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| **Authors:** | Matthew Weston[1], Angela E. Hibbs [2], Kevin G. Thompson[3], Iain R. Spears[1] |

[1] Teesside University, Middlesbrough, UK
[2] Northumbria University, Newcastle Upon Tyne, UK
[3] University of Canberra, Canberra, Australia

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| **Corresponding author** | Matthew Weston, Sport and Exercise Subject Group, School of Social Sciences and Law, Teesside University, Middlesbrough, TS1 3BA<br>Email: m.weston@tees.ac.uk<br>Telephone: ++44 (0)1642 342380<br>Fax: ++44 (0)1642 342317 |

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**Abstract**

***Purpose:*** The aim of our study was to quantify the effects of a 12-week isolated core training programme on 50-m front crawl swim time and measures of core musculature functionally relevant to swimming. ***Methods:*** Twenty national-level junior swimmers (ten male and ten female, 16 ± 1 y, 171 ± 5 cm, 63 ± 4 kg) participated in the study. Group allocation (intervention [*n*=10], control [*n*=10]) was based on two pre-existing swim training groups who were part of the same swimming club but trained in different groups. The intervention group completed the core training, incorporating exercises targeting the lumbo-pelvic complex and upper region extending to the scapula, three times per week for 12 weeks. While the training was performed in addition to the normal pool-based swimming programme, the control group maintained their usual pool-based swimming programme. We made probabilistic magnitude-based inferences about the effect of the core training on 50-m swim time and functionally relevant measures of core function. ***Results:*** Compared to the control group, the core training intervention group had a possibly large beneficial effect on 50-m swim time (-2.0%; 90% confidence interval -3.8 to -0.2%). Moreover it showed small-moderate improvements on a timed prone-bridge test (9.8%; 3.9 to 16.0%) and asymmetric straight-arm pull-down test (21.9%; 12.5 to 32.1%), there were moderate-large increases in peak EMG activity of core musculature during isolated tests of maximal voluntary contraction. ***Conclusion:*** This is the first study to demonstrate a clear beneficial effect of isolated core training on 50-m front crawl swim performance.

**Introduction**

Muscular strength and power are major determinants of success in competitive swimming[1] and therefore, competitive swimmers are advised to perform specific dry-land training to improve performance.[1,2] There is, however, a recognized shortage of well-designed studies focusing on the effects of training interventions for swimmers.[2] Of the available studies, research has focused predominantly on the effects of land-based strength and power interventions, with inconsistent findings on swim performance.[3-6]

Exercises devised to train the core musculature are integral to many strength and conditioning programmes[7,8] as greater core stability may provide a foundation for greater force production in the upper and lower extremities.[9] However, while good core functioning is commonly believed to enhance athletic performance, recent reviews have concluded that core training provides only marginal benefits to athletic performance.[8] Difficulty in isolating a core training effect on athletic performance, as core training is rarely the sole component of athletic development,[8] and lack of sport specificity[10] could explain the absence of a greater beneficial effect.

Improved core stability could be particularly beneficial for sprint swimmers, allowing efficient transfer of force between the trunk and the upper and lower extremities to propel the body through the water.[9] Furthermore, swimming is different from ground-based sports in that the core becomes the reference point for all movement.[9] A targeted training programme to improve core functioning of sprint swimmers would therefore appear logical, yet presently there are no controlled trials examining the isolated effect of core training on swimming performance. The aim of our study was to quantify the effects of a 12-week isolated core training programme on 50-m front crawl swim time and measures of core musculature functionally relevant to swimming.

**Methods**

**Subjects**

Twenty national-level junior swimmers participated in this study. Ten swimmers (five male and five female, 15.7 ± 1.2 y, 172 ± 6 cm, 63 ± 5 kg) formed the core training intervention group and 10 swimmers (five male and five female, 16.7 ± 0.9 y, 170 ± 3 cm, 63 ± 3 kg) formed the control group. At baseline, both groups were performing similar weekly distances in training (average of 30 km) and the same number and type of swimming training sessions (8 sessions per week). These consisted of recovery, tempo and endurance-based swimming sessions. During the study, pool-based training sessions continued as normal and both groups completed the same duration and intensity of training. These pool-based training sessions were coach-led with the two groups performing the sessions at the same time but in different parts of the pool. All participants were familiar with, but not actively engaged in, core training exercises prior to the study. The Ethics Committee of the local University approved the study and informed consent was provided by all study participants.

