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# Association of Respiratory Endurance with Core And Physical Performance In Collegiate Boxers-Systematic Review

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**Abstract**
**Background and Purpose**: This study's aim was to conduct a systematic review to investigate whether respiratory endurance with core training enhances boxers' athletic performance. **Methods**: Identification of studies via PubMed, Scopus, Google Scholar, Web of Science, CINAHL, SPORT Discus, and SciELO between January 1970, and November 2022 were included in there view.
**Results**: 2540 citations that the search technique turned up, 29 of them matched the inclusion criteria, according to the systematic review's findings. When increased respiratory endurance and core strengthening were coupled, its how a noticeable positive effect on boxers' performance.
**Discussion and Conclusion: In conclusion** on, improving core strength and respiratory endurance in boxers will enhance their athletic performance. Closer attention required during athletic Competition and more aggressive progression of training intensity including respiratory endurance and core strengthening may show greater improvements in future studies.
**Keywords:** boxing, corestrengthening, respiratory endurance, endurance, respiration, core, athlete, boxers, performance, sports and fitness

## 1. INTRODUCTION

The human body’s capacity to engage in prolonged physical activity at medium to higher intensities is known as respiratory endurance (RE). It is an essential component of everyone's everyday health. With this method, the heart and lungs make an extended period of physical effort to absorb and transfer oxygen. The duration of endurance may also be referred to as respiratory stamina. It is a symbol of a person's ability or energy. Respiratory endurance refers to the body's ability to perform persistent activities of moderate to high intensity. It is essential to someone's overall fitness. The heart and lungs work to transfer and absorb oxygen during this sustained period of physical exertion. It's common to use the terms "endurance" and “respiratory stamina" interchangeably. It indicates a person's aptitude

or fortitude. Inspiration becomes a dynamic process when the inspiratory muscles contract. The volume of the chest cavity rises when these muscles contract and the pleural pressure decreases to below atmospheric levels. The pressure difference induces air flow from the atmosphere into the lung, resulting in sub atmospheric alveolar pressure. The primary inspiration muscle is the diaphragm. The diaphragm separates the thoracic and abdominal chambers with a substantial muscle layer shaped like a dome. When the diaphragm contracts, the center of the muscle is pulled downward. Additional inspiration muscles include the external intercostals, which connect neighboring ribs and slope forward and downward. When the ribs contract, they rotate upward and toward the horizontal, increasing the volume of the lungs. Additional accessory muscles include the sternocleidomastoid and scalene muscles, which attach to the sternum and the first two ribs. When these muscles flex, the ribcage is raised, which aids in inspiration.[1]
By elastically recoiling the lung and chest wall during calm breathing at rest, exhalation is passively performed. During exercise, the muscles of expiration are engaged to forcefully expel air and return lung capacity to normal resting levels. Expiration depends on the abdominal muscles, particularly the rectus abdominis, internal and external obliques, and transversus abdominis. It can be difficult to pinpoint exactly how certain muscles are used during dynamicactivity in people. However, it is generally acknowledged that they have re-recruited inproportion to the increase in exercise intensity.[2]

The advantages of core stability training for reducing athletic injuries are of great interest to physical therapists, athletes, physicians, musculoskeletal researchers, and fitness instructors. Core stability training assists the lower and upper limbs in transmitting torque and momentum during the rigorous dynamic activities of sporting events by focusing on muscle activation, neuromuscular control, static stabilization, and dynamic stability. Although the main
trainingconceptistoincreasesportsperformanceoptimization,thereisnotenoughinformationonhowitdirectly affects athletes' lower limb performance.[3]
Since sports activities necessitate movement in these planes, the core musculature must be assessed and developed in the sagittal, frontal, and transverse planes. Transverse or rotational activities are frequently disregarded in core training. Assessment tools for the functional evaluation of these motions (lunge, step-down, single-leg push, balance, and reach) have proven to be reliable, despite not having undergone extensive testing. But they offer accurate and reliable measures form multiplanar excursion (multidirectional excursion assessments in all cardinal planes). Single-leg squattests (either with or with out step downs) are also trust worthy evaluation tools.[4,5,6,7]
Performance is cited as a vital element in achieving success for an individual. It demonstrates the effort made to analyse and modify strategic goals and create cutting-edge methods to improve outcomes. Performance management refers to the system a company establishes to make sure that every employee is aware of the level of performance expected of them in that function and any specific goals that must be met in order to reach the bigger organizationalgoals.[8,9]Professional boxing has received very little study in the scientific literature, despite being known as one of the most physically and mentally grueling sports in the world and enjoying tremendous popularity. The necessity to juggle fitness, strength, and boxing-specific training within a condensed time frame before a contest—typically 8 to 12 weeks—complicates a professional boxer's preparation. In professional boxing, there are brief intervals of low-intensity activity or rest between those sets of repeated high-intensity motions. The oxidative and non oxidative power sources must significantly contribute in order to meet these demands.[10] In a boxing match, a knockout victory is probably the most

well-known. A punch usually results in a knockout, but several real high-force hits are frequently delivered before that. The cerebellum and brainstem experience tremendous internal torque in head-on crashes, resulting in severe neurological trauma that causesaknockout.[10,11]

