± 3.67Kg).

The somatotype body ratings obtained at the beginning of the training were similar to those from the final evaluation. Even though the somatotype values present a tendency to maintain mesomorph, endomorph reduction and increased ectomorphy, the ratings remained unchanged when compared before and after the test, with two athletes classified as meso-endomorphs, four as endo-mesomorph and one as endomorph-mesomorph.

Regarding physical fitness (table 3), we observed statistically significant differences for all variables. We found that the main significant differences found after training were related to the mean values of VO_{2peak}, which at first was 44.7 ± 4.71ml.(kg.min)$^{-1}$ and then after 50.3 ± 3.28ml.(kg.min)$^{-1}$, and to the numbers of laps performed, which had, at first, the average of 50.17 ± 15.07 and then, after training, of 68.3 ± 11.3 laps.

We also observed positive effect of training on the anaerobic parameters of minimum, average and maximum power, showing an increase of 23.25%, 11.08% and 3.5%, respectively. Therefore, the fatigue index decreased by 26.6%, and we can note a statistical difference between the means for before and after training.

DISCUSSION

Physical training can cause significant changes in the parameters of body composition, especially in body fat and lean mass, thus being an

Table 3
Behavior of the physical fitness variables after 16 weeks of training

	Before			After			Δ%
	Max.	Min.	Mean	Max.	Min.	Mean	
# Laps	76	31	50.17 ± 15.07*	91	60	68.3 ± 11.3*	36.13
VO_{2peak} (ml.kg.min)	52.7	38.6	44.7 ± 4.71*	56.9	47.9	50.3 ± 3.28*	12.52
Pmin (W)	360.3	292.8	328.9 ± 26.7*	508.8	267.7	405.4 ± 79.66*	23.25
Pmean (W)	513.6	382.3	442.8 ± 47*	627.7	422.2	491 ± 72.9*	11.08
Pmax (W)	690.2	437.7	556.6 ± 86.7	746.8	495.9	576.6 ± 88.3	3.5
FI (%)	51.18	25.29	39.8 ± 10.3*	53.6	18.5	29.2 ± 12.79*	–26.6

Laps: number of laps; Min.: Minimum; Max.: maximum; Pmin: minimum power; Pmean: mean power; Pmax: maximum power; FI: fatigue index; Δ%: percentage difference between the moments before and after.
*statistical difference $p \leq 0.05$.

important factor in the regulation and maintenance of body mass. If, on one hand, the anabolic effects of physical training induce an increase in lean mass, on the other hand, the relative body fat tends to undergo reduction[20].

In this study, we analyzed the relationship between training and anthropometric variables. Despite a slight reduction in the percentage value of body fat and absolute fat and increased levels of fat-free mass, we did observe no statistically significant differences. This fact may be associated with the sample having an history of elite sport practice for a long period, suggesting that, if there was a control group of subjects who did not exercise, significant differences would be noticed.

Regarding physical fitness, 5-a-side football requires, from the athletes, high levels of aerobic and anaerobic conditioning due to quick changes of direction, sudden stops, technical efforts and rapid recovery, to be able to be in shape for the next intense stimulation. In this sense, studies show that exercise training provides morphological and biochemical changes that increase muscle mass, strength development and endurance[21,22].

When comparing the values before and after the tests, there was significant improvement in the test results used as indicators of aerobic capacity and anaerobic parameters. This may influence the level of play of the athletes of the Brazilian team, as the characteristics of 5-a-side football matches are very similar to futsal, which require intense movement of participants generating a high energy expenditure, as well as an extremely high metabolic and neuromuscular request, showing that only the extensive technical skill is not a sufficient requirement for success in this modality[20].

These results show positive effects of physical training on motor variables, as the higher the levels of aerobic components, the larger and better the performances of lactic and alactic anaerobic metabolism, because aerobic fitness allows physiological and metabolic adaptations for the rapid recovery of intense exercise[23]. And, although it is not a determining factor, aerobic fitness influences the performance and the competitive level of the futsal team, as the greater the team's cardiovascular capacity, the better the competitive performance[24, 25].

The values of anaerobic power and fatigue index, maintenance of optimal levels of power and quick recovery from intense actions are essential for the proper performance of the footballer, making it important to analyze the acute effects of a succession of exercises of high intensity (repeated sprints) on the ability to generate muscle power[26].