**Design**

The design of our exploratory study was a clustered controlled before and after study, as allocation was performed at a group level, based on two pre-existing swim training groups who were part of the same swimming club but trained in different groups. We applied this design as allocation on an individual level may have resulted in significant crossover contamination.[11] The study was performed one month into the swim season, therefore all swimmers were in full training when the study commenced.

**Intervention**

The intervention group completed a 12-week core training programme in addition to their normal pool-based swimming regimen. For the purposes of this study, the regions of the body which are included in the term "the core" are the upper legs, pelvis, trunk and shoulders.[7] Specifically, the regions targeted in this training programme were the lower spine, lumbo-pelvic complex and upper region extending to the scapula. The core training programme consisted of five exercises based on the existing literature (Table 1) which were as follows; prone-bridge (Figure 1a), side-bridge (Figure 1b), bird-dog (Figure 1c), straight leg raise (Figure 1d), overhead squat (Figure 1e) and medicine ball sit twist (Figure 1f).[12-16] In a previous study[14] these exercises were found to induce EMG activity greater than threshold levels[15] required for improving core stability (10-25% of maximal voluntary contraction [MVC]) and core strength (>60% of MVC). Notably the side-bridge has been reported to elicit peak EMG values of $42 \pm 24\%$ of MVC in lumbar multifidus[16] and the bird-dog exercise to elicit peak EMG of $42 \pm 17\%$ of MVC and $56 \pm 22\%$ of MVC in gluteus medius and maximus, respectively.[16] The prone-bridge elicited peaks of $47 \pm 21\%$ and $43 \pm 21\%$ of MVC in the external oblique and upper rectus abdominis, respectively.[16] In addition, a sixth exercise termed an asymmetrical horizontal shoulder press was included (Figure 1g). Each exercise was performed twice for a total of 60 s with 60 s recovery between sets. A model for exercise progression was incorporated by gradually increasing the number of repetitions, sets and where appropriate the level of resistance (Table 1) or period of time in a hold position. Over the 12-week training period the core exercises were performed three times a week. Each core training session lasted approximately 30 min. The quality of the exercises was monitored during the sessions by a National Level Amateur Swimming Association coach and fortnightly by a British Association of Sport and Exercise Sciences accredited sport scientist. To minimise learning effects all participants were given a familiarisation exercise session seven days before the intervention.

**Outcome measures**

All outcome measures were assessed pre- and post-intervention. Testing sessions took place seven days either side of the training intervention and commenced following the swimmers' usual session preparation, which involved a cardiovascular warm-up followed by static and dynamic stretching. Swim performance was quantified by a timed 50-m front crawl race. In groups of four, commencing with the usual dive start, the swimmers sprinted the length of a 50 m pool. Using split-timing stopwatches (Fastime 5, Fastime Ltd., UK) the swim coaches recorded the times, with each coach recording the times of two swimmers per race. Hand timing by experienced swim coaches has been reported to have acceptable precision.[17] To examine the effectiveness of our core training intervention on shoulder extension in the sagittal plane, a straight-arm latissimus dorsi pull-down test was used. A strong relationship exists between upper body strength and sprint swimming performances[6,18] and shoulder extension in the sagittal plane is integral to the front crawl swim stroke. Here, the participant stood facing a stacked cable-based weight machine (Life Fitness CMDAP C/Motion Dual Adjust Pulley, Powerhouse Fitness, UK), held the bar with a pronated grip and extended elbow and with the shoulder flexed to 90 degrees. Participants pulled the cable down until the hand reached the hip. Following 30-s rest periods, weight was increased in increments of 1.25 kg until the participant was no longer able to perform the movement without observable flexion of the elbow or of the lumbar region. To examine the effectiveness of our intervention on core endurance, participants performed a timed prone-bridge test as exercise performed in the prone position appears to be specific to the core requirements of swimming.[9] During this test the participants remained in a prone-bridge position (forearms and toes in contact with

floor and with the spine in a neutral position). The position was held until observable movements of the pelvis signalled the end of the test.

