The Impact of Core Muscle Group Training on Muscular Strength, Static and Dynamic Balance, and Skill Performance Level of Kickboxing Athletes.

* Dr / Salah Ashraf Mohamed

Abstract:

The research aims to determine the effect of training on the muscle groups of strength and balance, both static and dynamic, on the skill performance level of kickboxing players. The researcher employed an experimental method on a sample consisting of (10) players from the Military Institution Club, who were divided into two groups, one of which was experimental and comprised (8) players. Additionally, (2) players were selected from the same research community from the Military Institution Club for the purpose of conducting a pilot study on them..

The most significant results indicated that core muscle group training has a positive impact on all physical variables under investigation, namely (core muscle strength – leg muscle strength – dynamic balance – static balance), as well as on all skill variables under investigation, which include (hook punch – low roundhouse kick) for kickboxing athletes.

Keyword: Core Muscle Group muscles center, Core ability , Core strength , Core power,

Problem and introduction :

The researcher has observed that a kickboxing athlete requires significant stamina and control while performing punches and kicks, which are characterized by power and speed, depending on the nature of the bout. Executing these techniques effectively necessitates the integration of strength, balance, speed, and ability. By reviewing specialized scientific references to identify the primary muscle groups that are most effective in performing various punching and kicking skills, the researcher has identified the following muscle groups: (the trunk muscles, the leg muscles, and the back muscles).

Core exercises enhance muscle strength and balance and are often utilized in daily training as they are methods that maintain the balance of the spine and hips. Additionally, they are a critical factor in development as they serve as a training method that accelerates the athlete's return to the field, enhances physical performance, and protects against sports injuries and rehabilitation.

In this regard, trunk exercises are included in training programs for almost all branches of sports based on physical performance. In trunk training, exercises are performed in two different ways: both stability and dynamic. (2:13) (21:31)

* Doctorate lecturer in the Department of Sports Training and Movement Sciences, Faculty of Physical Education for Boys - Benha University.

Both "Vom Hofe" (1995) and "Ron Jones" (2003) and "Michael Boyle" (2004) agree that core muscle group training is considered one of the newly used training forms in the sports field and is one of the important exercises suitable for all ages, regardless of their training levels, as it addresses body movement functions and improves the quality of athletic performance and enhances it. (36) (29) (7:25)

The researcher has observed through his field experiences as a coach and former player at both local and international levels that there is a clear deficiency among kickboxing athletes in effectively executing certain punches and kicks during competitions, despite their importance, which in turn affects the players' results during matches, particularly in international competitions. Additionally, the reliance of these skills on the abdominal and back muscles during execution is significant. Therefore, providing players with traditional training does not contribute to enhancing their level nor achieves integration between strength and balance simultaneously.

This was confirmed by "Amal Mohamed" (2005) citing "Marigg Roynalds" that traditional strength training, especially that performed on machines, focuses on performance in a static condition, whereas functional strength training removes the external support provided by machines and allows multiple muscle groups to work simultaneously and integratively. (1: 1,2)

Thus, the research problem crystallized in searching for a non-traditional training method that diversifies the training means and tools in order to avoid monotony and repetition, which allows for diversity in the training used that leads to development in physical level and specifically targets the muscle groups that significantly impact the performance of punches and kicks, directing these trainings to simulate the same movement path of these skills

Research aim :

The research aims to determine the effect of training on the muscle groups of strength and balance, both static and dynamic, on the skill performance level of kickboxing players

Search assumptions :

- There are statistically significant differences between the means of the measurements (pre-test - post-test) in muscle strength measurements, favoring the means of the post-test measurements for the sample under study.
- There are statistically significant differences between the means of the measurements (pre-test - post-test) in both static and dynamic balance, favoring the means of the post-test measurements for the sample under study.
- There are statistically significant differences between the means of the measurements (pre-test - post-test) in skill performance, favoring the means of the post-test measurements for the sample under study.

