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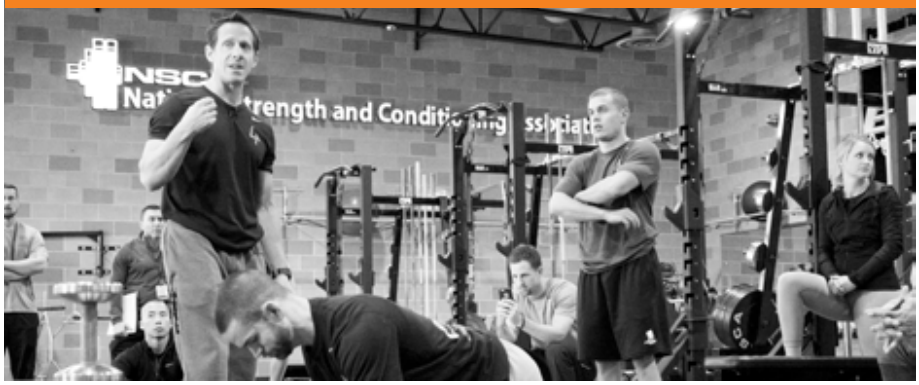

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DRY-LAND STRENGTH AND CONDITIONING FOR PREPUBERTAL AND PERIPUBERTAL SWIMMERS

NUNO AMARO, MSC, DANIEL MARINHO, PHD, NSCA-CPT, MÁRIO MARQUES, PHD, NUNO BATALHA, PHD, AND PEDRO MOROUÇO, PHD, CSCS

INTRODUCTION

Swimming success depends on several factors. The ability to apply in-water force is crucial, particularly in short distances (13,15). Among others methodologies, dry-land strength and conditioning training is a common practice in competitive swimming. There are two main goals in strength and conditioing training: to improve swimming performance and to prevent injuries (2,4,5,8,9,14,16,17). Although training is often recommended to improve strength and power outputs, the swimming community has yet to reach a concensus regarding specific benefits on swim performance. Still, no negative effects on swimming performance were reported in the available literature, to date.

Lack of specificity of strength and conditioning training is one of the main reasons thought to impair results in some of the conducted investigations. Several exercises have been used to mimic in-water movement; the bench press being one of the most commonly applied. Yet, results are not convincing, because in-water movement has particular characteristics that are impossible to replicate in dry-land training, such as water tension and drag (3). For instance, neuromuscular demands are far from similar in both conditions. The more a swimmer mimics an in-water movement in a dry-land condition with resistance, the more the swimmer could be potentially disrupting motor patterns acquired in-water. Thus, in order to promote transferibility of dry-land strength gains to swimming performance, it is suggested to concurrently implement tecnhical swimming training (2). Strength and conditioning coaches should focus on strengthen muscles involved in swimming with the intent of increasing force production and to prevent muscular imbalances, according to each swimmer's needs (4).

The ability to produce a high rate of force developoment is crucial in short distances and decreases as the distance increases. Training with heavy loads (maximal strength) requires low execution velocity and likely is not related with swimming demands, particularly in short-distances bouts. Thus, dry-land training should be performed with a velocity similar to in-water movementss, trying to fulfil similar neuromuscular demands. When adding strength and conditioning training for short-distance swimming, explosiveness should be the main goal. Therefore, it is expected that movement velocity increases specificity of strength and conditioning exercises and overall power output (10).

Previous investigations have focused on older and high-level swimmers. Very few studies have been published regarding prepubertal (before puberty) and peripubertal (during puberty) swimmers. This could be due to ethical issues or unclear information available to coaches, making them skeptical toward strength and conditioning training swimmers in those age groups (3). Nevertheless, dry-land and in-water power outputs and strength have a determinant influence in youth swimming performance (12,13). It is recommended that youth athletes engage in resistance training, not only to enhance health, fitness, and performance, but also to prevent sports-related injuries (6,12). Therefore, it seems reasonable that strength and conditioning

can aid performance of prepubertal and peripubertal swimmers. The objective of this article is to provide strength and conditioing coaches with practical training recommendations to improve performance through the addition of a strength and conditioning program to prepubertal and peripubertal swimmers.

