



Effect of Core Muscle Strength Training on Physical Abilities and Performance of Curved Back Aerial Flip Skill Preceded By The Arab Jump on The Floor Exercise Mat For Juniors

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Abstract
<p>Objectives. The primary objective of this study was to investigate the impact of core muscle strength exercises on improving the technical performance of the back handspring (curved back aerial flip) in junior male artistic gymnasts. Specifically, the research aimed to address deficiencies in skill execution by enhancing specific physical abilities such as speed-strength, flexibility, and explosive power through targeted core strengthening exercises.</p> <p>Materials and Methods. The study utilized an experimental design with a one-group pre-test and post-test model. The research population consisted of five junior male artistic gymnasts, aged between 11 and 13 years, who were registered and actively training at the Gymnastics Federation Training Center, Dhi Qar branch, under the Central Federation of Gymnastics during the 2024–2025 training season. All participants were selected as the research sample. The intervention included a series of core muscle strength exercises developed by the researcher. Pre- and post-tests were conducted to measure changes in core strength, speed-strength of the arms and legs, core flexibility, and the technical performance of the back handspring skill (preceded by a round-off on the floor).</p> <p>Results. The results demonstrated statistically significant improvements in all tested physical abilities after the implementation of the core strength exercise program. These included enhancements in arm and leg speed-strength, core flexibility, and explosive power. Additionally, the technical execution of the back handspring showed marked improvement, with reduced performance deductions and better control and form during execution.</p> <p>Conclusion. The study concluded that core muscle strength training plays a vital role in improving the technical performance of the back handspring skill in junior male gymnasts. The specially designed exercises contributed effectively to developing essential physical components required for successful skill execution. Therefore, it is recommended that gymnastics training programs incorporate core strengthening exercises tailored to the demands of the sport and the developmental level of the athletes.</p>
<p>Keywords : Core Muscle Strength, Physical Abilities, Curved Back Aerial Flip, Arab Jump, Junior Gymnastics.</p>

Introduction

The most important characteristic of our current era is the great scientific and technical development that has occurred in all areas of life, including the sports field, and this is evident through what developed countries have reached in achieving high sports achievements, and gymnastics is one of the sports that have achieved an amazing development in performance during the past few years, the emergence of new skills with high

difficulties on various devices is the best evidence of keeping pace with training programs for this development.(Rüppell & Hilfert-Rüppell, 2024)

Physical capabilities are one of the important factors on which the success of sports performance is based to reach the highest levels, and to achieve results with positive effects of physical abilities and skill performance in accordance with the requirements of sports practice.(Kim et al., 2025)

Especially core muscles exercises that work to transfer the force dynamically from the upper limb to the lower limb and vice versa and control the movement of the body by contraction and relaxation to attract the parties from one position to another and whenever these parties.(Wang et al., 2024) The more effective the better, the legs are the origin and fulcrum from which the muscles of the arms derive the momentum and the ground movements rug device is one of the basic technical gymnastics devices on which the level of the player is based and most of the skills of the ground movements mat depend in their performance on pushing the movements of the legs and the kinetic transfer of the rest of the body and limbs(Hall & Holt, 2023).

Especially the skill of the curved back aerial flip can't complete any movement without the involvement of the muscles of the core is considered the area of control in the performance of the skill, especially if it depends on the force of thrust so and from the foregoing has been manifested the importance of research in the statement of the active role and the great importance of the muscles of the center (core) in the transfer of force and the completion of motor duties easily and easily.(Ji et al., 2025)

One of the most problems facing coaches in the types of gymnastics championships is the deduction of the players' grades as a result of the mistakes they commit as a result of deficiencies in the elements of special fitness and technical errors of performance, and many motor skills performed in gymnastics depend on the limbs as a source of motive power and the muscles of the center (core) a major and decisive role in the transfer and enhancement of the amount of movement generated and the success of the performance of motor duty.(Ortiz-Morales et al., 2023)