Research method :

Research procedures :

The experimental method was used with a one-group design employing pre-test and post-test measurements.

samp le of research :

The research community includes kickboxing players in the Cairo area at the Military Institution Club, aged between 18 and 20 years, who are registered with the Egyptian Kickboxing Federation for the year 2022/2023. The size of the primary sample reached 8 players, and 2 players were used in the exploratory study, making the total sample size 10 players.

Table (1)

Statistical description of the research sample individuals in the variables (height - weight - chronological age - training age)

Variables	unit	Mean	Median	SD	Skewness	Kurtosis
Height	Cm	169.80	171.00	3.726	-0.545	-0.900
Weight	Kg	65.00	65.00	2.903	0.808	-0.171
Age	Year	19.36	19.60	0.67061	-0.087	-1.925
training Age	Year	4.800	5.00	1.014	-0.019	-1.346

It is evident from Table (1) the normal distribution of the research sample individuals in the variables (height - weight - chronological age - training age), as the values of the skewness coefficients range between (±3), indicating that they fall under the normal curve, which suggests the homogeneity of the research sample individuals in those variables.

Means and Tools for Data Collection:-

First: Means and Tools:-

•Restameter
•Dynamometer
•Medicine ball weighing (3-5-7 kg)
•Swiss balls (elastic exercise balls)
•Rubber elastic
•Dumbbells
•Casio stopwatch for precise timing
•Kickboxing ring
•Balance disc
•Half balance ball
•TRX
• Free weights of various sizes (bars – dumbbells – plates)

Second: The Physical Tests Used:

- Back muscle strength test measured with a dynamometer.
- Leg muscle strength test measured with a dynamometer.
- Abdominal muscle strength test (sitting up from a lying position with knees bent).
- Static balance test.
- Dynamic balance test.

Third: Skill Performance Level Tests:

- Selection of skill performance level assessment for the hook punch skill.
- Selection of skill performance level assessment for the low roundhouse kick skill.

Exploratory Study:

The researcher conducted two exploratory studies. The first study took place from 11/2/2023 to

12/2/2023, involving a sample of (2) individuals outside the main sample. This study aimed to verify the validity of the tools and devices used and to train the assistants. The second study occurred from 24/2/2023 to 27/2/2023 and aimed to standardize the training loads specific to the training program.
Main Experiment:

After conducting the exploratory study and analyzing its results, the researcher carried out the main study as follows:

- **First: Pre-Test Measurements:**

Pre-test measurements were conducted for the research sample from 1/3/2023 to 2/3/2023 at the Military Institution Club and included:

Day one Measurements of growth rates (height - weight - training age) and physical measurements.

Day two Skill measurements for the hook punch and low roundhouse kick.

A- Defining the Objective of the Proposed Trainings:

The aim of the proposed training sessions is to strengthen the core muscle groups (abdominal and back muscles) to assess their impact on:

• Muscular strength of certain muscle groups

• Static balance and dynamic balance

• Level of skill performance, as presented to the esteemed experts

- The foundations that the researcher considered when applying the experiment:-

Characteristics of the load aimed at developing the core muscle strength using the **proposed training program:**

The program was implemented 4 times a week for a duration of 50:35 minutes over 8 weeks during the specific preparation period, resulting in a total of 32 training units. The intensity of the functional training was progressively increased over the weeks from 55% to 80%.

Load Volume:

• The appropriate volume for functional strength training ranges between 10 – 12 repetitions and 3 to 5 sets for weights; for bodyweight exercises, the volume ranges from 15 to 20 repetitions.

• For stability exercises, the repetitions range from 10 to 15.

• A standardized warm-up was performed in the training units for both research groups (experimental) with an air load intensity of 30% - 50%, which included exercises that contribute to raising body temperature, preparing the muscles for work, and activating blood circulation (such as varied jogging and jumping), followed by various stretching exercises.

• The main part was then executed, which included general preparation exercises for both research groups, targeting most parts of the body (inclined push-ups from standing– arm bends from inclined push-ups – pull-ups).

Rest Intervals:-

• The inter-set rest periods ranged between 10 to 15 seconds between exercises.