To provide additional information on neuromuscular adaptation to the intervention, and to potentially elucidate any mechanisms underpinning changes in performance, we elected to analyse EMG activity of some of the core muscles while performing maximal voluntary isometric contractions (MVCs) pre- and post-intervention.[19] Maximal EMG signals are representative of net neural drive [20] and changes in which are considered to represent neural adaptations and seem to play a role in explaining strength gains.[19] Surface EMG data were collected using a reference electrode placed on the right iliac crest, with sensor muscle positions as per Cram.[21] The maximal tests were resisted trunk rotation targeting the external oblique; resisted back extension targeting the superficial lumbar multifidus and resisted hang targeting the latissimus dorsi muscle.[14] Lumbar multifidus is a difficult muscle to analyse and the resulting EMG signal will likely include cross-talk from the thoracis longissimus muscle [22] and unlikely include activity of the deep fibres, which differ in function from the superficial fibres in terms of stabilising the spine.[23] Each maximal voluntary contraction test was performed three times for 15 s with 1-min rest. Further details of the procedures involved in recording and processing the EMG variables and also the reliability of these measures for a similar population have been published elsewhere.[14] The peak EMG amplitude during a maximal voluntary contraction was used as our proxy measure of net neural drive and it is recognised that this variable will only have a monotonic relationship with the force-generating capacity of that muscle, does not reflect its endurance capacity and is prone to large variability due to inaccurate sensor placement when recording on separate days. [24] We took photographs of the skin-mounted sensors at baseline and used these to reposition the sensors for the post-intervention tests to reduce the variability that arises from inaccurate sensor placement. As is consistent with previous training studies the EMG data was not normalized [19] as this would mask any potential training effects on neural adaptation.

**Statistical Analysis**
Data are presented as the mean ± SD. Prior to analysis all outcome measures were log transformed and then back transformed to obtain the percent difference, with uncertainty of the estimates expressed as 90% confidence intervals (CI), between the post and pre-tests. This is the appropriate method for quantifying changes in athletic performance.[25] Mixed effects linear modelling (IBM SPSS version 21.0) was used to analyse the effect of the core stability training intervention on our outcome measures. This method allows for and quantifies, as a standard deviation, individual differences in response to an intervention, which are often highly variable. An analysis of covariance (ANCOVA) method was used to compare the two groups, with the pre-test score, age and body mass as covariates to control for imbalance in our measures between the control and intervention groups at baseline.[26] We made probabilistic magnitude-based inferences about the true value of the outcomes, based on the likelihood that the true population difference was substantially positive or substantially negative. With a between-competition variability of ~1% for top junior swimmers, any strategy to improve performance needs to be at least 0.5 of this variability.[27] Therefore, our threshold values for assessing the magnitude of small, moderate and large effects in 50-m swim times were 0.5, 1.5 and 2.7%, respectively.[25] Standardised thresholds for small, moderate and large changes (0.2, 0.6 and 1.2, respectively)[25] derived from between-subject standard deviations of the baseline value were used to assess the magnitude of all other effects. Inferences were then based on the disposition of the confidence interval for the mean difference to these standardised thresholds and calculated as per the magnitude-based inference approach using the following scale: 25–75%, possibly; 75–95%, likely; 95–99.5%,

very likely; >99.5%, most likely.[25] Inference was categorised as clinical for changes in 50-m swim time, with the default probabilities for declaring an effect clinically beneficial being <0.5% (most unlikely) for harm and >25% (possibly) for benefit.[25] Magnitudes of effects for all other measures were classified unclear if the 90% confidence interval overlapped the thresholds for the smallest worthwhile positive and negative effects.[25]

**Results**
The core training intervention had a possibly large beneficial effect on 50-m front crawl swim time (Table 2). The standard deviation of the individual responses for 50-m swim time following core training was 1.4% (90% confidence interval 1.0 to 1.7%). This represents the variability in the mean effect of the core training intervention due to individual swimmer responses. The core training group showed small-moderate improvements on the prone-bridge and straight-arm pull down test, when compared to controls. Secondary to this, there were moderate-large increases in peak EMG activity of the latimuss dorsi, external oblique abdominis and lumbar extensor muscles (lumbar multifidus/thoracis longissimus) muscles during isolated tests of maximal voluntary contraction. The effect of the intervention on body mass of the intervention group (1.5%; 0.8 to 2.3%) and the control group (0.7%; -0.1 to 1.4%) was likely to be trivial (0.9%; -0.2 to 1.9%).


