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Core stability training and young para-swimmers' results on 50 meters and 100 meters freestyle

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Abstract

Background: Central stabilization training aims to improve neuromuscular coordination. It is used to prevent injuries and complement swimmers' training process. The aim of the study was to access the impact of this training on the results by disabled swimmers at 50 and 100 meters' freestyle. Material/Method: 20 competitors with similar dysfunctions of the musculoskeletal system, randomly assigned to an experimental and a control group, participated in the study. Each group consisted of 7 swimmers starting in competitions from the standing starting position and 3 starting from water. The study included a 4-week set of stabilization exercises, 4 times a week instead of pulling by legs. Exercises were performed under specialist swimming conditions and involved controlled circuit muscles movements, while maintaining a floating stable position in the water. Results: All groups improved their "best times", besides swimmers starting from the standing position in the control group. There were no significance differences between intergroup and intra-group results, both at distance 50 and 100 meters' freestyle. Conclusions. Better improvements in the experimental group were noted, but this effect cannot be attributed to 4-week stabilization training. However, this investigation might suggest that this type of training could be beneficial for junior disabled swimmers.

Keywords

trunk exercises, para-athletes, youth, swimming

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Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Data Interpretation
E Manuscript Preparation
F Literature Search
G Funds Collection

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INTRODUCTION

Swimming for the disabled was used only for rehabilitation purposes, because it allows symmetrical and balanced development of muscles and recruits approximately 80 percent of muscle mass [1, 2]. However, the level of Paralympic Sports in recent years has improved and brought their daily practices in common to Olympic sportsman, particularly in swimming [3]. That means that disabled swimmers' routine requires not only traditional pool-based trainings but also dry-land exercise programs [4]. However, para-sport is complicated because of the specificity of disabilities, which determines belonging to a particular sports class and is often conducive to sport success. Even though verification of the sport success potential is difficult and unclear, great aerobic and anaerobic capacity, aerobic and aerobic power along with good technique, strength and condition are characteristic of well-prepared swimmers [5, 6].

Over a decade ago, the emphasis on defining the core, core stability and prescribing exercises that position the body increased in order to enhance the motor control and create the optimal recruitments of trunk stability and mobility in sports specific movements [7]. The core was defined as the lumbopelvic-hip complex, and during training it had great benefits for athletes of all disciplines [8]. When considering swimmers, the definition can be extended to define the core as the area between shoulders and knees and to represent the point of reference for all movements [7, 9]. The core stability is the ability to control a stable trunk position and motion to ensure optimal production, transfer, and control of internal and external forces [10]. The aim of core stability training is neuromuscular and sensory motor control, and a crucial role of the core musculature is to maintain the stability of the trunk. In addition, research proves its positive effect on reducing back pain and risk injury or correcting posture [7, 11, 12]. It has been said that trunk stability promotes distal limb mobility and helps to control movements such as push, pull, kick, or throw. A valid core stability system requires great connection between neurological steering and muscle strength. Therefore, core muscle training for athletes is not necessarily focused on developing maximal strength so much as on developing greater motor control [11]. However, the core musculature functions differently from the limb musculature; the core muscles often contract and stiffen the trunk so all muscles become synergists [13, 14]. This suggests that core stability training should be divided in terms of the time using and recruiting the appropriate muscles in a given sport activity. But according to the general division of this training, core endurance, core stability and core strength stand out. [15, 16]. However, swimming does not use ground-based recruitment patterns, and a good program is still unknown. Traditionally, it uses stable or unstable ground and base techniques, which usually consist of plank exercises.

There is lack of evidence, showing the impact of core stability training on performance. This research tries to shed light on core stability training in water and as a specific method for swimmers. The hypothesis put forward in this study assumed that the use of specialized stabilization training can improve the swimmers' results at the distance of 50 and 100 meters. The aim of this study was to demonstrate the effect of specialized core stabilization exercises on the results achieved by disabled young swimmers at 50 and 100 meters' freestyle, with any style taking into account the starting position. Para swimming in low groups (S1–S4), sometimes also in groups S5–S6, differs in physiological responses to effort from swimming from people from higher groups. This is especially visible in competitors with small training experience. This means that effort over a distance of 50 meters will not be a sprint for them (0–30 seconds)

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and 100 meters will involve more aerobic changes than in higher groups. This view requires changes in the programming of specialized training for given groups in terms of distance, style and time of the race.