• The inter-set rest periods ranged between 60 to 90 seconds between sets.

The components of the training load

for the training program were determined based on a reference survey of the relevant studies.

- The experimental variable (core muscle group training) was applied in the preparation section of the training unit for the experimental group, alongside specific exercises for the working muscles.

• The cool-down section was implemented in the training units for the experimental group, which included exercises that contribute to recovery, such as swings and stretches.

Post-Measurements:

Post-measurements for the experimental group were conducted on the variables used in the research under the same conditions as the previous measurements during the time period of 13–14/5/2023.

Statistical Variables:-

The data was processed using the following statistical methods:

- Wilcoxon - The difference between the two means T.T.

- Arithmetic Mean - Improvement Ratios

Secondly: Presentation and Discussion of the Results of the first Hypothesis:

1- Presentation of the Results of the Second Hypothesis:

Table (2)

Wolcikson Test for calculating the significance of the differences between the pre-test and post-test measurements in (back muscle strength - leg muscle strength - abdominal muscle strength) for the sample under investigation.

Variables	Unit	Measurements	Mean	Mean ranks	Sum of ranks	Z
Strength of the back muscles	kg	pre	103.3541	0.00	0.00	-
		post	114.0000	4.50	36.00	2,521
Strength of the leg muscles	kg	pre	142.0000	0.00	0.00	-
		post	149.7500	4.50	36.00	2,527
Strength of the abdominal muscles	number	pre	54.8750	0.00	0.00	-
		post	61.7500	4.50	36.00	2,533

The tabulated value of (z) at a significance level of 0.05 = ±1.96 It is evident from Table (2) that the calculated value of (z) is greater than its tabulated value, indicating statistically significant differences between the pre-test mean and the post-test mean in (back muscle strength - leg muscle strength - abdominal muscle strength) in favor of the post-test for the experimental group under investigation.

Table (3)
The ratio of improvement between the average of the pre-test and post-test measurements in (back muscle strength - abdominal muscle strength - leg muscle strength) for the sample under study

n	Variables	pre mean	Post mean	Improving rat%
1	back muscles strength	103.3541	114.000	10.300
2	abdominalmuscles	54.8750	61.7500	12.549
3	legs muscles strength	142.000	149.750	5.457

It is evident from Table (3) that there are improvement percentages between the pre-test and post-test measurements in (back muscle strength - abdominal muscle strength - leg muscle strength). The highest improvement percentage recorded was (12.549%) and the lowest was (5.457%).

1- Discussion of the Results of the First Hypothesis:-

It is evident from the results in Table (2) that there are statistically significant differences between the two measurements (pre-test and post-test) in (back muscle strength), as the calculated value of (z) is greater than its tabulated value at a significance level of ±1.96. The mean scores for the pre-test and post-test measurements of back muscle strength ranged between (103.3541 - 114.0000). Furthermore, it is clear from Table (3), which pertains to the improvement percentages between the mean scores of the pre-test (103.3541) and post-test (114.0000), that there is an improvement percentage of (10.300%).

It is also evident from the results in Table (2) that there are statistically significant differences between the two measurements (pre-test and post-test) in (leg muscle strength), as the calculated value of (z) is greater than its tabulated value at a significance level of ±1.96. The mean scores for the pre-test and post-test measurements of leg muscle strength ranged between (142.0000 - 149.7500). Additionally, it is clear from Table (3), which pertains to the improvement percentages between the mean scores of the pre-test (142.0000) and post-test (149.7500), that there is an improvement percentage of (5.457%).

As evidenced by the results in Table (2), there are statistically significant differences between the measurements (pre-test and post-test) in (abdominal muscle strength), as the calculated (z) value is greater than its tabulated value at a significance level of ±1.96, where the mean scores for the pre-test and post-test of the variable of back muscle strength ranged between (54.8750-61.7500). Furthermore, it is evident from Table (3), which pertains to the improvement percentages between the average pre-test (54.8750) and post-test (61.7500) in abdominal muscle strength, that there is a percentage improvement of (12.549%).

that the researcher implemented on the sample individuals in the study.

