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TRAINING EFFECTS ON BODY COMPOSITION AND STRENGTH OF JUNIOR HANDBALL PLAYERS

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ABSTRACT. Introduction: Coaches and fitness trainers strive through various testing methods to identify appropriate short-term training techniques to achieve the greatest improvements in athletic performance in the shortest possible time. Therefore, studies are needed to evaluate the effects of handball-specific training on selected physical fitness (speed, agility, explosive power, and explosive arm strength) and physiological variables (body fat, body mass, capacity, maximal heart rate, anaerobic endurance) of handball players. The main aim of this study was to develop a complementary strength training program for the development of physical training of professional handball players at junior level, as well as the selection of a test methods to assess fitness. **Materials and methods**: The research was conducted over a period of 12 months, and during this time a complementary strength training program was applied on an experimental group. The experimental group was represented by 16 junior I athletes from the SCM Politehnica Timișoara handball club, and the control group consisted of 16 junior I athletes from the CSM Resita handball club. The tests aimed the evaluation of the following parameters: body composition and strength before and after training for both groups. **Results and discussions**: The results obtained show a slight progress of the experimental group in front of the control group in terms of body composition, but an important progress in terms of strength. Conclusions: The study validated that through the modern means of training applied, substantial contributions are made to the increase of sports performance.

Key words*: junior handball players, body composition, training, strength*

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REZUMAT. ***Efectele antrenamentului asupra compoziției corporale şi puterii la jucătorii juniori de handbal.*** **Introducere***:* Antrenorii şi preparatorii fizici se străduiesc prin diverse procese de încercare, să identifice tehnici de antrenament adecvate de scurtă durată pentru a obține cele mai mari îmbunătățiri ale performanţei sportive într-un timp cât mai scurt. Prin urmare, este nevoie de studii care să evalueze efectele antrenamentului specific handbalului asupra aptitudinilor fizice selectate (viteză, agilitate, putere explozivă, forţa explozivă a braţului) şi variabilelor fiziologice (ţesutul adipos, masa corporală, capacitatea, ritmul cardiac maxim, anduranţa anaerobă) a jucătorilor de handbal masculin. Principalul scop al acestui studiu a fost de a elabora un program de antrenament de forţă complementar pentru dezvoltarea pregătirii fizice a handbaliştilor profesionişti la nivel de juniori, precum şi selectarea unei baterii de teste pentru evaluarea pregătirii fizice. **Materiale şi metode***:* Cercetarea s-a desfăşurat pe o perioadă de 12 luni de zile, perioadă în care au fost aplicate mijloacele de antrenament pentru grupa experimentală. Grupa experimentală a fost reprezentată din 16 sportivi juniori I din cadrul clubului de handbal SCM Politehnica Timişoara, iar grupa de control a fost formată din 16 sportivi juniori I din cadrul clubului de handbal CSM Reşiţa. Prin intermediul testelor s-a urmărit evaluarea următorilor parametrii: compoziţia corporală şi forţa înainte şi după antrenament pentru ambele grupuri. **Rezultate şi discuţii:** Rezultatele obţinute au arătat un uşor progres al grupului experimental comparativ cu grupul de control în ceea ce priveşte compoziţia corporală, dar un progres important în ceea ce priveşte forţa. Studiul a validat că prin mijloacele şi moderne de antrenament aplicate, se aduc contribuţii substanţiale la creşterea performanţelor sportive.

Cuvinte cheie*: jucători de handbal juniori, compoziţie corporală, antrenament, forţă*

Introduction

In handball, the ability to perform is acquired in a relatively long period of time, through an effort that is often not easy, the road to performance being often difficult. The "human material" plays an important role in the performance, but without a training aimed at optimizing the process of physical training of handball players, which ultimately ensures the efficiency of the activity is more difficult to achieve (Balasubramanian, 2014; Marques, van den Tillaar, Vescovi & González-Badillo, 2007; El-Din, Zapartidis & Hassan, 2011). That is why the use of scientific methods to eliminate the hazard in the handball players training, the application of the latest news in the field, are landmarks from which any coach must start in order to streamline the training process

(Póvoas, Seabra, Ascensão, Magalhães, Soares, & Rebelo, 2012; Nikolaidis, & Ingebrigtsen, 2013; Wagner, Finkenzeller, Würth, von Duvillard, 2014; Hermassi, Chelly, Fieseler, Bartels, Schulze, Delank, Shephard, & Schwesig, 2017).