MATERIAL AND METHODS

PARTICIPANTS

30 disabled swimmers were examined in this study and divided to two groups: experimental (with specialist core stability training) and control (without this training). At the beginning, each group consisted of 15 swimmers, but 10 swimmers were randomly selected for a detailed examination (starting position was taken into account). In addition, respondents were characterized by different locomotor and physical disabilities that resulted in different starting classes. The mean age was 13 years ±2 years, and training experience did not exceed 3 years. At baseline, both groups performed the same number and type of sessions (5 sessions per week). The studies were conducted on a 25-meters indoor swimming pool, first in October 2018 and second in November 2018, after 4-week investigation. Both group continued to participate in regularly scheduled swimming practice in a direct pre-race participation period, but the experimental group switched leg exercises for core stability training in water. Participants were excluded from study if they had suffered some injury, had not done their physical examination up to date, had not had a defined sport class, or if they had left any training session. Prior to testing, all subjects were informed about the nature and the course of the study, and written assent was obtained from them followed by the parent's agreement.

METHODS

Swimming performance at 50 and 100 meters' freestyle was measured with a stopwatch. The subjects started individually from the starting position they are able to take, depending on their dysfunction. Each group consisted of 7 swimmers starting from a standing position and 3 from water (Tab. 1).

Table 1. Characteristics of the starting position in each group, including sport class

Starting position	Experimental group	Control group	Sport class
From water	3	3	S3, S5, S6
Stand position	7	7	S7, S8, S9, S10

To create specific core stability training for disabled swimmers, the author used a similar approach as in motor control and core endurance exercises on land. The weekly periodization was linear and comprised adding 1 repetition to the next week. The study presumed that maintaining a stable position could be difficult for some disabilities and, for this reason, swimmers could stop the exercise and retry to achieve the required 30 seconds. The experimental group participated in core stability training twice a week. All eight sessions consisted of the same 7-exercise program in the 4-week period:

- 1 week: 7 exercises of 3 repetitions each, work 30 seconds, rest 30 seconds,
- 2 week: 7 exercises of 4 repetitions each, work 30 seconds, rest 30 seconds,
- 3 week: 7 exercises of 5 repetitions each, work 30 seconds, rest 30 seconds,
- 4 week: 7 exercises of 6 repetitions each, work 30 seconds, rest 30 seconds.

The rest between the series of repetitions was 1 minute.

During the training, swimmers were using swimming tools, such as: large board, small board, snorkel, short fins, and swimming pads.

Statistical analysis

All statistical analyses were performed using Statistica 9.1 and Microsoft Office, and were presented as means with standard deviations (SD). The Shapiro-Wilk, Levene and Mauchly's tests were used in order to verify the normality, homogeneity and sphericity of the sample's data variances, respectively. The differences between the analyzed variables of EX and CON before and after core stabilization training were verified by one-way ANOVA. When significant differences were found, Tukey HSD post-hoc tests were used. Effect sizes (η^2 – Eta-squared) were reported where appropriate. Parametric effect sizes were defined as large for $\eta^2 > 0.139$, as medium for $\eta^2 = 0.060$, and as small for $\eta^2 = 0.010$ [17–22]. Statistical significance was set at $p < 0.05$.

Results

A comparative analysis of descriptive statistics showed that in the experimental group the largest absolute variation in the value of sports score parameters was shown by the variable 100m after (S = 42.22). The largest relative differentiation, however, was shown by the variable: 50 after (V = 32.48%) (Table 2).

In the control group, the largest absolute differentiation was recorded for the variable: 100 before (S = 47.71) and the relative same variable (V = 27.08%) (Table 3).