## 2. METHODOLOGY

### SelectionofArticles

There were no linguisticorregional limitations in the literature searches; the language included German, Chinese and Japanese which were translated into English through Microsoft translation extension. Identification of studies via PubMed, Scopus, Google Scholar, Web ofScience, CINAHL, SPORT Discus, and SciELO between January 1970, and November 2022, were included in the systematic review. The search was made using the keywords boxing, core strengthening, respiratory endurance, endurance, respiration, core, athlete, boxers, sports, performance, and fitness. The University Ethics Committee approval was obtained for this review.

### Eligibility

### Inclusive and exclusive criteria

The inclusion and exclusion criteria set the boundaries of the systematic review. Articles were included if:(a) participants were athletes; (b) theirageshouldbe18-30 ; (c) participants should be male; (d) the study was a randomized controlled trial (RCT) and correlational study that compared respiratory endurance and core strength with performance; (e) the study included outcomes of sports performance. Articles were excluded if participants: (a) have any impairment such as musculoskeletal disorder, neurological disorder, metabolic diseases, or skeletal disorders; (b) were healthy adults but were not athletes.

## 3. RESULT

For the treatment and avoidance of various Musculo skeletal conditions, core strengthening has a theoretical basis. Research is severely lacking, apart from the studies on the treatment of LBP. Corestability programs come into sight on the cusp of innovative new research with advancements in anatomy and motor learning theories.[24] When increased respiratory endurance and core strengthening were coupled, it showed a noticeable positive effect on boxers' performance.

## 4. DISCUSSION

Respiratory Endurance

Respiratory endurance is the ability of the human frame to carryout extended sporting activities from medium to better ranges of intensity. It is a critical part of the standard health of an individual. In this technique, the coronary heart and lungs attempt to absorb and transport Oxygen over a prolonged length of bodily exertion. Sometimes the time period of staying power is likewise called respiratory stamina. It is a sign of the ability or energy of an individual. The human body’s capacity to engage in sustained activities with medium to high degrees of intensity is known as respiratory endurance. It is a crucial component of someone's overall fitness. During this prolonged duration of physical effort, the heart and lungs work to transfer and absorb oxygen. The words endurance and respiratory stamina are sometimes used interchangeably. It serves as a sign of a person's ability or strength.[1]

Physical therapists, athletes, physiatrists, musculoskeletal researchers, and fitness instructors are all very interested in the benefits of core stability training for preventing athletic injuries. By concentrating on muscle activation, neuromuscular control, static stabilization, and

dynamic stability, core stability training helps the lower and upper extremities transmit torque and momentum during the demanding dynamic activities of sporting events. Although the core training idea aims to improve the optimization of sports performance, there is insufficient data on how it specifically affects athletes' lowerlimb performance.[3]
In general, it is true that a healthy lung and chest wall are over built to meet the demands of the activity. This near-perfection does not apply to exercise-induced diaphragm fatigue, which can occur during both short-term and long-term exercise. The diaphragm is a muscle sheet that is heavily capillarized, highly oxidative, and has long been thought to be extremely fatigue resistant.[1]

