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DIFFERENT EXPLOSIVE STRENGTH AND PHYSIOLOGICAL DEMANDS BETWEEN MALE AND FEMALE BASKETBALL TEAMS

Gaetano Altavilla[1ABC], Tiziana D'Isanto[2BDE], Gaetano Raiola[2ABD] and Francesca D'Elia[2ABC]

[1]University of Salento
[2]University of Salerno

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Gaetano Raiola, E-mail: gaetano.raiola2012@gmail.com
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Abstract

Background. The several types of running in the team sports such as basketball, soccer and rugby, vary according to physical characteristics and sports. In particular, in the basketball the running is characterized by continuous acceleration and deceleration phases, which entails greater energy expenditure. This study aimed to assess the strength decrease of the lower limbs and energy expenditure at different running conditions (n=4) with/without the ball during Linear running and Shuttle run (180°) in two groups (male: n=15; female: n=15).

Materials and methods. Experimental approach required the following tests/devices: Squat Jump to assess the strength of the lower limbs before/after each test, and a portable Metabolimeter was used to assess the metabolic parameters. The T-test was used for independent samples and Two-way repeated measures ANOVA was used to assess the significant differences for each variable between each running conditions.

Results. Initial hypothesis has been confirmed, showing a significantly different strength decrease in different running conditions (Linear Running and Shuttle run with and without ball) and between the two teams considered (male and female). In addition, different energy expenditure between the two groups increases even more during the running with the ball compared to running without the ball.

Conclusions. The results of this study could be useful for coaches to optimize training with different training load related to gender and to the running conditions (with and without the ball), but also to optimize the work load of young players in relation to the abilities, skills and experiences of players.

Keywords: physical fatigue, strength decrease, training load, performance.

Introduction

The match analysis showed that basketball players perform sprint at different velocities (Ben Abdelkrim et al., 2007), over distances between 10 and 20m, within a limited timeframe of up to 20 sec. (Narazaki et al., 2009), changing direction with and without ball; indeed, basketball is characterized by multiple high-intensity actions and it represents a multi-task sport (Sanchez-Sanchez et al., 2019). All these displacements on field determine considerable and different energy expenditure (Ben Abdelkrim et al., 2010). In addition, in basketball has been considered fundamental (Altavilla et al., 2022) since physiological demands under stress can negatively alter players' performance. Therefore, is important to understand fatigue adaptations, because the players must be able to effectively perform specific tasks under physical fatigue during training and match (Kamandulis et al., 2013). The several types running in the team sports such as basketball, soccer and rugby, vary according to physical characteristics and sports (Esposito et al., 2019). Continuous acceleration and deceleration phases characterized the running in the basketball, which entail a greater energy expenditure. In team sports is essential to optimize the training program through the study and workload analysis. These activity, generally, limited to the overall load and they not assess the different running conditions related at gender and to the positions by players. Researches are not many that concern the physiological load, due to accelerations and decelerations during changes of direction every 15 m. Specifically, we will verify both the decrease in strength of the lower limbs that the energy expenditure in two different running conditions (Linear run and Shuttle run), with and without changes of direction, with and without the ball between two teams of young basketball players (male and female). The analysis of decrement of the strength and the energy expenditure in different running conditions can be useful to differentiate the training load. It can contribute to the improvement the learning process on a specific motor task and to comprise how the energy expenditure change to the quality of the task performed. The purpose of this study is to assess the level of decrement of the strength and the energy expenditure in different running conditions: Linear running and Shuttle running between two youth basketball teams (male and female). The hypothesis formulated is as follows: the strength of the lower limbs may decrease more in the running with ball and between two groups (male and female); while the energy expenditure should be different in four running conditions with ball compared to running without ball.

Materials and methods

Study participants

The subjects who participated were thirty young basketball players aged 20±1. They represented two teams (male n=15 and female n=15). All players had at least five years of training experience and they participated voluntarily. The variables detected were the following: Jump performance (cm) and mechanical work (j·(kg·m)$^{-1}$). Data collection required the use of the following devices and tests: Lower limb muscle strength assessed with Optojump (Bosco et al., 1983), Yo-Yo endurance test (Bangsbo et al., 2006); Linear running and Shuttle running (Vaquera et al., 2016) assessed with Metabolimeter K4b2. In table 1 showed the anthropometric characteristics of the two groups considered (male and female). The mean age of the male group was 19.8 ± 0.6 years, the body height was 191.4 ± 4.2 cm, the body weight was 82.3 ± 2.9 kg, the body mass index was 22.4 ± 2.7 kg/m² (indicated as normal value). The mean age of the female group was 19.5 ± 0.5 years, their body height was 180.1 ± 3.8 cm, the body weight was 75.2 ± 3.1 kg, the body mass index was 23.2 ± 2.9 kg/m².