The researcher attributes these differences and improvement percentages to the effectiveness of the proposed exercises using core muscle group training, which were diverse and targeted in developing the abdominal and back muscles specifically (the muscle group surrounding the spine) and all body muscles in general. Additionally, the core muscle group exercises included a variety of exercises that contribute to achieving balance in movement aspects across their axes and levels. The researcher noted that the activation exercises used during the warm-up period help increase strength production, as their use reduces internal resistance in the muscle and the structure of the sensory muscle spindles, thereby increasing muscle contraction strength and speed.

The results of this study are consistent with the findings of studies by "Stricevic et al." (1991) (35), "Norris" (1993) (26), "O'Sullivan et al." (1998) (27), and "Plamondon et al." (1999) (28), which concluded that strengthening the abdominal muscles and consequently the back muscles (core muscle strength) leads to...

Secondly: Presentation and Discussion of the Results of the Second Hypothesis:

1- Presentation of the Results of the Second Hypothesis:-

Table (4)

Wolcoxon's test to calculate the significance of the differences between the pre-test and post-test measurements in (static balance - dynamic balance) for the sample under investigation

Variables	Unit	Measurements	Mean	Mean ranks	Sum of ranks	Z
Static balance	Sec	pre	14.0000	0.00	0.00	-2،527
		post	25.6250	4.50	36.00	
Dynamic balance	Sec	pre	58.8750	0.00	0.00	-2،524
		post	67.2500	4.50	36.00	

The tabulated value of (z) at a significance level of 0.05 = ±1.96. It is evident from Table (4) that the calculated value of (z) is greater than its tabulated value, indicating statistically significant differences between the pre-measurement mean and the post-measurement mean in (static balance - dynamic balance) in favor of the post-measurement for the experimental group under study.

Table (5)

The ratio of improvement between the mean of the pre-test and post-test measurements in (dynamic balance – static balance) for the sample under study.

n	Variables	pre mean	Post mean	Improving rat**%**
1	Static balance	58.8750	67.2500	14.225
2	Dynamic balance	14.0000	25.6250	22.870

It is evident from Table (5) that there are improvement percentages between the pre-test and post-test measurements in (dynamic balance - static balance), with the highest improvement percentage being (22.870%) and the lowest improvement percentage being (14.225%).

2- Discussion of the Results of the Second Hypothesis:-

It is evident from the results in Table (4) that there are statistically significant differences between the two measurements (pre-test – post-test) in (static balance - dynamic balance), where the calculated value of (z) is greater than its tabulated value at a significance level of ±1.96. The mean scores for the pre-test and post-test for the static balance variable ranged between (14.0000 - 25.62500) and for dynamic balance between (67.2500 - 58.8750). Additionally, as shown in Table (5), which pertains to the improvement rates between the mean scores of the pre-test for static balance (14.0000) and the post-test for static balance (25.62500), as well as the pre-test for dynamic balance (58.8750) and the post-test for dynamic balance (67.2500), there is an improvement rate of (22.870%) in static balance and (14.225%) in dynamic balance.

The researcher attributes these differences and improvement rates to the effectiveness of the proposed training using core muscle group exercises, which had a significant and clear impact on the development of static and dynamic balance for kickboxing athletes. This is because it included many unconventional exercises and training tools such as (balance discs, Swiss balls, half balance balls, elastic resistance bands, and the TRX tool) to generally develop static and dynamic balance, and specifically to enhance static and dynamic balance in the direction of the movement path that simulates performance.

The results of this study are consistent with the findings of studies by Freeman, Gear, and Paul (2010), Kibler (2006), Wilson (2005), and also Junker (2019), indicating that the more these exercises are mastered using various training tools, the higher the rates of static and dynamic balance for the athlete will increase.

Samson (2005) also indicated that core muscle group exercises directly affect both types of balance, as they enable the athlete to acquire numerous physical adaptations, which in turn directly influence the athlete's gains in static and dynamic balance.