Table 2. Intra-group analysis of differences in the values of variables before and after stabilization training using the Student's T-test, in the 50 meters' experimental and control group

Variable	Differential value before training [s]	Differential value after training [s]	p	η^2
50 before vs. 50 after EX.G. STAND	40.75	39.95	0.047	0.063*
50 before vs. 50 after C.G. STAND	42.89	42.41	0.092	0.010
50 before vs. 50 after EX G. WATER	73.64	70.01	0.049	0.052*
50 before vs. 50 after C.G. WATER	80.14	79.54	0.097	0.009

* medium effect

** large effect

Table 3. Intra-group analysis of differences in the values of variables before and after stabilization training using the Student's T-test, in the 100 meters' experimental and control group

Variable	Differential value before training [s]	Differential value after training [s]	p	η^2
100 before vs. 50 after EX.G. STAND	40.75	39.95	0.047	0.063*
100 before vs. 50 after C.G. STAND	42.89	42.41	0.092	0.010
100 before vs. 50 after EX G. WATER	73.64	70.01	0.049	0.052*
100 before vs. 50 after C.G. WATER	80.14	79.54	0.097	0.009

* medium effect

** large effect

There were no statistically significant intra-group differences in the values of the tested variable before and after. Nevertheless, the effect on the experimental group (50 meters), starting from water and from standing, was assessed as medium. In the experimental group (100 meters) in both starting groups, the effect was defined as large.

DISCUSSION

The aim of this study was to demonstrate the effect of specialized stabilization exercises on the results achieved by disabled young swimmers at 50 and 100 meters' freestyle. The hypothesis set out in this study was that specialized core stabilization exercises, when added to routine swimming training, would improve the 50 and 100 meters' distance freestyle swimming time, any style taking into account the starting position. Although the results at both distances in the experimental group improved, the impact of using a 4-week program of stabilization exercises in water (within the group and between groups) was not determined as statistically significant. Moreover, 100 meters' control group decreased their results, and the control group of 50 meters slightly improved their times.

Swimmers are qualified as overhead athletes and 90 percent of the propulsive force supplied by the upper extremities [23]. In addition, it is presumed that swimming, due to its specificity, involves core as a reference point of all movements, in place of ground (like in land-based sports). Therefore, core exercises should use trunk as the main factory to provide a foundation for better force production in all extremities, and up-to-day programing dry-land for swimmers is difficult and not clear in prescribing. The last decade has stayed under questionably useful core stability exercises, and the majority of research does not show significant effects in using core exercises on performance [24]. However, some studies show significant improvements and identify the importance of a strong core in relation to improving sport performance [25, 26]. They were based on land sport-based core workout that can only be taken to a swimming program focusing on starts and turns. Therefore, there is a lot of evidence showing that dry-land strength and power sessions improve performance in swimmers without and with disabilities [27, 28]. Muscle strength and power are major determinants in sprint competitions, and it is advised to perform specific land training for competitive swimmers to improve performance [29]. Better reaction time, "push" from the starting platform or a wall, gives advantage in sprint event, not only in able-bodied swimmers, but also in para-swimmers in low and high groups [30]. One study verifies that truck stabilization exercise may help reducing the time in the five-meter start phase and, as a result, improve swimming performance [27]. Bishop has found that eight-week plyometric training provided reduction of the start time, and also start performance significantly increased [31]. Another investigation shows that the six-week resistance training for Paralympic swimmers improved not only dry-land measure, but also in both timed dive starts and 50 meters' performance [28].

Some studies focus more on exercises using the trunk as a transmitter between upper and lower extremities [31, 32]. Those exercises much more correspond to the neurological use of the trunk than to enhancing the core strength, but beneficial effects on measures of core functioning and 50 meters' front crawl time after twelve-week isolated core training were found [33]. Another research indicated that added six-week core muscle land training was a significantly beneficial method to improve 50 meters' freestyle time, velocity and stroke index [32].

Those investigations used similar core recruits' pattern as in this study, but there were no articles using core stability training in water. In this case the author used 7 exercises based on water to correspond more to the endurance concept rather than to core strength and power. That may suggest that an external stimulus was not strong enough, and future studies should include exercises concentrated on different systems of energetic purpose. Also, the 4-week period may have been too short to make any changes, but an individual plan to develop core stability separately in each type of disability seems to be a crucial thing.

Despite the fact that good core functioning is still commonly believed to improve athletic performance, recent studies have had many gaps and have concluded that a core training program provides only marginal benefits to athletic performance [34]. The last few years have brought a new look at the core practice in swimming performance and showed core stability training as beneficial for swimming performance particularly applied in youth athletes. Moreover, resistance training has become more commonplace, especially in short course swimming, and a loss of strength, range of motion and coordination in the kinetic chain and asymmetries can entail swimmers to fall short of their potential performance [35, 36].

Overall, research on exercise training and swimming is sparse, and more research in the field is needed for operational definition purposes, developing valid and reliable core stability training for swimmers without and with disabilities.