The skill of the curved back aerial flip is one of the skills of the third group of the ground movements rug device rear acrobatic movements, which depends in its performance on the force of pushing the legs to the ground and the kinetic transfer of the force generated through the muscles of the center (core) to transfer the mass of the body in a continuous rotational movement of (360) degrees, as the body is oblique and the parts centered around the axes of rotating time fixed transverse while the axis of rotation is free in the non-localized

parts, To ensure the success of the performance of this skill, it depends on the momentum and rise in generating the kinetic energy necessary to reach the center of gravity of the body to the highest point that allows its rotation to be completed easily and easily.(Al-Bassal et al., 2024)

Therefore, and from the foregoing, the research problem has been diagnosed through the poor technical performance of the skill of the curved back aerial flip, represented by the deductions of grades for the players as a result of the inability to meet the requirements of physical performance of a correct technique and lack of understanding of the active role of the work of the center muscles .The current research aims to identify the effect of training the strength of the muscles of the center on some special physical abilities, as well as to identify the impact of developing some special physical abilities on the level of technical performance of the skill of the curved back aerial flip preceded by the Arab jump on the mat of ground movements for juniors.

Materials and Methods

Study Participants.

The study involved five junior male artistic gymnastics athletes aged between 11 and 13 years, all of whom were registered with the Central Gymnastics Federation and were training at the Gymnastics Federation’s Dhi Qar branch training center during the 2024–2025 season. Due to the limited number of athletes in this age category in Dhi Qar Governorate, all five athletes were selected to form the research sample. Homogeneity testing was conducted to ensure the consistency of the participants' characteristics, with values for skewness coefficients falling within the acceptable range (± 3), confirming a normal distribution in height, body mass, chronological age, and training age.

Study organization.

The study employed an experimental one-group design with pre- and post-testing to evaluate the effects of core muscle strength training. An exploratory study was conducted prior to the main experiment to ensure the appropriateness of the training exercises, determine training loads, identify potential implementation issues, and verify the adequacy of tools and timing.

Pre-tests were conducted from November 7 to 9, 2024, covering physical and technical performance metrics. The training program, designed based on previous literature and expert consultation, was implemented over eight weeks from November 14, 2024, to January 16, 2025. The program included 24 training sessions (three sessions per week), each lasting 35–45 minutes, and conducted on Sundays, Tuesdays, and Thursdays. Training

intensity ranged from 60% to 80% of each participant’s maximum capacity, with loads adjusted based on individual strength assessments.

The post-tests were administered from January 18 to 19, 2025, under conditions identical to the pre-tests to ensure consistency.

Statistical analysis.

The collected data were analyzed using the Statistical Package for the Social Sciences (SPSS), version 26. Descriptive statistics were used to evaluate the normality and homogeneity of the sample. Paired sample t-tests were conducted to assess significant differences between pre- and post-test results, with a significance level set at $p < 0.05$.

Results

Results of Physical Tests and Technical Performance of the Pre- and Post-Tests for the Curved Back Aerial Flip Skill

Table 1. presents the means, standard deviations, calculated *t*-values, and *p*-values for the physical and technical performance variables assessed during the pre- and post-tests of the research sample in the curved back aerial flip test.

Variables	Unit	Pre-Test Mean ± SD	Post-Test Mean ± SD	t- value	p- value	Significance
Arms power	reps	9.13 ± 0.83	11.38 ± 0.52	15.875	0.000	Significant
Legs power	reps	19.95 ± 1.12	24.41 ± 1.56	7.872	0.001	Significant
Core power	reps	8.25 ± 0.50	11.50 ± 0.58	3.000	0.039	Significant
Core flexibility	cm	63.50 ± 6.28	73.60 ± 0.70	5.267	0.006	Significant
Arms explosive power	m	6.41 ± 0.11	7.41 ± 0.78	3.650	0.021	Significant
Legs explosive power	cm	41.06 ± 3.44	43.86 ± 2.39	13.743	0.000	Significant
Curved back aerial flip	degree	3.75 ± 0.29	6.38 ± 0.63	6.412	0.003	Significant

Based on the results shown in Table 2, it is evident that all *p*-values for the tested variables are less than the significance threshold of 0.05. This indicates that there are

statistically significant improvements between the pre-test and post-test results across all measured physical and technical performance variables, including the curved back aerial flip skill. These findings suggest the effectiveness of the core muscle strength training program implemented in this study.