Third: Presentation and Discussion of the Results of the Third Hypothesis:

1- Presentation of the Results of the Third Hypothesis

Table (6)
Wolcoxon test to calculate the significance of the differences between the pre-test and post-test measurements in (hook punch – low roundhouse kick) for the sample under investigation in the experimental group.

Variables	Unit	Measurements	Mean	Mean ranks	Sum of ranks	Z
Hock punch	Degree	pre	3.1230	0.00	0.00	-2،585
		post	3.7500	4.50	36.00	
Low round kick	Degree	pre	3.5000	0.00	0.00	-2،555
		post	4.0000	4.50	36.00	

The tabulated value of (z) at a significance level of 0.05 = ±1.96. It is evident from Table (6) that the calculated value of (z) is greater than its tabulated value, which indicates statistically significant differences between the pre-test mean and the post-test mean in (hook punch – low roundhouse kick), in favor of the post-test measurement of the experimental group under investigation.

Table (7)
The ratio of improvement between the average of the pre-test and post-test measurements in (hook punch - low roundhouse kick) for the sample under investigation.

n	Variables	pre mean	Post mean	Improving rat%
1	Hock punch	3.1230	3.7500	20.076
2	Low round kick	3.5000	4.0000	14.285

It is evident from Table (7) that there are improvement rates between the pre-test and post-test in the hook punch - low circular kick, with the highest value of improvement rates being (20.076%) and the lowest value of improvement rates being (14.285%)

Discussion of the Results of Hypothesis Three:-

It is evident from the results in Table (6) that there are statistically significant differences between the pre-test and post-test measurements in skill performance, as the calculated value of (z) is greater than its tabulated value at a significance level of ±1.96. The average scores for the pre-test and post-test in the hook punch ranged between (3.1230-3.7500), and for the low roundhouse kick, it ranged between (4.0000, 3.5000). Additionally, Table (7), which pertains to the improvement percentages between the average pre-test (3.1230) and post-test (3.7500) for the hook punch, and the pre-test (3.5000) and post-test (4.0000) for the low roundhouse kick, shows an improvement percentage of (20.76%) in the hook punch and (14.285%) in the low roundhouse kick.

The researcher indicates that this result suggests a positive impact of the training program under study, which

consists of exercises targeting the core muscle group that the researcher applied to the sample individuals in the study. The researcher attributes these differences and improvement percentages to the effectiveness of the proposed exercises using core muscle group training and their direct effect on improving skill performance, as these exercises simulate the motor and temporal pathways of the skills under study and their nature. This is due to the integrated and multiple movements across the body's levels and axes (anterior–transverse–sagittal), characterized by acceleration, stabilization, and deceleration aimed at enhancing the motor capabilities specific to the skills, core strength (mid-body), neural and muscular efficiency, and balance, which positively affects the relationship between physical abilities and the level of skill performance.
The results of this study are consistent with the findings of the studies by Yasumura et al. (2000) and Cymara et al. The main objective of core strength programs is to achieve muscular strength, self-stability, and neuromuscular control in the core muscles, as well as to produce strength and convert it into immediate speed in the desired direction, which contributes to achieving the skill level.

Recommendations:-

Based on the results obtained, the researcher recommends the following:

For Coaches:-

- Implement core muscle strength training in the youth training programs for kickboxing athletes.
- Apply, develop, and segment core muscle strength training with the same intensity, repetitions, and rest intervals used in the proposed program.
- Utilize core muscle strength training in a manner that simulates the movement and timing patterns of the skill, taking into account its subdivisions.

For Researchers:-

- Conduct more studies similar to the nature of this research on the performance of composite skills in kickboxing athletes, particularly among youth.
- Carry out studies across different weight categories and age stages.

References :-

1- Amal Mohamed Mohamed Morsi (2005): The effectiveness of integrated functional training on certain specific physical variables and the level of skill performance in some balances and rotations in rhythmic exercises, Comprehensive Sports Education Research Journal, Faculty of Physical Education for Girls, Zagazig University, Issue Five.