Core Strengthening
There hasn't been much study done on how core-strengthening regimens affect clinical results. The lack of agreement on what makesup a core-strengthening program hinders research. Some discuss of functional education and sports-specific training, while others discuss remedial neuromuscular retraining.[4]
Strengthening and conditioning experts at the collegiate and professional levels frequently employcore training regimens for athletes. One of them any in tricate phenomena that make up balance is core strength. A multifaceted interaction between the central, peripheral, sensory, and motor systems is necessary for balance. Balance training is crucial for functional activities. Moving on to labile surfaces may enhance proprioception and balance. Different workout regimens integrate different components of core development and could be a good strategy to keep many people compliant.[4,5,6]
Sports activities require movement in the sagittal, frontal, and transverse planes, hence core musculature needs to be evaluated and trained in these planes. In core training, transverse or rotational exercises are sometimes overlooked. Although they have not been thoroughly tested, assessment tools for the functional evaluation of these motions (lunge, step-down, single legpress, balance,and reach) have shown to be reliable. However, trustworthy and valide valuations of multiplanar excursion include the multidirectional reach test and the star-excursion balancing test (multidirectional excursion assessments in all cardinal planes). Tests of the single leg squat(either with or withoutstep downs) are also reliable assessmentinstruments.[4,5,6,7]
Amateur boxing has been practised in India since the 1920s, and in the 1950s and 1960s i t gained popularity throughout Asia. At the moment, it constantly competes for medals on a global scale. Boxing, one of themost well-liked sports in the world, has a long history of being connected to the Olympics. Boxing dates back to Egypt in 3000 BC and first emerged as a global sport at the 23rd Olympiad in 688 BC. A boxing style known as the mushti-yuddha is also mentioned in early Indian literature, such as the epic Mahabharata (war of fists). However, in the framework of the contemporary Olympics, amateur boxing made its Summer Gamesdebutat the 1904 Olympics in St. Louis, USA.[13]

## 5. CONCLUSION

A major finding of our systematic review was respiratory endurance with the core is directly related to the performance of collegiate boxers or not. In conclusion, improving core strength and respiratory endurance in boxers will enhance their athletic performance. Closer attention required during athletic competition and more aggressive progression of training intensity including respiratory endurance and core strengthening may show greater improvements in future studies.
Conflict of Interest: None

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Figure1.PRISMAFlowDiagram -searchstrategyandretrievalofarticles.

