Modern Sport

Volume 25 | Issue 2 Article 13

6-29-2026

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Recommended Citation
Mansoor, Abbas Tawfeeq (2026) "The Effect of Strength Training on the Development of Selected Core Muscles and Arm Strength in Young Boxers Aged 17–18 Years," *Modern Sport*: Vol. 25: Iss. 2, Article 13.
DOI: https://doi.org/10.54702/2708-3454.2135

MODERN SPORT 2026;25:217–224

ORIGINAL STUDY

The Effect of Strength Training on the Development of Selected Core Muscles and Arm Strength in Young Boxers Aged 17–18 Years

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Abstract

This study aimed to investigate the effect of strength training on the development of selected core muscles and arm strength in young boxers. Boxers utilize maximum and fastest arm punches and core movements to achieve optimal performance against their opponents in bouts. Despite the importance of these elements, variations in specific strength levels are observed among young boxers aged 17–18 years. The problem lies in the fact that traditional training may not adequately or specifically focus on the "selected core muscles" that support dynamic balance during a fight, or on the link between core strength development and increased arm strength efficiency. The researcher's sample consisted of 16 young boxers from the Army Sports Club, in the lightweight category (46–56 kg). The sample was divided into two groups: a control group and an experimental group, each with 8 boxers. The results showed significant differences favoring the experimental group. The percentage of improvement in the tests (dynamic sitting, plank, sitting from a prone position, and medicine ball throw to the left and right) was 34%, 20%, 38%, 26%, and 29% for the experimental group, while for the control group it was 4.4%, 1.34%, 4.54%, 2.56%, and 2.76%, respectively. This study also contributes to achieving one of the United Nations Sustainable Development Goals in Iraq, namely improving physical health, by enhancing the physical capabilities and performance of junior boxers.

Keywords: Core muscles, Motor transmission, Muscular endurance, Motor coordination

1. Introduction

Specialists and researchers in the field of sports have a wide range of diverse and multifaceted areas in which to address and resolve issues related to sports, with the aim of helping athletes achieve their highest possible performance levels and secure top rankings in all local, international, and Olympic competitions.

Performance in sports requires a constant effort to identify and understand the factors surrounding training. Training is defined as the controllable processes through which performance is improved via exercises (Kasper, 2019) It is a comprehensive and integrated process aimed at bringing the athlete to peak condition during various training phases and, consequently, during competition. High athletic performance requires continuous and effective preparation for the training process, which implies a deep understanding of the structure and mechanics of athletic performance.

Combat sports are gaining increasing popularity and one of the most prominent among them is boxing which demands intense effort over relatively short bouts. This places boxers under pressure to undergo various training regimens in order to improve their skills and meet the demands of the sport.

Through the researcher's review of club training, he did not notice sufficient attention to these exercises in a comprehensive manner. Likewise, through his review of previous studies, he found a scarcity of studies that addressed the effect of strength training on core muscles and arm power among young boxers in the Iraqi context. Therefore, previous studies looked at basic core training on static muscle

Received 21 May 2026; revised 3 June 2026; accepted 12 June 2026.
Available online 29 June 2026

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https://doi.org/10.54702/2708-3454.2135

procedures such as plank exercises, which alone contribute to improving dynamic athletic performance to a limited extent, and they did not examine in detail its effect on the abilities studied in this research, through the use of selected exercises, which are exercises targeting the back oblique line and the front oblique line.

The researcher believes that physical fitness can be divided into two categories: health related physical fitness and physical fitness related to motor skills in specialized sports. Health related fitness refers to fitness characteristics that are strongly associated with beneficial health outcomes, such as body composition, cardiovascular endurance, flexibility, and muscular endurance (Corbin et al., 2000; Utesch et al., 2018). Physical fitness related to motor skills, on the other hand, includes the physical fitness and motor skills that enhance athletic performance, such as flexibility, balance, coordination, speed, reaction time, and strength (Caspersen et al., 1985). Therefore, physical fitness is the most important factor for boxers, as a high level of physical fitness enables them to achieve the highest possible performance during competitions.

The term “core muscles” refers to a group of muscles that surround the spine, hips, and pelvis, including the deep muscles of the spine, the abdominal muscles, and the gluteal muscles. The diaphragm and the pelvic floor muscles are also part of this group of muscles”(Behm et al., 2010).