Coaches and fitness trainers strive through various testing methods to identify appropriate short-term training techniques to achieve the greatest improvements in athletic performance in the shortest possible time. Therefore, studies are needed to evaluate the effects of handball-specific training on selected physical fitness (speed, agility, explosive power, and explosive arm strength) and physiological variables (body fat, body mass, capacity, maximal heart rate, anaerobic endurance) of handball players (Cardoso Marques, & González-Badillo, 2006; Gertjan, Gløsen, & van den Tillaar, 2008).

Conducting specific tests in handball and developing a training strategy customized to the positions and individualized to the players is a necessity given that the FRH does not have a database, test methods and training methodology by age, gender, level of training in order to streamline the technical-tactical actions at the modern game level. Testing must precede, accompany and complete the training process so that the coach knows where the players are physically related to international standards, but also to the initial values of testing.

The main aim of this study was to develop a complementary strength training program for the development of physical training of professional handball players at junior level, as well as the selection of a test methods to assess fitness.

Materials and methods

The research was conducted over a period of 12 months, and during this time a complementary strength training program was applied on an experimental group. During these months we tried to observe if the training influence the specific parameters of physical training of the experimental group. The final test was performed under the same conditions and using the same tests as the initial test. Subjects who participated in the personal research were divided into two groups (experimental and control groups).

The experimental group was represented by 16 junior I athletes aged between 16-18 years, from the handball club SCM Politehnica Timişoara. In addition to the training program, which included specific traditional means of handball training, it was applied an additional training program to increase strength and endurance. The number of workouts planned during a week was 6 / week with a day off.

The complementary training is detailed in table 1.

Table 1. Training program

Day	Movement
Day 1	Dumbbell chest press 3x10 reps
	Dumbbell biceps 3x10 reps
	Triceps 3x10 reps
	Inclined dumbbell press 3x10 reps
	EZ bar curl 3x10 reps
	Bodyweight pushups 3x10 reps
	90° leg raises 20 rep x 4 series
Day 2	Front squat 3x12 reps
	Heel raises 3x12 reps
	Leg extension 3x12 reps
	Leg press 3x8 reps
Day 3	Neck strain exercises 3x12 reps
	Seated pushups 3x12 reps
	Wide grip tractions 3x12 reps
	Seated dumbbell shoulders 3x12 reps
	Dumbbell push press 3x12 reps
	Knee to chest raise 10x4 series
Day 4	Incline chest press 3x10 reps
	Tractions 3x10 reps
	Sitting triceps 3x10 reps
	Triceps rope pulldown 3x10 reps
	Proprioceptive pushups 3x20 reps
Day 5	High bar squats 3x12 reps
	Forward lunge 3x12 reps
	Adductions and abductions of the lower limbs 3x12 reps
	Jumping at different heights 3x10 reps
	Candle raises 10x4 series
Day 6	Seated dumbbell shoulders 3x10 reps
	Shoulder plate rotation 3x10 reps
	Cable face pull 3x10 reps
	Pushups 3x10 reps
Day 7	Rest

The control group consisted of 16 junior I athletes aged between 16-18 years, from the CSM Resita handball club. The tests aimed the evaluation of the following parameters: body composition and strength. Body composition tests measured the weight, body fat index (body fat BF) and body mass index (BMI). The strength tests assessed 1RM for squats, deadlifts and bench press. The effect of the training was achieved with the Wilcoxon statistical test which determines the magnitude of the differences between the results obtained by a group of subjects before and after an action (test, retest).

Results and discussions

Assessment of body composition parameters following initial and final testing of the both groups are listed in Table 2.