TRAINING RECOMMENDATIONS

There are several aspects of strength and conditioning training: type, frequency, intensity, volume, recovery, and progression. The following training recommendations are intended to follow the National Strength and Conditioning Association (NSCA) guidelines, as well as the relevant literature on strength and conditioning training with youth athletes (6,11). Therefore, strength and conditioning training based on power is presented. The strength and conditioning program is designed for six weeks with two sessions per week. After the six weeks of strength and conditioning training, swimmers are allowed a four-week adaptation period. The goal is to allow the transferability of new strength levels acquired in the strength and conditioning training to in-water actions. In this period, swimmers engage in their normal swimming training prescription and cease strength and conditioning training. Prior to the implementation of the strength and conditioning program, a pre-test is recommended to assess each subject's tolerance to the prescribed loads, always maintaining the goal of power-based training.

In each session, a warm-up of about 10 min should be performed. The goal of the warm-up is to elevate body temperature and enhance motor unit excitability. Rope skipping and similar mobilization to strength and conditioning exercises are recommended. Based on previous observations, swimmers should follow a sets/time scheme instead of sets/repetitions for the strength and conditioning program, as seen in Table 1 (1). The goal is to perform the repetitions as rapidly as possible, maintaining high-quality movements. The time spent in each set should approach the time spent in short-distance swimming. Through controlling fatigue, participants should perform a similar number of actions as in swimming competitions, in order to be sport-specific. Rest periods between sets should be calculated by the multiplication of the execution time by four (1,11).

The strength and conditioning training presented consists of five exercises: medicine ball throw down, countermovement box jump, dumbbell fly, Russian twist, and triceps push-ups. The main goal is to workout muscles involved in swimming, especially in front-crawl stroke. It is intended to use bodyweight and materials with easy transportability, aiming to reduce time transporting training equipment. It is recommended that swimmers engage in familiarization sessions to enhance exercise technique before program implementation.

MEDICINE BALL THROW DOWN (FIGURE 1)

Execution: The swimmer starts in an upright position with the medicine ball (1 kg) above their head and the upper limbs fully extended. Then throw the medicine ball to the ground as fast as possible.

Muscle Involvement: pectoralis major, pectoralis minor, anterior deltoid, medial deltoid, serratus anterior, latissimus dorsi, posterior deltoid, teres major, teres minor, and infraspinatus.

FIGURE 1. MEDICINE BALL THROW DOWN (WITH PRIMARY MUSCLES RECRUITED IN RED)

COUNTERMOVEMENT BOX JUMP (FIGURE 2)

Execution: The swimmer starts in an upright position, squats down until the knees are bent at 90 degrees, then immediately jumps vertically as high and fast as possible, landing on the box (30 cm) on both feet at the same time.

Muscle Involvement: rectus femoralis, vastus lateralis, vastus medialis, gluteus medius, gluteus maximus, biceps femoris, semitendinosus, semimembranosus, and gastrocnemius.

DUMBBELL FLY (FIGURE 3)

Execution: The swimmer should lay on the ground and start with the upper limbs in a vertical position holding dumbbells. Then the dumbbells (1.5 kg) should be moved outward and downward, utilizing the minimum distance needed to reach to the ground without contacting it.

Muscle Involvement: pectoralis major, pectoralis minor, anterior deltoid, medial deltoid, trapezius, teres major, teres minor, infraspinatus, rhomboids, posterior deltoid, and triceps brachii.

FIGURE 2. COUNTERMOVEMENT BOX JUMP (WITH PRIMARY MUSCLES RECRUITED IN RED)

FIGURE 3. DUMBBELL FLY (WITH PRIMARY MUSCLES RECRUITED IN RED)

RUSSIAN TWIST (FIGURE 4)

Execution: The swimmer starts in a seated position on the floor with the hands grasping a medicine ball (3 kg) in the front of the chest with the feet off the ground. The ball should be displaced from the one hip to the other in a controlled motion.

Muscle Involvement: rectus abdominis, external oblique, internal oblique, and external oblique.

PUSH-UP (FIGURE 5)

Execution: The swimmer starts with the upper limbs fully extended close to the upper body and in adduction. The swimmer should lower their body until the chest almost touches the floor and return to the initial position by extending the upper limbs. The body must remain in a plank position with the upper limbs close to the upper body during the entire exercise.

Muscle Involvement: pectoralis major, pectoralis minor, anterior deltoid, medial deltoid, posterior deltoid, and triceps brachii.