This study is characterized as a first evidence in the literature regarding the influence of training in 5-a-side football athletes. The results indicate that the program of 16 weeks of training resulted in positive effects for the variables related to the aerobic component (VO_{2peak}) and the anaerobic component (fatigue index). Therefore, we conclude that the training of 5-a-side football showed a trend for the parameters that are related to rapid recovery and performance of intense stimuli, due to the organic adaptations generated by the training process. However, we suggest future studies with larger samples to establish the real influence of the training of 5-a-side football in individuals with visual impairments.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

References

1. Munster M, Almeida J. Actividade física adaptada: qualidade de vida para pessoas especiais actividade física e deficiencia visual. En: Costa R, Gorgatti M, editors. Atividade Física Adaptada. Barueri: Editora Manole; 2005. p. 33-51.
2. OMS (Organização Mundial da Saúde). O atendimento de criança com baixa visão. Relatório de Bangkok, 2002.
3. Craft D, Lierberman L. Deficiência visual e surdez. En: Winnick J, editor. Educação Física e Esportes Adaptados [Tradução da 3ªed. Original]. Barueri: Editora Manole; 2004. p.181-5.
4. Conde AJM, Sobrinho PA, Senatore V. Introdução ao movimento paraolímpico: manual de orientação para professores de educação física. Brasília: Comitê Paraolímpico Brasileiro; 2006, p.74.
5. International Blind Sports Federation (IBSA). Futebol Sala; 2012 [citada 20 de mayo 2012]. Disponíble en:<http://www.ibsa.es/esp/deportes/football/presentacion.htm>.
6. Fontes MS. Futebol de cinco para cegos**.** En: Castelli, Dolvair P, Fontes MS, editors. Futebol paraolímpico: manual de orientação para professores de educação física. Brasília: Comitê Paraolímpico Brasileiro; 2006.
7. Morato MC, Gomes MSP, Scaglia AJ, Almeida JJG. A mediação cultural no futebol para cegos. Movimento; 2011;4:45-63.
8. Oliveira PR. Periodização: contemporânea do treinamento desportivo. São Paulo(SP): Phorte; 2008.
9. Thomas JR, Nelson JK, Silverman SJ. Métodos de pesquisa em atividade física. Porto Alegre(RS): Artmed; 2007.
10. Sampieri RH, Collado CF, Lucio PB. Metodologia de Pesquisa. São Paulo(SP): Mc Graw – Hill; 2006.
11. Matveev LP. Metodologia e Treinamento: Treino desportivo. Guarulhos (SP): Phorte Editora; 1997.
12. Jackson AS, Pollock ML. Factor analysis and multivariate scaling of anthropometric variables for the assessment of body composition. Med Sci Sports Exerc. 1976;8:196-203.
13. Siri WE. Body composition from Fluid Space and density. En: Brozek J, Hanschel A, editors. Techniques for measuring body composition. Washington, DC: National Academy of Science; 1961. p. 223-4.
14. Hebbelinck M, Carter L, De Garay A. Body build and somatotype of olympic swimmers, divers, and water polo players. En: Lewillie L, Clarys JP, editors. Swimming II. Baltimore: University Park Press; 1975. p. 285-305.
15. Carter L. Somatotipo. En: Norton K, Olds T, editors. Antropométrica. Porto Alegre: Artmed; 2005.p.151-72.
16. Léger LA, Lambert J. A maximal multistage 20-m shuttle run test to predict V02 max. Eur J App Phy. 1982:1-12.

17. Duarte MFS, Duarte CR. Validade do teste aeróbico de corrida de vai-e-vem de 20 metros. Rev Bras Ciên Mov. 2001;3:7-14.
18. Léger LA, Mercier D, Gadoury C, Lambert J. The multistage 20-meter shuttle run test for aerobic fitness. J Spot Sci. 1988;93-101.
19. Zacharogiannis E, Paradisis G, Tziortzis S. An evaluation of tests of anaerobic power and capacity. Med and Sci Spot Exe. 2004;4 (Supl 1):114-6.
20. Cyrino ES, Altimari LR, Okano AH, Coelho CF. Efeitos do treinamento de futsal sobre a composição corporal e o aptidão física de jovens atletas. Rev Bras Ciên e Mov. 2002;1:41-6.
21. Molinuevo JS, Ortega AM. Perfil morfofuncional de un equipo de fútbol-sala. I Congresso internacional sobre ciencia y técnica del fútbol; 1989; Madrid, Espanha. p.217-24.
22. Santos AF, Giarolla RA, Figueira AJ. Perfil de aptidão física de jogadores de futebol de salão. II Bienal de ciências do esporte. São Paulo: 3 e 4 de agosto de 1991.
23. Maud PJ, Foster C. Avaliação fisiológica do condicionamento físico humano. São Paulo(SP): Phorte; 2009.
24. Ekblom B. Applied physiology of soccer. Sport Med. 1986:3:50-60.
25. Santos JAR. Estudio comparativo fisiológico, antropométrico y motor entre futbolistas de diferente nivel competitivo. Rev Paul Edu Fís. 1999*:* 146-59.
26. Dal Pupo J, Almeida CZP, Detanico D, Silva JF, Guglielmo LGA, Santos SG. Potência muscular e capacidade de sprints repetidos em jogadores de futebol. Rev Bras Cineantropom Desem Hum. 2010;12:255-61.