Table 2. Comparison of pre-test and post-test changes of body composition of groups

Variables	Group	Pre-test	Post-test	Progress
Weight (kg)	EG	83.25±10.74	82.37±9.68	-0.88
	CG	80.87±7.21	80.75±6.67	0.12
Body Fat (%)	EG	18.82±2.14	18.43±1.97	-0.39
	CG	19.21±1.85	19.26±1.8	-0.05
Body mass index (kg/m^2)	EG	24.91±3.17	25.65±3.11	0.74
	CG	25.3± 2.49	25.47±2.48	0.17

Statistical processing of body composition results highlighted the following:

- Weight- In EG the lowest value at the initial test is 65 kg, and the highest value is 97 kg, the amplitude being 32 kg. The final test shows a slight weight loss of up to 3 kg. The initial mean is 83.25 kg, and the final mean is 82.37 kg. The standard deviation represents the average deviation value from the mean and this is 10.74 kg at the initial test, respectively 9.68 kg at the final one. The difference between the values obtained before and after training is not statistically significant as z = -0.492, p = 0.623> 0.05. The size effect r = 0.12 <0.5 shows a small difference between the two tests.

In CG the lowest value at the initial test is 68 kg, and the highest value is 92 kg, the amplitude being of 24 kg. The final test shows a slight weight loss of up to 1 kg. The initial mean is 80.87 kg, and the final mean is 80.75 kg. The standard deviation is 7.21 kg at the initial test, respectively 6.67 kg at the final test. The difference between the values obtained in both tests is not statistically significant as z = -0.057, p = 0.95> 0.05. The size effect r = 0.01 <0.1 shows a very small difference between the two tests.

- BF - In EG the lowest value at the initial test is 15.2 %, and the highest value is 21.6 %, the amplitude being of 6.4 %. The final test shows a slight decrease up to 0.3 %. The initial mean is 18.82%, and the final mean is 18.43 %. The standard deviation is 6.4 % at the initial test, respectively 6.3 % at the final test. The difference between the values obtained before and after training is not statistically significant as z = -0.697, p = 0.486> 0.05. The size effect r = 0.17 <0.5 shows a small difference between the two tests.

In CG the lowest value at the initial test is 16.9 %, and the highest value is 22.3%, the amplitude being of 5.4 %. The final test shows a slight increase up to 0.1 %. The initial mean is 19.21%, and the final mean is 19.26 %. The

standard deviation is 1.85 % at the initial test, respectively 1.8 % at the final test. The difference between the values obtained in tests is not statistically significant as z = -0.170, p = 0.86> 0.05. The size effect r = 0.04 <0.1 shows a very small difference between the two tests.

- BMI - In EG the lowest value at the initial test is 20.2 kg/m^2 and the highest value is 29.7 kg/m^2, the amplitude being of 9.5 kg/m^2. The final test shows a slight increase up to 0.74 kg/m^2. The initial mean is 24.91 kg/m^2, and the final mean is 25.65 kg/m^2. The standard deviation is 3.17 kg/m^2, at the initial test, respectively 3.11 kg/m^2 at the final test. The difference between the values obtained before and after training is not statistically significant as z = -0.641, p = 0.522> 0.05. The size effect r = 0.16 <0.5 shows a small difference between the two tests.

In CG the lowest value at the initial test is 20.8 kg/m^2, and the highest value is 28.9 kg/m^2, the amplitude being of 8.1 kg/m^2. The final test shows a slight increase up to 0.17 kg/m^2. The initial mean is 25.3 kg/m^2 and the final mean is 25.47 kg/m^2. The standard deviation is 2.49 kg/m^2, at the initial test, respectively 2.48 kg/m^2 at the final test. The difference between the values obtained in tests is not statistically significant as z = -0.339, p = 0.73> 0.05. The size effect r = 0.08 <0.1 shows a very small difference between the two tests.

The training progress between groups for body composition is presented in Figure 1.