Table 1. Anthropometric and physiological characteristics of the two teams

Variables	Male team (n=15)	Female team (n=15)
Age (years)	19.8 ± 0.6	19.5 ± 0.5
Height (cm)	191.4 ± 4.2	180.1 ± 3.8
Weight (kg)	82.3 ± 2.9	75.2 ± 3.1
BMI (kg/m²)	22.4 ± 2.7	23.2 ± 2.9
VO_2max (ml·kg^{-1}·min^{-1})	50.4 ± 2.6	42.6 ± 2.4
Heart rate max (b/min)	181.3 ± 2.4	183.5 ± 2.6

Procedures

At the two teams were provided explanations on the protocol to follow. The study envisaged five testing sessions on seven-day period and with two-day rest in-between. In the first session, the participants did an indirect continuous multistage field test to determine VO_2max (Léger & Boucher,1980) to set the relative intensities of the next experimental sessions. The two teams have performed two sessions of running without ball: in-line continuous running, Shuttle running on 15 meter with directional changes at 180°. The same sessions, were repeated with ball. All players were required to run at an intensity at 80% of VO_2max, this intensity was controlled with a frequency meter; while, beep sounds and track markers were used as spatiotemporal indicators. The tests were carried on a flat 100m course on a synthetic rubber base. All players performed at least 10 minutes of a warm-up before carrying out each test. After one week all tests were repeated to verify the reliability of measurements. The Yo-Yo endurance test has been performed by each participant, as an incremental test (di Prampero et al., 2009) to detect the VO_2max. After wards, the Squat Jump (SJ) has been performed, for each running condition, to assess the muscle strength decrement. Optojump evaluated lower limbs muscle strength before and after each running conditions, with and without ball, from the two teams (male and female). Finally, All participants were tested (on 1000m at 80% of VO_2max) and they were randomly selected. Each group performed randomly and evaluated in the different running conditions with and without the ball (n=4).

Statistical analysis

All data are presented as mean and standard deviation (Mean ± SD). The normality of the data distribution was verified by means of the Shapiro-Wilk test, while the homogeneity of the variances was verified with the Levene test. Intra-class correlation coefficient (Hopkins, 2000) was calculated to assess the reliability of the measures for each running condition. Regarding the energy expenditure, the t-test for independent sample was used to assess the significance of the differences in the different running conditions (with and without the ball). Instead, for lower limbs strength was used the two-way 2×2 between-within ANOVA to assess the main effect of the between-subjects factor Group (male and female), within-subjects factor Treatment (Pre and Post) together with the factorial interaction Group×Treatment. While for the measure of the effect size was used partial eta squared (η^2). The significance level was fixed at $P < 0.05$. All statistical tests were conducted through IBM SPSS Statistics version 23.

Results

The results of the study confirmed the initial hypothesis. The T-test was used for independent samples to verify any significant differences on the energy expenditure for each running condition between the two groups (with the ball and without the ball). Table 2 shows significant differences both two teams analyzed (male and female) depending for each running conditions: LR without the ball with p=0.01; SR without the ball with p=0.01; LR with the ball with p=0.00 and SR with the ball with p=0.00. The homogeneity of the variance was confirmed through the use of Levene's test. The values of Intraclass Correlation Coefficient was verified for the reliability of the measures of the energy expenditure were excellent, showing a range from 0.90 to 0.97. Regarding the men's team these are the outcomes: LR without the ball 0.97; SR without the ball 0.94; LR with the ball 0.95 and SR with the ball 0.92. While the women's team these are the outcomes: LR without the ball 0.96; SR without the ball 0.93; LR with the ball 0.94 and SR with the ball 0.90.