Therefore, the core muscles are one of the most important parts of the body that control an athlete’s movements, as most movements originate from these muscles (Yuan, 2009). The core plays a major role in the power and speed of the punches a boxer throws, as well as in trunk movements such as sidestepping, lunging forward and backward, and other maneuvers. Additionally, this area absorbs the opponent’s continuous punches. All of this makes this part of the body extremely important for boxers.

In this context, the importance and purpose of core muscle training for boxers is the total development of strength, endurance and neuromuscular control of the core, as well as the general motor performance of the body. These exercises must be designed and implemented in a manner consistent with the nature of boxing to enhance boxers’ performance (Barr et al., 2007).

Boxing is a sport that demands high levels of physical fitness. The core plays a pivotal role as a link in transferring power from the lower to the upper limbs, and arm strength is a crucial factor in the effectiveness and power of punches. Despite the importance of these elements, there is a noticeable disparity in strength levels among young boxers aged 17–18, a stage that requires structured training programs to develop muscle mass and explosive power. The problem lies in the fact that traditional training may not focus sufficiently or specifically on the "selected core muscles" that support balance during a fight, or on the connection between developing core strength and increasing arm power efficiency.

Research Objectives to develop strength training programs to enhance some basic core muscles and arm strength in young boxers, and to identify the effect of strength training on developing some basic core muscles and arm strength in young boxers.

1.1. Research hypotheses

- The experimental group is expected to show significant improvement in the measured variables when comparing the post-test results with the pre-test results.
- The control group is expected to demonstrate significant differences between the pre-test and post-test measurements, favoring the post-test measurements.
- The experimental group is expected to outperform the control group in the post-test assessment of the investigated variables.

2. Methodology

2.1. Research methodology

The researcher employed a two-group experimental design: control and experimental groups, due to its suitability for the nature of the problem, the research population consisted of 27 youth boxers from the Army Sports Club. 16 lightweights (46–56 kg) were selected to form the main research sample and were randomly divided into a control group and an experimental group, with eight boxers in each group.

2.2. Research domains

- Human Domain: Lightweight (46–56 kg) youth athletes from the Army Sports Club.
- Spatial Domain: The Army Sports Club gym in Baghdad.
- Temporal Domain from Thursday/August/1/2024 to Monday/October 28/2024.

2.3. Equivalence of the research sample

As shown in the Table 1, the (t) test for independent samples demonstrated no significant differences between the control and experimental groups in all tests at a significance level of (0.05), indicating that the two groups are equivalent.

Table 1. Demonstrates the equivalence of the two groups of researchers in the pretests being studied.

No.	Tests	Control Group Mean	SD	Experimental Group Mean	SD	t-value	Sig.	Type of Significance
1	Dynamic Bridge Test	8.37	1.50	8.75	1.48	0.501	0.93	Non-significant
2	Plank Test	93.00	9.27	100.00	17.84	0.98	0.24	Non-significant
3	Sit-up Test	8.37	1.18	9.00	0.75	1.25	0.11	Non-significant
4	Medicine Ball Throw (Left Arm)	9.22	0.71	9.35	0.83	2.26	0.14	Non-significant
5	Medicine Ball Throw (Right Arm)	9.55	0.83	9.52	0.90	2.24	0.31	Non-significant

2.4. Data collection tools

- Foreign and Arabic sources and references.
- Data collection form.
- Face-to-face interviews and social media interactions with specialists and experts.

2.5. Equipment and tools used in the research

HP Laptop (1), Canon camera (1), Medical scale (1), Gloves (16), Whistle, Measuring tape, Stopwatch, Camera tripod.

2.6. Tests

2.6.1. Dynamic sitting test (Wood, 2016)

Purpose: To measure dynamic abdominal muscle strength.

Equipment: Mat and stopwatch

Procedure: The subject sits on a flat surface with the knees bent at a 90-degree angle and knees and ankles together. The assistant holds the ankles and firmly presses them against the floor. Three different test levels are performed, with 5 repetitions for each level. The difference between the levels is the position of the hands. In the first level, the subject reaches the center of the patella with the fingertips of both hands while keeping the arms straight and the palms resting on the thighs. In the second level, the arms are folded across the chest, with the goal of touching the thighs with both elbows. In the third level, the person touches the back of their earlobe with their fingertips and attempts to touch their thighs with their elbows.