FIGURE 4. RUSSIAN TWIST (WITH PRIMARY MUSCLES RECRUITED IN RED)

FIGURE 5. PUSH-UP (WITH PRIMARY MUSCLES RECRUITED IN RED)

TABLE 1. SAMPLE SIX-WEEK DRY-LAND STRENGTH AND CONDITIONING TRAINING PROGRAM

EXERCISE	WEEKS 1 AND 2 (RECOVERY TIME)	WEEKS 3 AND 4 (RECOVERY TIME)	WEEKS 5 AND 6 (RECOVERY TIME)
Medicine ball throw down (1 kg)	3 x 15 s (60 s)	3 x 20 s (80 s)	3 x 25 s (100 s)
Countermovement box jump (30 cm)	3 x 15 s (60 s)	3 x 20 s (80 s)	3 x 25 s (100 s)
Dumbbell fly (1.5 kg)	3 x 10 s (60 s)	3 x 15 s (80 s)	3 x 20 s (100 s)
Russian twist (3 kg)	3 x 15 s (60 s)	3 x 20 s (80 s)	3 x 25 s (100 s)
Push-up (bw)	3 x 10 s (60 s)	3 x 15 s (80 s)	3 x 20 s (100 s)

CONCLUSION

The current strength and conditioning program for prepubertal and peripubertal swimmers provides an evidence-based strength and conditioning prescription for youth swimmers that is affordable, portable, and uses minimal equipment. It is imperative that strength and conditioing coaches control swimmers' execution and fatigue in each strength and conditioning session. Additionally, strength and conditioing coaches should apply strength and conditioning programs adjusted to each swimmer's ability to avoid overreaching and prevent injuries. Finally, it is important that strength and conditioing coaches allow swimmers to have a period to adapt to new strength levels acquired in the strength and conditioning program.

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ABOUT THE AUTHORS

Nuno Amaro is an Assistant Professor at the Human Movement Department of Polytechnics Institute of Leiria in Portugal and a member of the Performance Analysis group of the Research Centre in Sports, Health Sciences, and Human Development. He holds a Master of Science degree in Sports Sciences and he is a swimming coach. He works with the Portuguese Swimming Federation in the Department of Evaluation and Training Control, working with the swimmers and Portuguese coaches. He is also the author of several publications within the scope of sports training.

Daniel Marinho is an Associate Professor at the Sport Sciences Department of the University of Beira Interior in Covilhã, Portugal and the head of the Performance Analysis group of the Research Centre in Sports, Health Sciences, and Human Development. He holds a PhD in Sports Biomechanics and the National Strength and Conditioning Association Certified Personal Trainer® (NSCA-CPT®) certification. He works with the Portuguese Swimming Federation, coordinating the Department of Evaluation and Training Control and working with the swimmers and Portuguese coaches. He is also the author of several publications within the scope of sports training.

Mário Marques holds a PhD in Sport Sciences and is an Associate Professor at the Sport Sciences Department at the University of Beira Interior in Covilhã, Portugal. He works with the Portuguese Swimming Federation, coordinating strength and conditioning programs with several of the swimmers and Portuguese coaches. He is also the author of several publications within the scope of sports training.

Nuno Batalha holds a PhD in Sports Sciences and is an Associate Professor at the Sport and Health Department of the University of Évora in Évora, Portugal. He is also the head of the sports sciences course and an integrated member of the Performance Analysis group of the Research Centre in Sports, Health Sciences, and Human Development. He is currently the Vice President of the Portuguese Swimming Federation and he is also the author of several scientific publications within the scope of sports science.

Pedro Morouço holds a PhD in Sport Sciences and is a Certified Strength and Conditioning Specialist® (CSCS®) through the National Strength and Conditioning Association (NSCA). He is a Research Fellow and Head of the CDRsp BioFabrication Research Group. He is also a Member of the Editorial Board in several international peer-review journals and has been distinguished with the 2014 New Investigator Award from the International Society of Biomechanics in Sports. He is also the Chairman of the CDRsp Advanced Courses on Regenerative Medicine; engaged in several national and international projects focusing on biomechanics, Direct Digital Manufacturing (DDM), and sports and health for all; and the author of several scientific publications within the scope of sports science.

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