Table 2. T-test for independent samples: Energy expenditure for each running condition (n=4)

Variables	Mean male C_[j·(kg·m)$^{-1}$]	Mean female C_[j·(kg·m)$^{-1}$]	t-value	df	p	Levene's test F(1,df)	p Levene's test
LR without the ball	5.12 ± 0.20	5.28 ± 0.26	-2.81	28	0.01	0.633	0.452
SR without the ball	5.30 ± 0.34	5.50 ± 0.33	-2.77	28	0.01	0.466	0.524
LR with the ball	6.02 ± 0.27	6.40 ± 0.28	-2.43	28	0.00	0.008	0.932
SR with the ball	6.50 ± 0.45	6.96 ± 0.42	-2.90	28	0.00	0.564	0.454

LR – Linear Running; SR – Shuttle Run; p – p value.

Table 3. Two way (between-within) 2×2 ANOVA in four running conditions

Effects	LR without the ball		SR without the ball		LR with the ball		SR with the ball	
	P	Partial eta-squared (η^2)	P	Partial eta-squared (η^2)	P	Partial eta-squared (η^2)	P	Partial eta-squared (η^2)
Groups	0.01	0.16	0.00	0.30	0.00	0.18	0.00	0.36
R1	0.00	0.70	0.00	0.50	0.00	0.82	0.00	0.75
R1* Groups	0.20	0.04	0.14	0.08	0.36	0.03	0.18	0.08

LR - Linear Running; SR – Shuttle Run; p – p value; η^2 – effect size; R1 – Treatment.

The results shown in table 3 demonstrate the effects and interactions between two factors (Treatment-Groups) and the dependent variable (lower limb strength). Significant evidence was detected between the groups (p=0.01; p=0.00; p=0.00; p=0.00) and in treatments "R1" (p=0.00; p=0.00; p=0.00; p=0.00); while the interaction between the groups and treatments (R1*Groups) are not significant (p=0.20; p=0.14; p=0.36; p=0.18). Finally, the size of the partial effect for regarding the groups is small, while in the case of the treatments "R1" they result to be medium-sized.

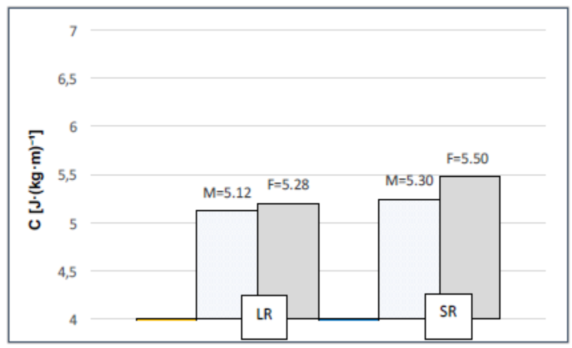

Fig. 1. Energy expenditure of running without ball between two teams (M = Male; F = Female; LR = Linear running; SR = Shuttle run)

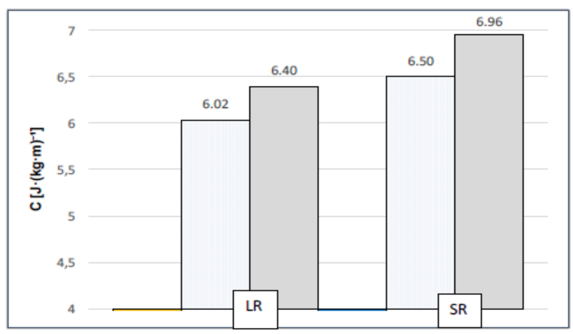

Fig. 2. Energy expenditure of running with ball between two teams (M = Male; F = Female; LR = Linear running; SR = Shuttle run)

Discussion

The strength's decrease and the energy expenditure between the two groups (male and female) in the Shuttle run result more expensive compared to linear running (Bekraoui et al., 2020). In the shuttle run with the ball a significant difference was detected between the two groups, as it required more muscular work due to the deceleration and acceleration action on each change of direction and at more motor control of the ball (table 2, p = 0.00). Male group, in all different running conditions (n=4) showed lower energy expenditure values than female group. In this study, the results obtained offers new information that allows an estimate of the energy expenditure due to acceleration and deceleration. The effects and interactions between the factors "Treatment and Groups" and the dependent variable (lower limbs strength) are shown in table 3. shows the effects and interactions between two factors (Treatment-Groups) and the dependent variable (lower limbs strength). There were significant differences between the two groups (Groups: 0.01; 0.00; 0.00 and 0.00) and in the treatments (R1: 0.00; 0.00; 0.00 and 0.00). For every running conditions (n=4) the result showed a significant difference in the decrease of strength in the comparison between the male and female groups, and so too in the before and after tests in each group. Finally, the interactions between the groups and the treatment did not provide significant outcome in the four running conditions (p: 0.20; 0.14; 0.36; 0.18). In this study, the multiple decelerations and accelerations require greater physiological demands at the players compared to linear running (Buglione & di Prampero, 2013). In addition, the different and significant energy expenditure between the two groups (male and female) increases even more in the running with the ball than that without the ball (Figures 1 and 2). This could be justified by an additional demand necessary both for the motor control of the ball and both due to possession of some quantitative and qualitative skills, result of specific training and also for gender characteristics.