Scoring: The test score is the number of repetitions performed correctly (a number ranging from 0 to 15).

2.6.2. The plank test (Bohannon et al., 2018)

Purpose: To measure the endurance of the major trunk muscles.

Equipment: A flat surface, a mat, a whistle, a stopwatch.

Procedure: Lie on the floor with your elbows and forearms supporting your upper body from the front and your feet supporting your lower body from the back. Your body should be straight parallel to the floor and raised in a straight line from head to toe.

Recording: Record the time from the moment the subject is in the correct position with the head facing down and not looking forward. Start the stopwatch and the test ends when the subject is unable to keep the back straight and the hips drop.

2.6.3. Sit-to-stand test (Jabbar, 2011)

Purpose: To measure the maximum strength of the rectus abdominis muscles of the anterior trunk.

Equipment: A set of steel discs of varying weights.

Procedure: The test is performed from a supine position with the subject holding the weight plate behind their head while an assistant holds their legs near the feet. The subject attempts to sit up from this position once then tries again with a heavier weight plate, and so on until they reach the maximum weight with which they can sit up while remaining just above the floor.

Recording: Number of repetitions.

2.6.4. Medicine ball throw test (Mohammed & Jalal, 2020)

Test 1: Left arm medicine ball throw (1 kg)

Purpose: To measure the explosive strength of the left arm.

Procedure: The player is behind a line placed on the ground in a boxing stance, and he has a 1-kilogram medicine ball in his left hand, and he throws the ball forward.

The player throws the ball forward as if he were throwing a left jab. Note that left-handed players perform the test with their left hand.

Scoring: The participant is given three attempts and the best attempt is recorded with distance measured in centimeters.

Test 2: Right arm medicine ball throw (1 kg)

Purpose: To measure the explosive strength of the right arm.

Procedure: Behind a line on the ground, the player is in a boxing stance with a 1-kilogram medicine ball in his right hand and pushes the ball forward.

The participant throws the ball forward as if throwing a perfect right straight punch. Note that left-handed players perform the test with their left hand.

Scoring: The participant is given three attempts and the best attempt is recorded with the distance measured in centimeters.

2.7. Scientific of testing

For tests to achieve the goals and purposes for which they were designed and to be considered reliable and valid, they must meet certain criteria and conditions including (validity - reliability and objectivity).

2.8. Test validity

There are several methods for measuring test validity including content validity which involves presenting the test to a group of experts and specialists in the field for which it is intended. This is the method the researcher used to establish the validity of the tests employed.

2.9. Test reliability

The test-retest method is one of the best ways to determine the test's reliability while maintaining the same test conditions as much as possible. The researcher employed this method by administering the test to a sample group and, after a period of five days, retesting the same individuals under the same conditions. The reliability coefficient of the test was calculated by the simple correlation coefficient (r) as shown in Table 2.

2.10. Test objectivity

This is defined as "the absence of subjective judgments by the experimenter, free from bias and personal interference; the higher the degree of subjectivity in the test judgments, the lower its objectivity; and the more the subjective judgments are free from influence, the higher the degree of objectivity" (Melhem, 2005). To ensure that the tests were highly objective, the researcher calculated the simple correlation coefficient between the experts' scores, as shown in Table 2.

As shown in Table 2, the reliability and objectivity coefficients of all tests indicate a high degree of reliability and objectivity; therefore, they are suitable for use in the research.

Table 2. Shows the objectivity of the tests used in the research.

No.	Tests	Reliability	Objectivity
1	Dynamic Sit-up Test	0.92	0.94
2	Plank Test	0.88	0.90
3	Sit-up Test	0.91	0.91
4	Medicine Ball Throw (Left Arm)	0.89	0.92
5	Medicine Ball Throw (Right Arm)	0.90	0.92

2.11. Pilot study

On August 2, 2024, the researcher conducted a pilot study at the Army Club Hall in Baghdad on a sample of five participants who were not included in the primary research sample. The objective of the pilot investigation was to:

- To confirm the instruments and tools' functionality.
- To train assistants on the application of the tests and procedures research.
- The suitability of the program for the selected sample.
- The suitability of the exercises for the sample (in terms of ease and difficulty).