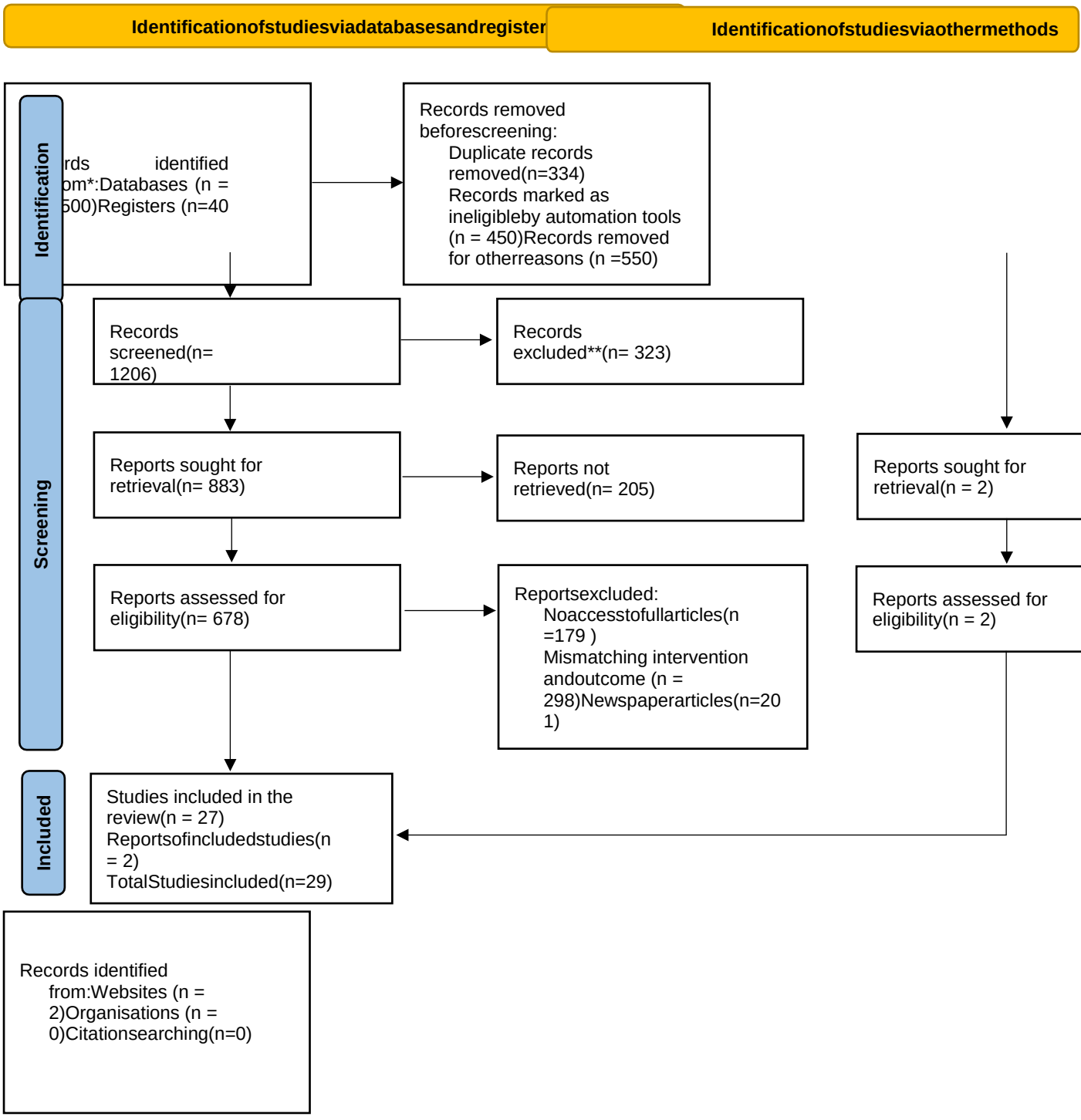

**Table1.RatingsoflevelsofevidenceandPEDro qualityassessment**

| **esupportingcorestrengthandrespiratoryenduranceisrelatedtoperformance** | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Core strength and respiratory endurance are related to performance** | | **PEDro Item Scoring** | | | | | | | | | | | **Scoring** |
| Author | Sackett Level of Evidence | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | PEDro Total Score |
| Shephard R etal. (1974) | V | 1 | | 1 | 1 | | | | | | 1 | 1 | 5 |
| ergmanetal. (1999) | IV | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | | 1 | 9 |
| heelAetal. (2002) | V | 1 | 1 | | 1 | | | 1 | 1 | | | 1 | 6 |
| Arendtetal. (2007) | V | 1 | 1 | 1 | | | | | | 1 | 1 | 1 | 6 |
| Akuthota Vetal. (2008) | V | 1 | 1 | 1 | 1 | 1 | | | | | | 1 | 6 |
| ugustsson S etal. (2009) | IV | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| JdgeL etal. (2012) | III | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| illaut F et al.(2012) | V | 1 | 1 | 1 | | 1 | | | | 1 | 1 | | 6 |
| El-Ashker S etal. (2012) | II | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 10 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| arsonNetal. (2012) | V | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 10 |
| ulbin J et al. (2013) | V | 1 | | | | 1 | | | 1 | | 1 | 1 | 5 |
| IajghanbariBet al. (2013) | I | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| ackettDetal. (2013) | III | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| ong T et al. (2014) | V | 1 | | | | | 1 | 1 | 1 | | | 1 | 5 |
| umarS etal. (2015) | III | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | 9 |
| uddockA etal. (2016) | V | 1 | 1 | 1 | 1 | | | | | | | | 4 |
| vour C et al. (2017) | V | | | | 1 | | | | 1 | | 1 | | 3 |
| -AshkerSetal. (2018) | III | 1 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | | | 8 |
| ocahanTetal. (2018) | IV | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 | 8 |
| rmiş E et al. (2019) | V | 1 | 1 | 1 | 1 | 1 | | | 1 | | | | 6 |
| Akinoğlu B etal. (2019) | IV | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| içlüöverAetal. (2019) | I | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MazzeoFetal. (2020) | V | | | 1 | 1 | 1 | 1 | | | | 1 | | 5 |
| HackettA (2020) | V | | 1 | | 1 | 1 | 1 | | | | | 1 | 5 |
| Yüksel F et al. (2020) | IV | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| Fitriana M et al. (2020) | V | 1 | 1 | 1 | | | 1 | 1 | | | | | 5 |
| BayrakdarAetal. (2020) | IV | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |
| HoDetal.(2021) | V | 1 | | | | | | | 1 | 1 | 1 | 1 | 5 |
| CanFetal.(2021) | I | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 11 |

*Description of PEDro Categories: 1 = eligibility criteria were specified; 2 = subjects were randomly allocated to groups; 3 = allocation was concealed; 4 = the groups were similar at base line regarding the most important prognostic indicators; 5=blinding all subjects;6 =blinding of all therapists who administered the therapy; 7 = blinding of all assessors who measured at least1 key outcome;8 = measuresof1 key outcome were obtained from >85%of subjects initially allocated to groups; 9 = all subjects for whom outcome measures were available received the treatment or control condition as allocated or, where this was not the case, data for at least 1 key outcome was analysed by “intention to treat”; 10 = the results of between-group statistical comparisons are reported for at least 1 key outcome; 11 = the study provides both point measures and measures of variability foratleast1keyoutcome.