**Discussion**
The change in performance time needed to enhance a top junior swimmers chance of winning a medal is as little as 0.5%.[27] We are therefore confident that our clear beneficial effect (-2.0%) on sprint swimming performance following an isolated core training programme represents a true performance enhancement. Further to this enhanced performance effect, our intervention elicited improved shoulder extension in the sagittal plane and performance on the prone-bridge test. In addition, improvements in maximal EMG activity of key core musculature were also observed. As such, these improvements in functionally relevant measures of core function and neuromuscular adaptations in stroke-specific musculature provide evidence of potential mechanisms subtending the observed improvement in 50-m swim time.

There is a recognized shortage of well-designed studies focusing on the effects of training interventions for swimmers.[2] For the most part, research has focused on the effects of land-based strength and power interventions which may include, but do not necessarily examine in isolation, the effects of core training. The effects of these programmes on swim performance are inconsistent. A land-based training programme evaluated by Tanaka et al.[3] did not lead to any improvement in swim performance. These authors suggested that improved strength and power do not transfer to swimming performance. In contrast to this finding, Strass[4] and Sharp et al.[5] reported respective improvements of 2.1% (50 m) following a 6-week heavy, explosive strength training programme and 3.6% (22.9 m) after an 8-week swim bench training programme. However, the effect of an intervention should be measured relative to non-intervention (i.e., control) and the aforementioned studies either were uncontrolled trials or failed to report control group data. With this in mind, the ~2.0% improvement in 50-m swim time observed in our study is consistent with the work of Girold et al.[6] who examined the effect of dry-land and resisted and assisted sprinting on swimming sprint performances and found 1.9% and 1.4% improvements, respectively in 50-m swim times when compared to controls.

Our results demonstrate a clear beneficial effect of the core training intervention on measures of core functioning and given the improvements in swim time the improvements appear to have transferred to 50-m front crawl swim performance. There have been several attempts to examine the effects of core training on sports performance and generally the findings have been unclear. For example, the effect of a Swiss ball core training programme on the economy of running was found to be minimal[28] and it has subsequently been suggested that the lack of sport-specificity of core training programmes is to blame.[10] The difficulty in devising a sport-specific core training programme is potentially exacerbated for swimmers because not only are the general biomechanics of the core very complex but detailed biomechanical analyses of swimming are difficult to perform. Specifically, techniques for simultaneous kinetic and kinematic data capture required to perform detailed analyses are not widely available in aquatic environments. Consequently, it is difficult to develop an objectively determined exercise programme that is optimally designed for the specific needs of swimmers. Nonetheless, our observations of improved performance in all of our outcome measures would lend support to the proposition that positive training transfer has occurred for some of these core exercises.

Along with improved 50-m swim times our core training intervention also improved core endurance. Our training effect on the prone-bridge test appears to be less than that reported by Parkhouse and Ball,[29] who reported static and dynamic core exercises to improve core endurance by ~23.0%, although this was an uncontrolled study, however. Furthermore, our baseline values in the prone-bridge test were substantially greater and as such any training effect is likely to be smaller. Along with improved core endurance, we also found a moderate improvement in strength on an asymmetric straight-arm pull-down test. Comparisons with the literature are not possible here though as previous studies have only considered this action in symmetric conditions. As shoulder extension was not specifically targeted in the training intervention our finding is difficult to explain. Presumably, improved core functioning, contributed to the improvements in shoulder extension strength, via stabilization of the trunk. Moderate to large improvements in EMG activity during MVCs of key core musculature help to explain improved performance on our measures as an increase in the MVC EMG activity is considered to reflect an increase in neural drive and neuromuscular strength of the underlying muscle.[19,30] Thus, the improvements in MVC activity in these tests are considered beneficial and comparable with MVC improvements observed in other populations (e.g. Fimland[30]).