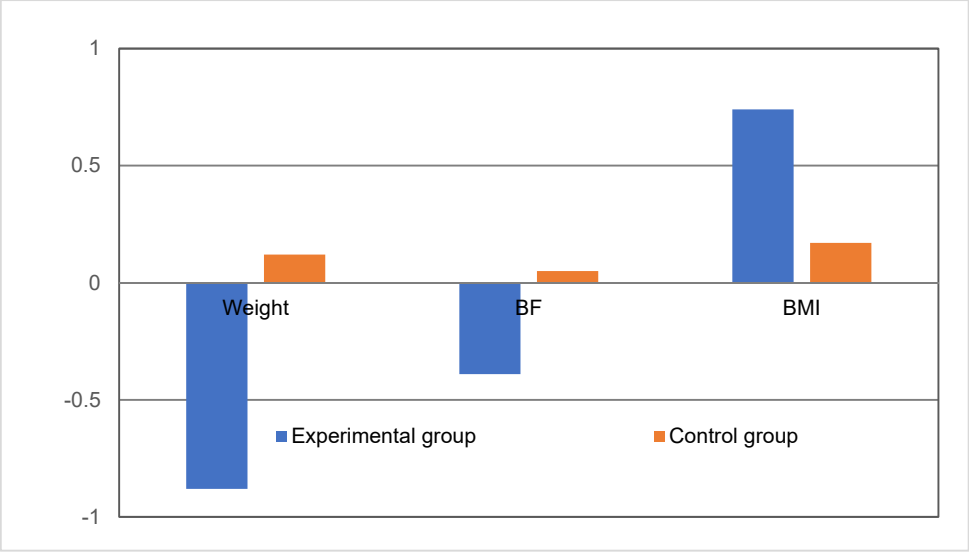

Fig. 1. Progress differences of body composition between the two groups

In the case of weight, the mean value for the experiment group is 0.88 lower and for the control group with 0.12. The difference in progress between the two groups is 0.76 kg in favor of the experimental group.

In the case of BF, the mean value for the experiment group is 0.39% lower, while for the control group it is 0.05% higher. The difference in progress between the two groups is 0.44% in favor of the experimental group.

In the case of the body mass index, the average value for the experiment group is higher by 0.74 and for the control group by 0.17. The difference in progress between the two groups is 0.57 kg in favor of the experimental group.

The results of strength tests for both groups are listed in table 3.

Table 3. Comparison of pre-test and post-test changes of strength of groups

Variables	Group	Pre-test	Post-test	Progress
Squats (1RM)	EG	85.93±7.57	94.37±7.93	8.44
	CG	88.12±7.14	87.5±6.58	-0.62
Deadlifts (1RM)	EG	75.62±5.12	82.81±6.57	7.19
	CG	75.31±7.04	76.25±6.58	0.94
Bench press (1RM)	EG	76.56±5.97	85.62±5.43	9.06
	CG	75.31±6.7	76.56±5.39	1.25

Statistical processing of strength results highlighted the following:

- Squats - In EG the lowest value at the initial test is 75 kg 1 RM, and the highest value is 100 kg 1RM, the amplitude being of 25 kg. The final test shows an increase up to 5 kg. The initial mean is 85.93 kg, and the final mean is 94.37 kg. The standard deviation is 7.57 kg at the initial test, respectively 7.93 kg at the final test. The difference between the values obtained before and after training is statistically significant as $z = -2.584$, $p = 0.01<0.05$. The size effect $r = 0.64>0.5$ shows big difference between the two tests.

In CG the lowest value at the initial test is 75 kg 1 RM, and the highest value is 100 kg 1 RM, the amplitude being of 25 kg. The initial mean is 88.12 kg 1RM and the final mean is 87.5 kg 1RM. The standard deviation is 7.04 kg at the initial test, respectively 6.58 kg at the final test. The difference between the values obtained in tests is not statistically significant as $z = -0.309$, $p = 0.757> 0.05$. The size effect $r = 0.07 <0.1$ shows a very small difference between the two tests.

- Deadlifts - In EG the lowest value at the initial test is 65 kg 1 RM, and the highest value is 80 kg 1RM, the amplitude being of 15 kg. The final test shows an increase up to 15 kg. The initial mean is 75.62 kg, and the final mean is 82.81 kg. The standard deviation is 5.12 kg at the initial test, respectively 6.57 kg

at the final test. The difference between the values obtained before and after training is statistically significant as z = -2.981, p = 0.003<0.05. The size effect r = 0.74>0.5 shows big difference between the two tests.