CONCLUSIONS

Stabilization exercises did not statistically significantly affect the speed of swimmers at a distance of 50 and 100 meters with freestyle, in both groups of swimmers taking off from the water and from the post.

However, the influence on the experimental group at 50 meters' time was assessed as a medium effect, and the 100 meters' experimental group showed it as large.

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APPENDIX

1st exercise (Fig. 1, Fig. 2)

On the back: upper limbs placed along the trunk, at an angle of 90 degrees in the elbows and shoulders. Movement: extend elbow (hands over head). The purpose of this exercise was to maintain the described position for 30 seconds in result.

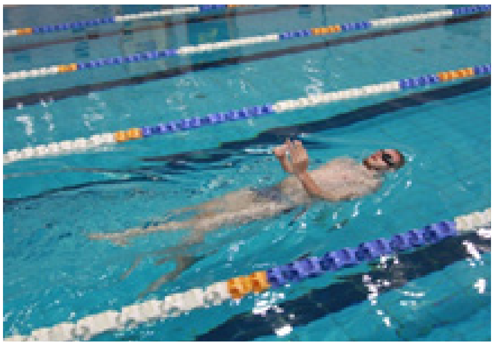

Fig. 1. Starting position

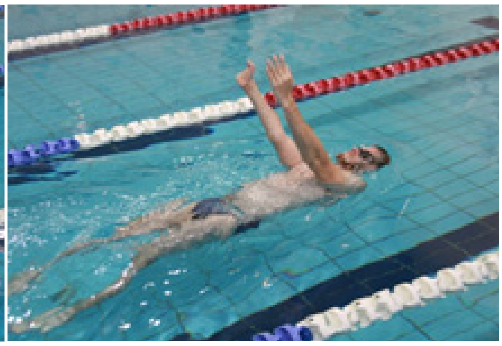

Fig. 2. Finished position (movement)

2nd exercise (Fig. 3, Fig. 4)

On the left side. The left arm extended in line, the second arm bend at an angle 90 degrees, with the elbow extended (over the head). The purpose of this exercise was to maintain the described position for 30 seconds in result.

3rd exercise (Fig. 3, Fig. 4)

On the right side. The right arm extended in line, the second arm bend at an angle 90 degrees, with the elbow extended (over the head). The purpose of this exercise was to maintain the described position for 30 seconds in result.

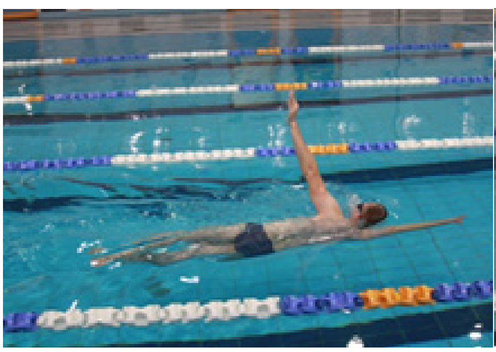

Fig. 3. Starting position

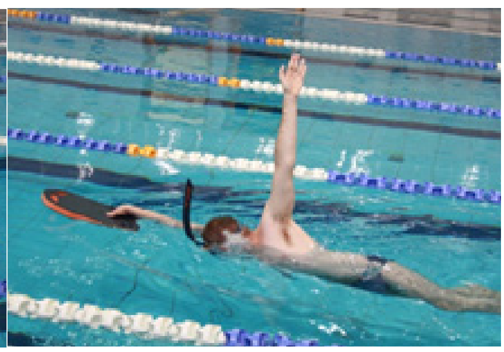

Fig. 4. Finished position (movement)

4th exercise (Fig. 5, Fig. 6)

On the back: upper limbs placed along the trunk, at an angle of 90 degrees in the elbow and shoulders. Movement: only the left arm used, the elbow extension to 90-degree flexion of arm (over the head) throughout whole 30 seconds.

5th exercise (Fig. 5, Fig. 6)

On the back: upper limbs placed along the trunk, at an angle of 90 degrees in the elbow and shoulders. Movement: only the right arm used, the elbow extension to 90-degree flexion of arm (over the head) throughout whole 30 seconds.