2.12. Pre-tests

Pre-tests were administered to the research sample at Saturday / August 3 / 2024 at 4:00 p.m. at the Army Club Hall in Baghdad for the tests under study.

2.13. Exercises used

The researcher designed the exercises taking into account the appropriate number of repetitions intensity and rest periods based on scientific sources expert opinions and the latest research. Therefore, it should include both low- and high-threshold dynamic exercises to emphasize neuromuscular control, endurance, and strength (Hibbs et al., 2008; Swinnen, 2016). With increased difficulty levels for 8 weeks. Dynamic exercises are subject to repetition and quantity restrictions. Three sets of all movements were executed. The activities were attempted to be executed with the appropriate technique. The resting time between movements is 30 seconds, and the resting time between sets is (1–1.30 minutes).

The researcher also reviewed the sample exercises in coordination with the team coach. The exercises were implemented as follows:

Training commenced on Monday, August 5, 2024, and concluded on Saturday, September 28, 2024, with a total of 24 sessions, with three sessions scheduled each week (Monday, Wednesday, and Saturday). The primary segment of the training was estimated to last

between 25 and 35 minutes, taking into account the team's core-training schedule.

Exercises used: (Frontal support in front of the opponent, Anterior oblique sling + force absorption, Barbell torque, Clapping push-up, MB push-up on 1 ball, Oblique crunch, One-arm cable press (1RM), Posterior Oblique Sling with rotational transfer, sling + force absorption, Spiral sling. Vertiball slam, Medicine Ball Rotational Throws).

2.14. Post-tests

The post-tests were administered to the research sample at the Army Club Hall in Baghdad on Monday, September 30, 2024, at 4:00 p.m. The same procedures used by the researcher in the pre-test were followed.

3. Results

As shown in Table 3, no statistically significant differences were found between the pre and post tests of the control group at the (0.05) significance level, indicating that no significant improvement in the studied variables.

As shown in Table 4, statistically significant differences were observed at the 0.05 level of significance, indicating that the strength training exercises had a positive effect on the studied variables.

As shown in Table 5, statistically significant differences were observed between the post-test results of the control and experimental groups at the 0.05 significance level, in favor of the experimental group.

Table 3 shows that there are no statistically significant differences between the pre and post-tests for the control group across all research variables. In Table 4, there are significant differences between the pre and post-tests for all research variables in the experimental group, favoring the post-tests. The aim of the study was to determine the effect of Strength Training on the on the Development of Selected Core Muscles and Arm Strength variables studied which were used in the experimental group and were designed to develop muscle and joint strength in those areas of the body (Ahn et al., 2018). Unlike the control group which stuck to standard traditional core exercises such as sit ups and leg raises we conclude that incorporating major core muscle exercises is essential despite the widespread use of forward trunk flexion exercises to develop the muscles in this region they appear to be less effective than core exercises, as the latter work to stabilize and strengthen the core muscles through an integrated kinetic chain which is consistent with previous literature (McGill, 2010; Okada et al., 2011).

Table 3. Demonstrates the importance of the control group's pre- and post-test mean differences in the variables under investigation.

Variable	Unit of Measurement	Pre-test Mean	SD	Post-test Mean	SD	t-value	D rate	Sig.	Significance
Dynamic Bridge Test	Repetitions	8.37	1.50	8.75	1.58	2.04	4.4%	0.08	Non-significant
Plank Test	Seconds	93.00	9.27	94.25	8.29	1.93	1.34%	0.09	Non-significant
Sit-up Test	Repetitions	8.37	1.18	8.75	1.16	2.04	4.54%	0.08	Non-significant
Medicine Ball Throw (Left Arm)	Meters	9.22	0.71	9.88	0.42	3.01	2.56%	0.12	Non-significant
Medicine Ball Throw (Right Arm)	Meters	9.55	0.83	9.98	0.65	4.64	2.67%	0.11	Non-significant

Table 4. Demonstrates the importance of the variations in the experimental group's pre- and post-test means for the variables under investigation.