In CG the lowest value at the initial test is 65 kg 1 RM, and the highest value is 80 kg 1 RM, the amplitude being of 15 kg. The initial mean is 75.31 kg 1RM and the final mean is 76.25 kg 1RM. The standard deviation is 7.04 kg at the initial test, respectively 6.58 kg at the final test. The difference between the values obtained in tests is not statistically significant as z = -0.588, p = 0.556> 0.05. The size effect r = 0.13 <0.5 shows a small difference between the two tests.

- Bench press - In EG the lowest value at the initial test is 60 kg 1 RM, and the highest value is 85 kg 1RM, the amplitude being of 15 kg. The final test shows an increase up to 10 kg. The initial mean is 76.56 kg, and the final mean is 85.62 kg. The standard deviation is 5.97 kg at the initial test, respectively 5.43 kg at the final test. The difference between the values obtained before and after training is statistically significant as z = -3.705, p = 0.001<0.05. The size effect r = 0.92>0.5 shows big difference between the two tests.

In CG the lowest value at the initial test is 65 kg 1 RM, and the highest value is 85 kg 1 RM, the amplitude being of 20 kg. The initial mean is 75.31 kg 1RM and the final mean is 76.56 kg 1RM. The standard deviation is 6.7 kg at the initial test, respectively 5.39 kg at the final test. The difference between the values obtained in tests is not statistically significant as z = -0.467, p = 0.640> 0.05. The size effect r = 0.11 <0.5 shows a small difference between the two tests.

The training progress between groups for strength is presented in Figure 2.

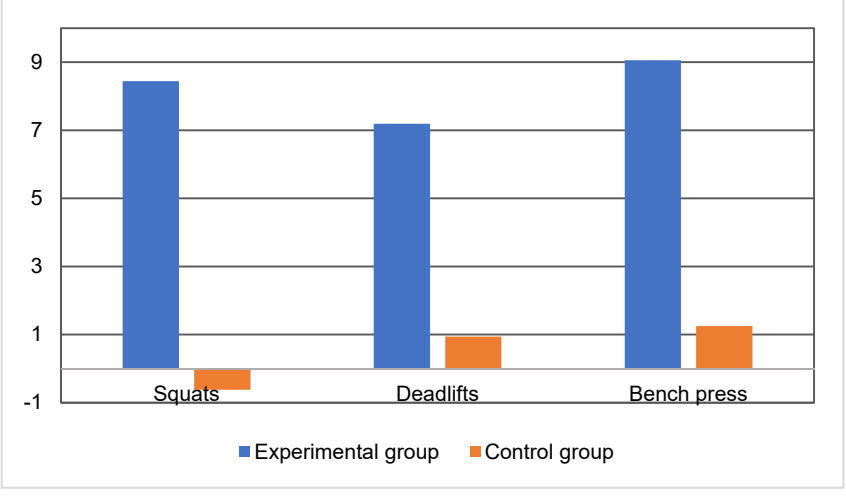

Fig. 2. Progress differences of strength between the two groups

The mean value for 1RM squats in the experiment group is 8.44 higher, and for the control group it is 0.62 lower. The difference in progress between the two groups is 9.06 kg in favor of the experimental group.

In the case of 1RM deadlifts, the mean value for the experiment group is higher by 7.19 at the final test, while for the control group it is higher by only 0.94. The difference in progress between the two groups is 6.25 kg in favor of the experimental group.

For 1RM bench press, the mean value for the experiment group is higher by 9.06 and for the control group by 1.25. The difference in progress between the two groups is 7.81 kg in favor of the experimental group.

Conclusions

The results obtained show a slight progress of the experimental group in front of the control group in terms of body composition, but an important progress in terms of strength.

The study validated that through the modern means of training applied, substantial contributions are made to the increase of sports performance.

The practical implications of the study are the tactical approach to the matches, given a very good physical preparation. The theoretical implications of the study are that the study highlights a common phenomenon in Romania in general, and in handball in particular, when specific physical training is not in line with the requirements of the game.

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