Therefore, the evaluation training and continuous monitoring of the physiological aspects become an important aspect for the control of the performance.

Conclusions

In light of these results, it could be useful to design training loads adapted to the effective energy and physiological needs of the game situations and in relation to the different of position in field, of gender, conditional and coordinating capacities requests. Therefore, it is necessary to differentiate and to customize the training load. For example, intervening on the variables such as exercise duration, distance, intensity and recovery time.

Conflict of Interest

The authors declare that they have no conflict of interest.

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РІЗНА ВИБУХОВА СИЛА ТА РІЗНІ ФІЗІОЛОГІЧНІ ВИМОГИ МІЖ ЧОЛОВІЧИМИ ТА ЖІНОЧИМИ БАСКЕТБОЛЬНИМИ КОМАНДАМИ

Ґаетано Алтавілла[1ABC], Тіціана Д'Ізанто[2BDE], Ґаетано Раіола[2ABD], Франческа Д'Елія[2ABC]

[1]Університет Саленто
[2]Університет Салерно

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 5 с., 3 табл., 2 рис., 15 джерел.

Історія питання. Кілька типів бігу в командних видах спорту, таких як баскетбол, футбол і регбі, відрізняються залежно від фізичних характеристик і видів спорту. Зокрема, у баскетболі біг характеризується безперервними фазами прискорення та уповільнення, що тягне за собою більші витрати енергії. Метою цього дослідження було оцінити зниження сили нижніх кінцівок і витрати енергії за різних умов бігу (n=4) з м'ячем та без м'яча під час прямолінійного бігу та човникового бігу (180°) у двох групах (чоловіки: n=15; жінки: n=15).

Матеріали та методи. Експериментальний підхід вимагав наступних тестів/пристроїв: для оцінки сили нижніх кінцівок до/після кожного тесту використовували стрибки зігнувши ноги, а для оцінки метаболічних параметрів використовували портативний метаболіметр. Для незалежних вибірок використовували t-критерій Стьюдента, а для оцінки статистично значущих відмінностей для кожної змінної між кожними умовами виконання використовували двофакторний дисперсійний аналіз повторних вимірювань.

Результати. Початкова гіпотеза була підтверджена, показуючи статистично значущо різне зниження сили в різних умовах бігу (прямолінійний біг і човниковий біг із м'ячем і без нього) і між двома розглянутими командами (чоловічою та жіночою). Крім того, різниця витрати енергії між двома групами ще більше збільшується під час бігу з м'ячем порівняно з бігом без м'яча.

Висновки. Результати цього дослідження можуть бути корисними для тренерів для оптимізації тренувань із різним тренувальним навантаженням залежно від статі та умов бігу (з м'ячем і без нього), а також для оптимізації робочого навантаження молодих гравців залежно від здібностей, навичок і досвіду гравців.

Ключові слова: фізична втома, зниження сили, тренувальне навантаження, результативність.

Information about the authors:

Altavilla, Gaetano: gaetano.altavilla@unisalento.it; https://orcid.org/0000-0001-8436-7819; Department of Biological and Environmental Science and Technologies, University of Salento, Piazza Tancredi, 7, 73100 Lecce LE, Italy.

D'Isanto, Tiziana: tizidisanto@libero.it; https://orcid.org/0000-0001-7151-7486; Department of Human, Philosophical and Education Sciences, University of Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano SA, Italy.

Raiola, Gaetano: graiola@unisa.it; https://orcid.org/0000-0002-7659-1674; Department of Political and Social studies, University of Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano SA, Italy.

D'Elia, Francesca: fdelia@unisa.it; https://orcid.org/0000-0003-1441-8101; Department of Human, Philosophical and Education Sciences, University of Salerno, Via Giovanni Paolo II, 132, 84084 Fisciano SA, Italy.

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