Discussion

The researcher attributes the reason to the good selection of exercises of the training program and their organization and the legalization of training load in a scientific manner for its components, which had a clear positive impact on improving and developing the strength of the muscles of the lower and upper limbs and the muscles of the center and this is consistent with what was pointed out by (Huang, 2021) Appropriate planning for the use of body energy in general and the energy of the center in particular helps to exert the appropriate energy to perform the movement and the body's access to the correct position, which has a positive impact on the performance of the skill, which needs to Strengthening the muscles of the center and the muscles of the lower and upper limb and the attachment of these muscles to the spine and pelvis, and in order to strengthen them, there must be a stable base, which allows increasing the forces and the efficiency of the movement of the limbs.(Huang et al., 2021)

The selected exercises also worked on the development of physical abilities explosive power and speed distinctive force of the muscles working on the skill of the upper and lower limbs and the muscles of the center and linking them and preventing the leakage of the acquired force, which contributed positively to the good transfer of kinetic energy generated from the limbs through the core to complete the motor duty easily and easily, and this is consistent with what he pointed out (Khamraeva, 2024) The center muscles work on the full transfer of the resulting force from the lower limb through the core to the upper limbs.(Khamraeva et al., 2024)

The researcher also attributes the improvement of the skill of the curved back aerial flip to the containment of the training program in addition to exercises to strengthen the muscles of the center and the upper and lower limbs to qualitative exercises similar in their work to the motor path of the skill, which worked to improve and strengthen the neuromuscular compatibility of the working muscles and the muscles corresponding to them, which had a clear impact on improving skill performance.(Antal et al., 2023)

In this regard, (Addo, 2024) points out that the strong central muscles work to connect the upper limb to the lower limb, in addition to the fact that the center muscle exercises include multi-directional movements that lead to focusing on one limb, making them the best exercises used that lead to improved skill performance.(Addo-Akoto et al., 2024)

On this basis, the work of the muscles of the center (core) is the basis for all sports skills can't complete any successful movement without the involvement of the core area it provides skill performance with the strength necessary to complete the motor duty as it works to provide stability and balance.(Zemková, 2022)

Conclusions

The findings of this study underscore the significant role that core muscle strength exercises play in improving various physical attributes critical to gymnastics performance, particularly the curved back aerial flip preceded by the Arab jump. The strengthening of the arms, legs, core flexibility, and explosive power directly contributed to the improvement in technical execution. These results emphasize the need to focus on selecting exercises that strengthen the core muscles in alignment with the specific requirements of the sport. Furthermore, it is crucial to emphasize the use of skill-specific exercises designed to enhance technical proficiency in gymnasts. This approach not only optimizes physical performance but also ensures better mastery of complex skills. Beyond gymnastics, these training methods should be applied to other age groups and sports to explore their broader effectiveness, promoting overall athletic performance across various disciplines.

By adopting these recommendations, coaches can enhance the performance and safety of athletes while fostering long-term development in their respective sports.

Recommendations

In light of the objective of the research and its results and guided by the conclusions, the researcher recommends the following:

- 1- The need for further research to validate and expand upon the current findings.
- 2- The need for longitudinal studies or replication with larger and more diverse samples would add value.
- 3- The need to use the proposed training curriculum because of its positive impact on players performance.
- 4- Directing the results of this research to the coaches and training Committee to benefit from these results.
- 5- Conducting more studies and scientific research using various training curricula and programs to improve the skills of all activities in general.

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