2- Dua Mohammed Abdel Moneim (2004): The impact of a proposed program for the abdominal and back muscles on some body composition variables and the level of performance in explosive and descending movements in modern dance, Master's Thesis, Faculty of Physical Education for Girls, Zagazig University.

3- Rami Salama Abdel Hafiz (2011): A proposed training program for functional strength to improve certain

physical and skill variables for youth football players, Unpublished Master's Thesis, Faculty of Physical Education, Helwan University.

4- Reda Mohamed (2009), Amal Mohamed (2005), Reda Mohamed Ibrahim (2009): The effectiveness of functional strength training on the strength of core muscles and motor power and their relationship to the level of skill performance in breaststroke swimming, Unpublished Doctoral Dissertation, Faculty of Physical Education for Girls, Zagazig University.

5- Reda Mohamed Ibrahim (2009): The effectiveness of functional strength training on the strength of core muscles and motor power and their relationship to the level of skill performance in breaststroke swimming, Unpublished Doctoral Dissertation, Faculty of Physical Education for Girls, Zagazig University.

6- Safia Ahmed Mohy El-Din, Samia Rabi Mohamed (2002): Ballet and Modern Dance, Cairo, Dar Al-Fikr Al-Arabi.

7- Izzat Khalil Mahmoud (2007): The effectiveness of functional strength training on the gene expression of superoxide dismutase enzyme and some physical variables and the time of 800m freestyle swimming, Scientific production published in the Arab Scientific Conference, Promoting Arab Sports, Cairo Center.

8- Kamal Abdel Hamid, Mohamed Sobhi Hassanien (2002): Modern Handball Quartet (Part Three), Center for Book Publishing.

9- Mahmoud Abdel Rahim Al-Zuhri, Hany Abdel Ghani Talba, Mohamed Ahmed Hamam (2022): The Effect of Core Muscle Strength Training on Some Specific Physical Variables and the Level of Shooting Accuracy from Below the Basket in Young Basketball Players, Journal of Sports Science and Physical Education Applications, Faculty of Physical Education, South Valley University.

10- Mahmoud Mohamed Ahmed, Mohamed Mohamed Ahmed (2004): The Effectiveness of Integrative Functional Training on Some Physical Variables, Levels of Major Blood Elements, and Digital Performance in Short-Distance Running, Scientific Production, Published in the Medical Journal, Faculty of Medicine, Zagazig University.

11- Mahmoud Mohamed Metwally (2006): The Effectiveness of Functional Strength Training on Some Physical and Skill Variables and the Levels of Major Blood Elements in Young Football Players, Scientific Production Published in the Egyptian Journal of Basic and Applied Physiology, Volume Five, Issue Two.

12- Nada Hamed Ramah, Nariman Mahmoud Al-Husseini (2005): The Effectiveness of Integrative Functional Training on Some Physical Variables and Performance Levels in Gymnastic Movements, Scientific Production, Published in the Comprehensive Education Journal, Faculty of Physical Education for Girls, Zagazig University, Issue Four.

13- Boyac, A., & Biyikh, T. (2018): The Effect of Core Training on Physical Performance: The Example of

Male Footballers. Kilis 14- Aralik University Journal of Physical Education and Sport Sciences, 2(2), 18-27.

14- Cress, M.E. et al. (1996): Functional training: Muscle structure, function, and performance in older women, J Orthop Sports PhysTher. Jul; 24(1): pp 4-10.

15- Crisafulli A, Vitelli S, Cappai I et al.(2009): Physiological responses and energy cost during a simulation of a Muay Thai boxing match. Appl Physiol Nutr Metab 2009; 34: 143-150.

16-Cymara, P.K. et al. (2004): Chair irse and lifting characteristics of elders with knee arthritis: Functional training and strengthening effects, J American Physical Therapy Associatin Vol. 83. N. 1. January.

17- Dave, S.(2003): Functional Training Pyramids, New Truer High School, Kinetic Wellness Department, USA.