Our experiment was performed in a pragmatic setting in which there were no opportunities to isolate and discriminate the effects of the individual components of the intervention. Therefore, it is impossible to ascertain with confidence which of these exercises was the most important. Since front crawl swimming is performed in a prone position - requiring the maintenance of horizontal posture via lumbar extensors - it may have been that the side-bridge, shown to elicit high-levels of activity in the lumbar multifidus and/or longissimus thoracis muscles,[16] may have contributed disproportionately to the success of our intervention. In contrast, for each stroke in which the hand pushes against the water to provide propulsion, the dynamic reaction forces exerted on the hands will be directed away from the joint centres of the spine, thus creating dynamic moments about the three rotational axes of the vertebrae. The ability to maintain stability and control of the trunk during body roll and to resist these asymmetrical moments is likely to be enhanced by dynamic asymmetrical exercises such as the bird-dog. Specifically, this exercise elicits high-levels of activity in gluteus maximus, external oblique abdominis and gluteus medius[14,16] while stabilising the trunk in a prone position. Thus, taken together, it may be that the static symmetrical exercises are secondary to the dynamic asymmetrical exercises in terms of importance (or *vice versa*).

Similarly, it may be that some elements of progression (e.g. increasing the number of sets) were more effective than others (e.g. increasing the hold times). Regardless, an improved understanding of swimming technique through aquatic-based measuring tools will in time improve this understanding and allow further refinement of the intervention.

**Practical applications**
Our findings suggest that the implementation of isolated core exercises would appear to be a worthwhile addition to the programming of a swimmers dry-land training routine. There were, however, several limitations associated with our study. First, we were unable to provide precise information with regard to the intensity of pool-based training sessions undertaken by both groups of swimmers. However, the breakdown of session typology between groups was consistent, leading to similar training volumes (km). Further to this, all sessions were prescribed and delivered by experienced swim and strength and conditioning coaches. Second, while we have demonstrated a clear beneficial effect of our core training intervention on 50-m swim performance, we were unable to examine the training effect on swim stroke mechanics, namely stroke depth, rate and length, and also dive mechanics. This is an area that warrants further research. In particular, the effect of isolated core training on stroke rate, given that in a 50-m sprint this variable is important, as to be efficient the 50-m swimmer has to generate relatively moderate to high levels of maximal strength *but* at a high stroke rate.[6] Third, timing error may increase when the number of swimmers measured by the coach increases. Therefore, for future studies we recommend video analysis and/or timing pads as a solution to this potential problem. Fourth, when utilising clustered experimental design observations, individuals in the same cluster tend to be correlated.[31] Failing to account for dependence between individual observations and the cluster to which they belong produces confidence intervals that are too narrow.[11] In the absence of any previously reported intracluster correlation coefficients for 50-m swim performances of elite junior swimmers following an exercise intervention we were unable to determine the design effect and allow for clustering in our analysis. Fifth, our secondary measure to monitor neuromuscular adaptation is simple yet pragmatic. Further lab-based work to derive rates of activation and torque development alongside additional measures such as MVC torques, muscle cross-sectional area and co-contractions would improve our understanding of the specific nature of the muscular response to the training programme. Finally, a major hurdle when studying young athletes is that the effects of growth and maturation may mask or be greater than the effects of training.[32] However, we found clear improvements in our measures of performance and fitness, after controlling for the effect of age and body mass. Given the short-term nature of our core-training intervention and the age of the swimmers it is unlikely that maturation will have impacted upon our results, especially as young swimmers tend to be average or slightly advanced in maturity status.[32] Further to this, the effect of the intervention on body mass was trivial, which we believe provides further support for neuromuscular gains, not growth or maturation, subtending the improvements we observed in all our outcome measures.

**Conclusion**
Our findings represent the first piece of evidence for the beneficial effect of isolated core training on sprint swim performance in national-level junior swimmers. Further to this we have evidenced adaptations that could well subtend the improved 50-m swim times, namely enhanced performance on functional tests relevant to the front crawl swim stroke and greater maximal voluntary contractions of involved musculature.