**Table2. Overview of Studies included in this Review**

| Author / Year | Journal | Title | Objective | IC/EC (Inclusiveand Exclusive criteria) | Methodology | OutcomeMeasures | Result | Conclusion |
|---|---|---|---|---|---|---|---|---|
| Shephard R.J. 1974 | Journal of Human Ergology | Future research on the quantifying of endurance training | This article starts off by looking at the problem's current state and the lessons learned for future research on subject selection, training schedules, and endurance Fitness. | IC-group using a similar experimental design EC-same sample size | Possible combinations of intensity, duration, and frequency of exercise sessions and the total period of observation are viewed against the background of likely biochemical responses. | Ad-hoc decisions and assessment | The future will see a broadening of research To cover also interval work and the effects of age, sex, and disease on the response | A full definition of response curves will require the study of a very large population, making a "multi-center" trial a necessity. |

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|---|---|---|---|---|---|---|---|---|
| Bergman, Bryan C, Brooks George A.1999 | Journal of Applied Physiology | Respiratory gas-exchange ratios during graded exercise in fed and fasted trained and untrained men | Respiration gas-exchange ratios were used to evaluate the hypotheses that endurance training promotes relative lipid oxidation throughout a wide range of relative exercise intensities in fed and fasted states. | IC-7 trained and7 untrained healthy male subjects between the ages of 19 and 32 yrs EC-Any deformity and disorder | Seven untrained (UT) men and seven category2 and 3 US Cycling Federation cyclists (T) exercised in the morning in random order,with target power outputsof 20 and 40%peak V˙ O2 (V˙o2peak) for 2 h,60% V˙ o2peakfor 1.5 h, and80% V˙ o2peakfor a minimum of30 min after either a 12-h overnight fast or3 h after a standardized breakfast. | Mean lactate concentrations (E), peak oxygen consumption | Target relative exercise intensities of20, 40,60, and 80% V˙o2peak were matched experimentally with average V˙O2 values of22 60.33,40 6 0.31,596 0.32,and75 6 0.79%V˙ o2peak for both trained and untrained subjects. | Results of experiments do not support the hypothesis that trained subjects always oxidize relatively more lipid than do normalized to percentage of V˙o2peak. |
| Sheel A. William2002 | Sports Medicine | Respiratory muscle training in healthy individuals: | In healthy humans, that specific | IC-Athletes, RCT, Respiratory muscle and sport | Whole-body exercise performance is evaluated but signific | Sport performance, exercise capacity, spirometry, Yo-Yo | RM training influences relevant measures of physical | When performance is measured using time- |

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| | | Physiological | respiratory muscle (RM) training can increase the respiratory | performance and | ant improvements have also been reported in | | performance to a limited | trial type performance measures versus fixed |

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|---|---|---|---|---|---|---|---|---|
| | | Rationale and implications for exercise performance | muscles' stamina and strength. | Published in English EC-case studies | placebo-trained individuals. | tests, pedro | extent atmost. | Workload tests, performance is increased to a much lesser extent with RMtraining. |
| AkuthotaVenu , Arendt Elizabeth A.2004 | Arch Phys Med Rehabil | Core strengthening | To understand the concept of Corestrengthening. | IC-RCT, reviews, articles EC-Case studies | A descriptive study of the muscular control required around the lumbar spine to maintain functional stability. | Sahrmann's Level, fitness and core programs. | In the treatment of LBP, research is severely lacking. With advancements in motor learning theories and anatomy, core-stability programs appear on the cusp of innovative new research. | Core strengthening has a theoretical basis in the treatment and prevention of various Musculoskeletal conditions. |
| AkuthotaVenu, FerreiroAndrea,Moore Tamara, Fredericson Michael2008 | Current Sports Medicine Reports | Core stability exercise principles | Core stability is essential for proper load balance with in the spine, pelvis,and kinetic chain. | IC-Athletes EC-Any deformity and disorder | To develop advanced core strengthening: challenging balance and motor control. And preven | Evidenced-based core stability program, core score | Specific core stability programs in prevention of athletic injuries have not been well studied. | This article summarizes the anatomy of the core, the progression of core strengthening. |

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| | | | | | tion of injury. | | | |
| Augustsson Sofia Ryman, Bersås Ellen, Thomas Elin , Magnusson Sahlberg, Margarea, | Advances in Physiotherapy | Gender differences and reliability of selected physical performance tests in young women and men | This study aimed to evaluate the test-retest reliability of sit and push-ups and determine performance differences in muscular endurance and power. | IC-18 and 35 years of age, male and female EC-illness or injury of the musculoskeletal system during the past 2 months, Elite athletes | 13 women and men participants performed two test sessions of each test using a test-retest design. High reliability was noted for both the sit-up and the push-up tests. | Sit-ups and push-ups test-retest | Maximal number of sit-ups was 0.92 with a95% CI of0.73-0.98.(p=0.085),push-ups is 0.95 with a95% CI of0.85-0.99.(p=0.222) No significant | There were no significant differences between the men and the women. |