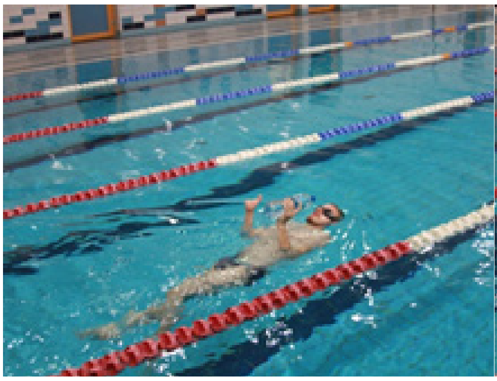
Fig. 5. Starting position

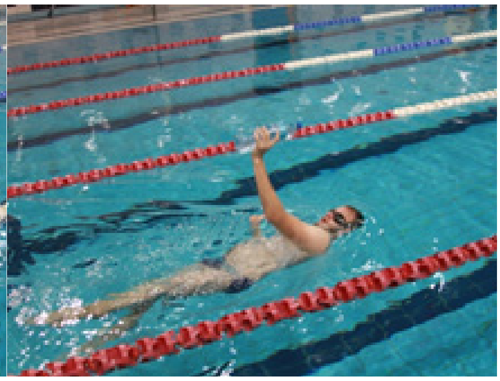
Fig. 6. Finished position (movement)

6th exercise (Fig. 7, Fig. 8, Fig. 9, Fig. 10)

With pads and a small board, adding arm to arm, only the left arm trains, with an extended recovery time of the left arm movements.

7th exercise (Fig. 7, Fig. 8, Fig. 9, Fig. 10)

With pads, and a small board, adding arm to arm, only the right arm trains, with an extended recovery time of the right arm movements.

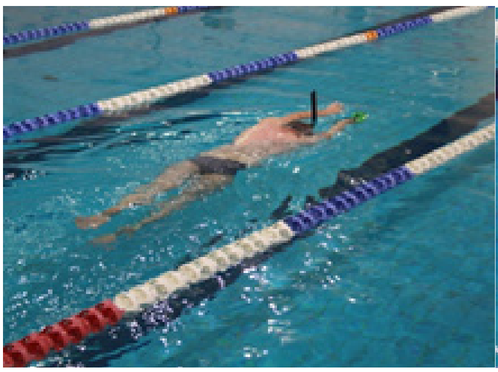
Fig. 7. Starting position

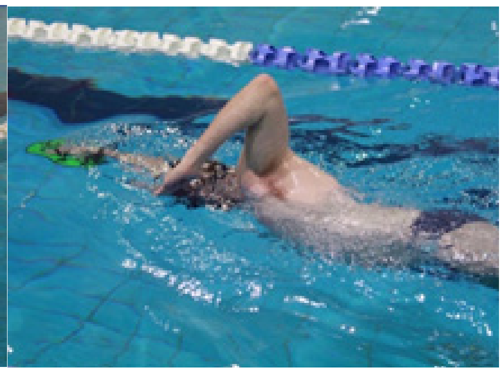
Fig. 8. Finished position (movement)

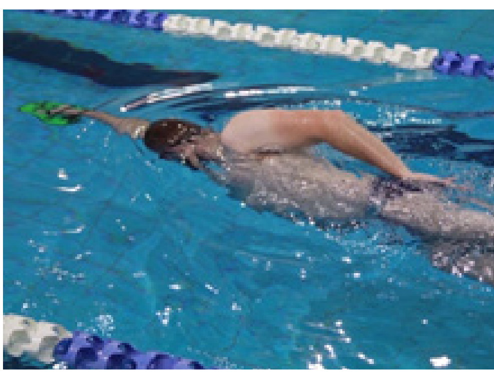
Fig. 9. Starting position

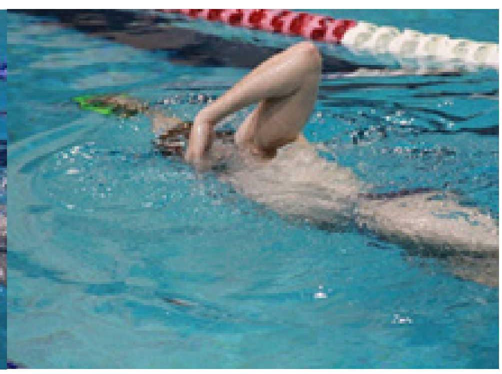
Fig. 10. Finished position (movement)

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