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Figure Captions.

Figure 1. Core training exercise details.
a) Prone-bridge. Hold a straight body position supported on elbows and toes. Brace the abdominal muscles and hold the back in a neutral position.
b) Side-bridge. Lie on one side, ensuring top hip is positioned above the bottom hip. Push up until there is a straight bodyline through feet, hips and head.
c) Bird-dog. Position hands below shoulders and knees below hips. Place back in neutral, slowly extend one leg backwards and raise forward the opposite arm until level with back. Ensure back does not extend and shoulders and pelvis do not tilt sideways. Bring leg and arm back to start position and swap sides.
d) Leg raise. Lie on back with knees extended on floor. Place back in neutral position and lift one leg straight up keeping knee extended and other leg held out horizontally off floor. Raise leg till hip at 75degrees, then return to start position and repeat with opposite leg.
e) Overhead squat. Using weighted medicine ball, place hands either side of ball and raise above head with straighten arms. Feet shoulder width apart, squat down as low as possible while maintaining balance, keeping ball, head and back vertical. Straighten legs and repeat.
f) Sit twist. Sit up with knees bent and lean back at 45°. Feet off floor, keeping back in neutral, using a 4 kg medicine ball, twist waist and shoulders to one side with ball held out in front of you. Return to forward and repeat to other side.
g) Shoulder press. Lie prone to the floor with both arms fully extended. With a 3 kg dumbbell in each hand, raise one arm upwards and then return the arm back to the floor. Repeat this movement with alternate arms.
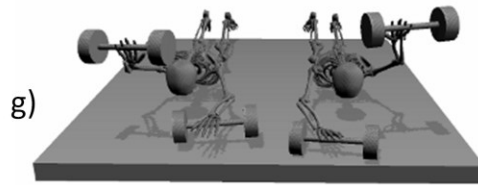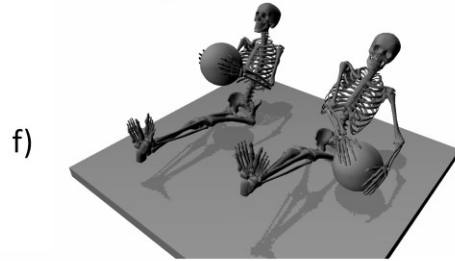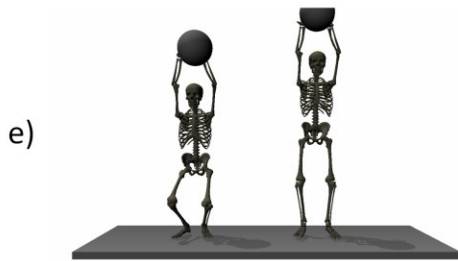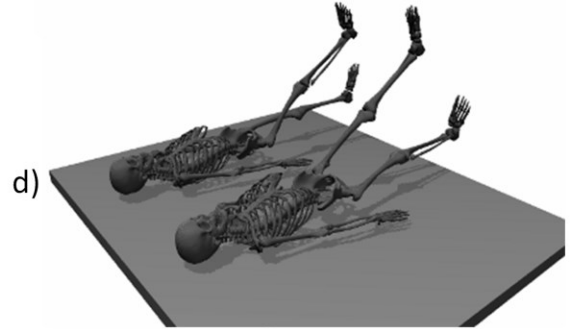
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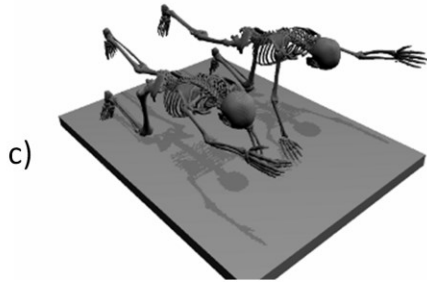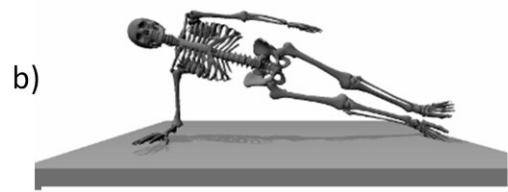
Table 1 Core exercise progression over the 12-week training regimen