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|---|---|---|---|---|---|---|---|---|
| Augustsson, Jesper,Svantessonulla 2009 | | | | | | | Difference between men and women(p=0.110;h2=0.038) | |
| Udge L, Awrence WJ, Bellar David2012 | Journal of strength handconditioning research | Modeling and Relationship of Respiratory Exchange Ratio to Athletic Performance | Relationship of Respiratory Exchange Ratio to Athletic Performance | IC-healthy individuals EC-Any deformity and disorder | The participants underwent a graded exercise test to determine both VO2maxandrespiratoryexchangemeasures. | VO2maxandrespiratoryexchangemeasures | Significant difference in the strength of the correlations for the points RER 0.95 (t=2.68957, p= 0.01),1.0 (t= 2.18516,p= .03) ,and 1.05 (t=1.85668,p= 0.04) And the correlations found for RER0.85. | The VO2Determined wassubsequently Correlated to race performance. |

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| Larson Noel Casteel, Sherlin Leslie, Talley Chris, Gervais Mike 2012 | Journal of Neurotherapy | Integrative Approachto High-PerformanceEvaluation and Training: Illustrative Data of a Professional Boxer | This article outlines a particular and distinctive performance-enhancing training approach for an accomplished and competitive heavyweightboxer. | Case Study of a Professional Boxer | This article describes a specific and unique performanceenhancement training paradigm for an eliteheavyweight boxer currently competitive and successful in his sport. | Case Study | The results from the training program, asjudged by objective data and self-reports at post-training evaluations, are discussed here. | In thecurrent casestudy, theeliteheavyweight boxerexperienced concurrentassessment. |

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| Billaut Franois Gore, Christopher J., Aughey RobertJ. 2012 | Sports Medicine | Enhancing team-sport athlete performance: Is altitude training relevant? | To examine The scientific evidence for use of altitude training for enhancing team-sport running performance. | IC-Athletes EC-Any deformity and disorder | Field-based team sport matches are composed of short, high-intensity efforts, interspersed with intervals of rest or submaximal exercise, repeated over a periodof 60–120minutes. | Muscle Glycolytic Capacity, Sprint Performance,Muscle Oxidative Power, Endurance Performance, SystemicO2 | Up to simulated altitudes of ~3500–4000 M to potentially boost muscle oxidative capacity, increase capillary density as well as enhance the muscle | The physiological responses to altitude training Maycontribute to improving team-sport athlete run-based performance. |

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| El-Ashker Said, Nasr Mostafa 2012 | Journal of Physical Education and Sport | Effect of boxing exercises on physiological and biochemical responses of Egyptiane lite boxers | The aim of the study is to assess the effects of boxing exercises on the physiological and biochemical responses of Egyptian elite boxers. | IC-Athlete registered in the Egyptian boxing federation, with a minimum of 4 years of national boxing participation. EC-non Egyptian | 17 Egyptian elite male boxers participated in the study. Physiological and biochemical measures were obtained at baseline and at the end of the boxing training program. | Student's (T) test was followed out to examine pre- and post-test values. Karvonen's formulae. | Hr rest decreased (from73.1to 67.3 beats/min), but, in contrast, boxers' mean hr peak increased (from197 to 204 beats/min). | It concludes that boxing exercises have A positive impact on the physiological and biochemical variables under research. |

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| Gulbin Jason, Weissensteiner Juanita OldenzielKaren, Gagné Françoys 2013 | European Journal of Sport Science | Patterns of performance development in elite athletes | This investigation sought to contrast generalized models of athlete development with the specific pathway trajectories and transitions experienced by 256 elite athletes across 27 different sports. | IC-Olympic athletes, age 20-25 yrs, males and female. EC-non-olympic athletes, illness or injury | This cohort included 51 athletes who had competed at an Olympic Games level. The average age of the participants was 23.2 years. 27 different sports were represented by the participant sample. | National Athlete Development Survey (NADS), Gagne´'sjunior level competition | Pure ascent (16.4%), Mixed ascent (26.2%) and Mixed descent (57.4%), (70%; pb0.001) | Elite athletes does not follow a predictable linear ascent from lower to higher competition levels. |