18- Freeman J, Gear M, Pauli A, et al.(2010): The effect of core stability training on balance and mobility in ambulant individuals with multiple sclerosis: a multi-centre series of single case studies. Mult Scler.;16(11):1377-84. https://doi.org/10.1177/1352458510378126

19- Gür, F. (2020): Kor (Core) Antrenman [Core Training] In: Ozen, G., Koc, H., (Eds), Sporun.

20- Hibbs, A, et,al, (2008): Optimising performance by improving core stability and core strength , Sports medicine, 38 (12) :p.995-1008.(97)

21- Junker D, Stöggl T.(2019): The training effects of foam rolling on core strength endurance, balance, muscle performance and range of motion: A randomized controlled trial. J Sport Sci Med.;18(2):229.

22- Kibler WB, Press J, Sciascia A.(2006): The role of core stability in athletic function. Sport Med.;36(3):189-98. https://doi.org/10.2165/00007256-200636030-00001

23- Luo, S., Soh, K. G., Nasiruddin, N. J., Sun, H., Du, C., & Soh, K. L. (2022): Effect of core training on skill performance among athletes: a systematic review. Frontiers in Physiology, 13 ،. https://doi.org/10.3389/fphys.2022.915259

24- Marwan ali , Mahmoud abdel Mohsen (2013) : Core stability relation to physical performance in some collectivity games theories & application, the international edition faculity of physical education abu qir , Alexandria university , volume no 11 july 2014.

25- Michael, B.(2004): Functional Balance Training Using a Domed Device, Spine, Vol. 21; pp: 2640-2650

26- Norris, CM. (1993): Abdominal muscle training in sport, Journal Article, (Laugh borough. Eng.), 27(1). Mar

27- O-Sullivan, P.B. et al. (1998): Altered abdominal muscle recruitment in patients with chranic back pain following a specific exerctsemtervention Journal. Article. (Baltmore. md.) 27(2): Feb

28- Plamondon, A. et al. (1999): Toward a better prescription of the prone back extension exercise to strength en the back muscles, Journal. Article. (Copenhagen) 9(4). Aug

29-Ron, J.(2003): Function Training 1: Introduction, Reebo Santana, Jose Carlos Univ., USA.

30- Rydzik Ł, Ambroży T (2021): Physical Fitness and the Level of Technical and Tactical Training of Kickboxers. Int J Environ Res Public Health٣٠٨٨ :١٨ .

31- Saglam, F., Rakicioglu, N., Karaagaoglu, N., Ready, T., Cinemre, A., & Tinazci, C. (2002): Physical fitness and nutritional status of primary school students. Hacettepe Journal of Sport Sciences, 13, 2-21

32- Samson, K. M. (2005): The effects of a five-week core stabilization-training program on dynamic balance in tennis athletes. [UnpublishedUniversity master thesis], West Virginia.

33- Sato, Kimitak, Mokha, Monique (2009): Does Core strength training influence running kinetics, lower-Extremity stability , and 5000-m performance in runners? , jornal of strength & conditioning research

34- Sekendiz B, Cug M, Korkusuz F.(2010): Effects of Swiss-ball core strength training on strength, endurance, flexibility, and balance in sedentary women. J Strength Cond Res.;24(11):3032-40

35- Stricevic, M.V. et al., (1991): Specificity of karate training comparative an a lysis of the isodynamic evaluation of a bdominal and back muscles. Book. Analytic. Tenenbaum. G. (ed.) and Eiger, D. (ed.).

36-VomHofe, A.(1995): The problem of skill specificity of functional exercise, vertex fitness. NESTA, USA.

37- Willson JD, Dougherty CP, Ireland ML, Davis IM.(2005): Core stability and its relationship to lower extremity function and injury. JAAOS - Journal of the American Academy of Orthopaedic Surgeons.;13(5):316-25.

38- Yasumura, S.T. et al. (2002): Characteristics of functional training and effects on physical activities of daily living, Nippon Koshu Eisei Zasshi. Sep; Vol. 47(9): 792-800.

39- Zabukovec R, Tiidus PM.(1995): Physiological and anthropometric profile of elite kickboxers. J Strength Cond Res; 9: 240-242.