| Exercise | Progression | Week 1-2 | | Week 3-4 | | Week 5-6 | |
|---|---|---|---|---|---|---|---|
| | | Repetitions | Sets | Repetitions | Sets | Repetitions | Sets |
| Prone-bridge | Volume | 30 s hold | 2 | 60 s hold | 2 | 90 s hold | 2 |
| Side-bridge | Volume | 30 s hold | 2 | 60 s hold | 2 | 90 s hold | 2 |
| Bird-dog | Volume | 10 | 3 | 15 | 3 | 20 | 3 |
| Leg raise | Volume | 10 | 3 | 15 | 3 | 20 | 3 |
| Overhead squat | Resistance | 10 (3kg) | 3 | 10 (4kg) | 3 | 15 (5kg) | 3 |
| Sit twist | Resistance | 15 (3kg) | 3 | 15 (4kg) | 3 | 15 (5kg) | 3 |
| Shoulder press | Volume | 10 | 3 | 10 | 4 | 15 | 4 |
| Exercise | Progression | Week 7-8 | | Week 9-10 | | Week 11-12 | |
| | | Repetitions | Sets | Repetitions | Sets | Repetitions | Sets |
| Forward-bridge | Volume | 90 s hold | 3 | 120 s hold | 2 | 120 s hold | 3 |
| Side-bridge | Volume | 90 s hold | 3 | 120 s hold | 2 | 120 s hold | 3 |
| Bird-dog | Volume | 25 | 3 | 25 | 4 | 30 | 3 |
| Leg raise | Volume | 25 | 3 | 25 | 4 | 30 | 3 |
| Overhead squat | Resistance | 20 (6kg) | 3 | 20 (7kg) | 4 | 25 (7kg) | 3 |
| Sit twist | Resistance | 20 (6kg) | 3 | 20 (7kg) | 4 | 25 (7kg) | 3 |
| Shoulder press | Volume | 20 | 3 | 20 | 4 | 25 | 3 |

Table 2 Outcome measures at baseline with effect statistics and inferences for within- and between-group comparisons

| | Core training group | | Control group | | Group comparison (core-control) | |
|---|---|---|---|---|---|---|
| | Baseline values (mean ± SD) | Adjusted change score (% mean; 90% CI) | Baseline values (mean ± SD) | Adjusted change score (% mean; 90% CI) | Difference between groups (% mean; 90% CI) | Qualitative inference |
| *Performance measures* | | | | | | |
| 50-m swim time (s) | 29.7 ± 2.1 | -2.7; -4.2 to -1.1 | 28.0 ± 1.9 | -0.7; -1.6 to 0.2 | -2.0; -3.8 to -0.1 | Large +ve* |
| Prone-bridge test (s) | 211 ± 71 | 14.1; 9.2 to 19.2 | 221 ± 92 | 4.7; 0.2 to 9.3 | 9.0; 2.1 to 16.4 | Small +ve* |
| Straight-arm pull down (kg) | 8.5 ± 2.6 | 26.2; 19.6 to 33.1 | 8.4 ± 2.4 | 2.5; -2.9 to 8.1 | 23.1; 13.7 to 33.4 | Moderate +ve** |
| *Peak EMG activity during an isolated maximal voluntary contraction test* | | | | | | |
| External oblique (mV) | 503 ± 29 | 8.4; 6.4 to 10.5 | 508 ± 19 | 0.7; -1.3 to 2.6 | 7.7; 4.6 to 10.8 | Large +ve** |
| Multifidus (mV) | 361 ± 22 | 17.6; 10.2 to 25.5 | 316 ± 21 | 1.2; -5.2 to 8.0 | 16.2; 3.9 to 30.1 | Large +ve** |
| Latimuss dorsi (mV) | 801 ± 76 | 4.4; 2.7 to 6.2 | 825 ± 72 | -1.4; -3.0 to 0.3 | 5.9; 3.4 to 8.5 | Moderate +ve* |

SD = standard deviation. CI = confidence interval. +ve = positive effect on core training group when compared to controls. -ve = negative effect on core training group when compared to controls.
*25-75%, possibly; **75-95%, likely.