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| Hajghanbari Bahareh Yamabayashi, CristianeBunaTerynR., Coelho | Journal of Strength and Conditioning Research | Effects of respiratory muscle training on performance in athletes: A systematic review with meta-analyses | The purpose of this study was to perform a systematic review to determine if respiratory muscle training (RMT) improves sport performance and respiratory muscle strength and endurance. | IC-Athletes, RCT, Respiratory muscle and sport performance and published in English EC-healthy adults but were not elite or recreational | To perform a systematic review to determine if respiratory muscle training (RMT) improves sport performance and respiratory muscle strength and endurance | Revman5.0.25 software, Sport performance, exercise capacity, spirometry, Yo-Yo tests, pedro | Respiratory muscle training can improve sport performance for some athletes and clearly increases respiratory muscle strength and endurance. | Inconclusion, RMT can improves sport performance. |

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| Jonathan D., Freedman Kyle D., Morton Trevor A., Palmer Sheree A., Melissa A., Walsh Cody, Sheel A. William ,Reid W., Darlene 2013 | | | | athletes, physical impairment that | | | | |
| Hackett, D. A., Johnson, N., Chow C. 2013 | Journal of Sports Medicine and Physical Fitness | Respiratory muscle adaptations: A comparison between body builders and endurance athletes | The purpose of this study was to compare the respiratory muscle and lung function measures of bodybuilders (BB) and endurance athletes (EA). | IC- Athletes EC- Any deformity and disorder | 42 male subjects Aged 20-35 years underwent respiratory muscle strength measurements, lung function testing, hydrostatic weighing andVO2maxtesting. One-repetition maximum(1RM) forbench press, squat and deadlift was performed by BB. | 1RM Testing BB, VO2max, Respiratory muscle strength and lung function testing MIP | BB had significantly greater MIP and MEP compared to EA by43% and 53% respectively. | In conclusion, body builders exhibited greater respiratory muscular strength, compared to endurance athletes |

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| Tong Tomas K., Wu Shing, Nie Jinlei, Baker Julien S., | Journal of Sports Science and Medicine | The occurrence of core muscle fatigue edurin g high-intensity runnin g exercise | Objective 1- This study investigated the occurrence of core muscle fatigue during high-intensity running exercise and its Limitation to | IC-(1) to perform a continuous treadmillrun at 85%VO2maxwith and with out core muscle fatigue in | 9 male recreational long-distance runners, The first trial (CRtrial) was to detect the occurrence of global CM and IM fatigue | Post-exercises port-specific endurance plank test (SEPT) And maximum inspirator | Group mean=15.9 ±1.5 km·hr-1.VO2=54.6± 3.9 ml·kg-1·min-1,equivalent to84.0±3.3% VO2max. | In conclusion, CM function in endurance runners subsequent to intense running to exhaustion was |

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| Lin Hua 2014 | | and its limitation to performance: The role of respiratory work | Exercise performance. Objective 2- A secondary aim was to investigate whether respiratory muscle work performed during intense running periods, would contribute to core muscle fatigue. | The CR_Fand CR trials, respectively; And (2) to mimic the treadmill run-induced Respiratory response (Mimic trial) EC-non eligible for IC. | Subsequent to intense running, atrial of voluntary iso capnic hyperpnea was performed and lastly MIMICTRIAL. | y mouth pressure (pimax)Measurement,mimic trial | Fatique= 10.7 ±4.5min | Impaired with fatigue. |

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| Kumar Sushee l, Savita 2015 | Ignited Minds Journals | Comparative Analysis of Performance of Indian and Chinese Boxers at Summer Olympic Games from 1948 to 2012 - | The researcher decided to compare to the performance of Indian and Chinese boxersat summer Olympic Games. | IC-Indian and Chinese Boxers at Summer OlympicGames from1948 to 2012 EC-non-eligible for IC. | Boxing is supervised by a referee over a series of one-to three-minute intervals called rounds. | Medaltallyscoringsystem ofOlympicsummergames | Olympics Games from1948to2012 includes total of 34 boxers of China and43 boxers of India. | It may be concluded that China have won one silver out of 34 participants and Indian boxers got no silver medal out of 43 participants. |
| Ruddockalan D., Wilson DanielC., Thompson Stephen W., Hembrough Dave Winter , Edward | Strength and Conditioning Journal | Strength and Conditioning for Professional Boxing: Recommendat ionsforPhysicalPreparation | This research is done for physiology and strength and conditioning to form a knowledge base for those | IC-Professional boxers, experience 4+years EC-healthy but is not professional boxer, illness, injury | A professional boxer's preparation is complicated by the requirement to include conditioning, strength, and boxing-specific training within ashort | HR=heartrate; LT=lactatethreshold; RPE=rating ofperceivedexertion;itrimp=trainingimpulse | A double "peak" in muscle activity is evident during striking actions. Stiffening of the body at impact through | Research regarding the physical preparation of professional boxers for the competition is limit |