Variable	Unit of Measurement	Pre-test Mean	SD	Post-test Mean	SD	t-value	D rate	Sig.	Significance
Dynamic Sit-up Test	Repetitions	8.75	1.48	11.75	2.49	6.48	34%	0.010	Significant
Plank Test	Seconds	100.00	17.84	120.00	19.10	9.74	20%	0.000	Significant
Sit-up Test	Repetitions	9.00	0.75	12.62	1.06	13.78	38%	0.000	Significant
Medicine Ball Throw (Left Arm)	Meters	9.35	0.83	11.80	0.95	5.521	26%	0.000	Significant
Medicine Ball Throw (Right Arm)	Meters	9.52	0.90	12.30	1.12	10.60	29%	0.001	Significant

Table 5. Demonstrates the importance of the discrepancies between the post-test means of the control and experimental groups in the variables under investigation.

Variable	Unit of Measurement	Control Group Mean	Experimental Group Mean	t-value	Sig.	Significance
Dynamic Sit-up Test	Repetitions	8.75	11.75	2.87	0.04	Significant
Plank Test	Seconds	94.25	120.00	4.06	0.03	Significant
Sit-up Test	Repetitions	8.75	12.62	2.87	0.04	Significant
Medicine Ball Throw (Left Arm)	Meters	9.88	11.80	5.24	0.04	Significant
Medicine Ball Throw (Right Arm)	Meters	9.98	12.30	4.96	0.03	Significant

A review of Table 5, which presents the post-test results for the control and experimental groups, reveals statistically significant differences in favor of the experimental group across all studied variables. The results demonstrated the effectiveness of the core muscle training program, which lasted, during which forward bending exercises and leg raises were excluded because they were used in the control group's training and also because they are considered routine exercises performed almost continuously and have a limited effect, as observed.

Compared to traditional methods of training this part of the body, strength exercises are a better approach to building core, as strong core muscles serve as key pivots in a boxer's kinetic chain, providing a foundation of stability for the upper and lower limbs. In other words: Core exercises improve overall control and the transfer of force to the final phase of various movements, and are therefore of paramount importance for improving performance (Luo et al., 2022). These training methods represent a new trend in physical fitness due to their effectiveness in improving and enhancing performance (Muhammad & Azza, 2022), which is exactly what boxing—a sport with extremely high demands—needs (Chabut, 2009).

These muscles are of critical importance to boxers, not only because they help them withstand their opponent's blows to the midsection, but also because they enable them to deliver more powerful and effective punches by contributing to the kinetic transfer and rotational force of the punch (Brittenham & Taylor, 2014).

The significant improvements observed in the experimental group can be explained by the nature of the selected strength-training exercises, which targeted the core muscles and enhanced force transfer during movement. In line with the above, proper planning for the use of body strength—and core (central) muscle strength in particular helps ensure that the right amount of energy is expended during performance, thereby increasing strength (Nassar et al., 2024). This is what the researcher seeks to develop through the proposed exercises in a scientific manner, as training based on scientific and practical principles will inevitably aim to improve the specific aspects for which it was designed, There is no doubt that following scientific methods in sports training is fundamental to achieving optimal performance in all aspects of training and to effectively leveraging that performance during competitions (Gök & Özen, 2023; Joda et al., 2021).

The findings of this study are consistent with those of a study by Abdelrahim and Mohammed**: (**2022**)** which indicates that "improving trunk stability and rigidity increases force production and performance," as evidenced by the results of post-hoc tests; which was the consequence of the scientifically applied exercises to the experimental sample and that the major trunk muscles can provide a rigid biomechanical platform for the peripheral muscles, as they serve as a link in the kinetic chain between the lower and upper limbs and play a crucial role in force generation during the performance of peripheral movements, such as punching (Bashir et al., 2019).

The researcher therefore believes that the selected strength exercises helped develop these muscles thereby enabling the performance of more powerful and effective movements.

The researcher explains that this development in results was due to the training that developed the exercises of the posterior oblique muscle system and the anterior oblique muscle system, as the former transfers force from the lower part to the upper part of the body, and generates and stabilizes the trunk rotation (Greenman, 1997) "anterior oblique muscle system, it releases energy during the central contraction of the muscles, which plays an important role during ballistic rotational movements such as throwing and punching" (Logan & McKinney, 1970).

4. Conclusions

- Core exercises have a positive effect on the study variables.
- Pattern based exercises have a limited effect on the core muscles.
- Core exercises outperform the trainers pattern-based exercises across all study variables.

5. Recommendations

- Focus on core exercises, given their significant impact on improving this important part of the body, and incorporate them into training programs on a regular basis.
- Conduct similar research on boxers to determine its impact on technical performance.
- Conduct similar research to determine its impact on various abilities, including boxers motor agility.

Author's declaration

Conflicts of interest

None.

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical clearance

This manuscript approved by the Scientific Committee of the Ministry of Education / General

Directorate of Education of Baghdad Al-Karkh Second, Iraq, on (1/5/2026).

Author's contributions

All contributions of this study were done by the researcher Abbas Tawfeeq Mansoor who get the main idea and work on writing and concluding also with Asst. Lecturer Badr Gaafar AMEEN (University of Kufa, College of Education, Department Of English language, M.A. in English Language/Applied linguistics) contributed to the translation of the research and the linguistic revision of the manuscript.

Facilitating the task

This study was supported by the General Directorate of Education of Baghdad Al-Karkh Second, Iraq / Ministry of Education.

Roles of each researcher in the research

The researcher, Abbas Tawfeeq Mansoor, was responsible for conceptualizing, designing, reviewing literature, collecting data, interpreting results, writing the draft, and final reviewing the manuscript.

Funding

This research received no external funding.

Data availibilty

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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تأثير تدريب القوة على تنمية عضلات الجذع المختارة وقوة الذراع لدى الملاكمين الشباب الذين تتراوح أعمارهم بين 17 و18 عامًا

عباس توفيق منصور

وزارة التربية/ المديرية العامة لتربية بغداد الكرخ الثانية

الخلاصة

هدفت هذه الدراسة إلى التعرف على تأثير تدريبات القوة في تنمية بعض عضلات الجذع المختارة وقوة الذراعين لدى الملاكمين الشباب. ونظرًا للدور المحوري الذي تؤديه عضلات الجذع في نقل القوة الحركية وتحقيق الكفاءة الأداءية أثناء المنازلات، فضلاً عن أهمية قوة الذراعين في تنفيذ اللكمات بفاعلية، فقد لوحظ وجود تباين في مستويات القوة الخاصة لدى الملاكمين الشباب الذين تتراوح أعمارهم بين (17–18) سنة. وتتمثل مشكلة البحث في أن البرامج التدريبية التقليدية قد لا تولي اهتمامًا كافيًا أو متخصصًا للعضلات الجذعية المختارة التي تسهم في تحقيق التوازن الحركي أثناء النزال، كما أنها لا تركز بصورة مباشرة على العلاقة بين تطوير قوة الجذع وزيادة كفاءة قوة الذراعين. تكونت عينة البحث من (16) ملاكمًا شابًا من نادي الجيش الرياضي ضمن فئة الوزن الخفيف (46–56 كغم)، وقُسِّمت عشوائيًا إلى مجموعتين متكافئتين: تجريبية وضابطة، بواقع (8) ملاكمين لكل مجموعة. وأظهرت النتائج وجود فروق ذات دلالة إحصائية لصالح المجموعة التجريبية، إذ بلغت نسب التحسن في اختبارات الجلوس الديناميكي، والبلانك، والجلوس من وضع الرقود، ورمي الكرة الطبية بالذراع اليسرى واليمنى (34%، 20%، 38%، 26%، و29%) على التوالي، مقارنةً بالمجموعة الضابطة التي بلغت نسب التحسن لديها (4.4%، 1.34%، 4.54%، 2.56%، و2.76%) على التوالي. وتسهم هذه الدراسة في تحقيق أحد أهداف الأمم المتحدة للتنمية المستدامة في العراق، والمتمثل في تحسين الصحة البدنية، من خلال تطوير القدرات البدنية ورفع مستوى الأداء لدى الملاكمين الشباب.

الكلمات المفتاحية: عضلات الجذع الأساسية، النقل الحركي، التحمل العضلي، الربط الحركي.