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| M.2016 | | | involved inpreparing Professional boxers for competition. | | time frame before a contest, usually 8–12weeks. | | isometric activity is postulated to create “effectivemass” and reduce Energy loss. | ed. |

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| Favour, Faulkner,Buskirk,Kollias, Balke2017 | Journal of Applied Physiology | Maximum aerobic capacity and running performance at altitude. | The purpose of the present investigation was to observe the effect of brief exposures to different altitudes and of prolonged periods of training at 2,300m. | IC-from University of Michigan and Pennsylvania state university EC-illness, injury, females, non-collegiate | A low-altitude group remained at 2,300 m for 6 weeks, a medium-altitude group underwent exposures to2,300and 3,100 m, and a high-altitude group spent time at2,300and4,300 m. | Bicycle ergometer testing, VO2max | At2,300 m Pulmonary ventilation at Vos max increased only 6% over SL values. At 2,300 mtime Trials of 1-3 Miles were 2-13% slower than at SL. | During the post-altitude control period, Vo max and time-trial perfo rmances were not significantly different from the pre-altitude control values. |

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| El-Ashker Said, Chaabene, Helmi Negra ,YassinePriesk e Olaf, Granacher Urs 2018 | Sports | Cardio-respiratory endurance responses following a simulated 3 × 3 Minutes amateur boxing contest in elite level boxers | This study aimed at examining physiological responses (i.e., oxygen uptake [VO2] and heart rate [HR]) to a semi-contact 3 ×3-min format, amateur boxing combat simulation in elite-level male boxers. | IC-Elite athletes, male boxers ECillness, injury | 11 trained boxers performed a maximal graded aerobic test on a motor-driven treadmill to determine maximum oxygen uptake (VO2 max),oxygen uptake (VO2 AT) and heart rate(HRAT) at the anaerobic threshold, and maximal heart Rate (hrmax). | Treadmill running test, aerobic test, 3 ×3-min Simulated Amateur Boxing Contest | VO2 values of 55.3,53.8, and 50.4ml·min−1·kg−1, during punching routine activities44, 43, and 44ml·min−1·kg−1 were recorded for the 1st and 2nd, and 3rd round, respectively | This is the first study to analyze the physiological responses of 3 × 3-mins emi-contact amateur Boxing combat in elite-level male boxers. |

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| KocahanTugba,AkinoğluBihter2018 | Journal of Exercise Rehabilitation | Determination oftherelationshipbetweencoreenduranceandisokineticmusclestrengthof elite athletes | The aim of the study is to determine the relationship between core endurance and isokinetic muscle strength of the knees and shoulders of elite athletes. | IC-Elite athletes, male boxers EC-illness, injury | 71 athletes perform Isokinetic muscle strength of shoulder internal-external rotation and knee flexion-extension was determined by using an Isomed 2000 device. | The Mcgill Core, Endurance Tests, Isomed 2000 device. | P<0.05 | In conclusion, result indicates that the upper and lower extremity muscle strength and core endurance of athletes are related with each other and must be evaluated and trained As a whole. |

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| Ermiş Egemen, Kerim Yılmaz, Ali Mayda Hakan 2019 | International Journal of Applied Exercise Physiology | Analysis of Respiratory Functions and Respiratory Muscle Strength of Martial Arts Athletes | The purpose of this study is to compare the respiratory functions and respiratory muscle strengths of elite athletes doing different branches ofmartial arts. | IC-Male, Elite athletes, Martial artist-Taekwondo, Muaythai, Judo, Boxing, experience 3yrs+ EC-healthy but is not included in these martial art, illness, injury | 58 male athletes participated. The samples' respiratory function tests were administered with spirometry in a sitting position, while their respiratory muscle strength tests were administered by using an intraoral barometer. | Respiratory muscle strength tests, intraoral barometer. Spirometry | No statistically significant difference was found between the respiratory function results of athletes doing different martial arts. | Judo and Muay Thai athletes had higher respiratory function levels when compared with Boxing and Taekwondo athletes. |

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| Bihter Akınoğlu, TuğbaKocahan, TaşkınÖzkan 2019 | Journal of Exercise Rehabilitation | The relationship between peripheral muscle strength and respiratory function and respiratory muscle strength in athletes | The aim of this study is to determine the relationship between peripheral muscle strength, respiratory function and respiratory muscle strength in athletes. | IC-elite judo, rowing and gymnastics athletes from the Olympic Preparatory Center be-tween 1 January–30April 2017. EC-less than 3years of experience, pain in the lower extremities in the last 6months, orthopedic ,acute or chronic illness | The study included a total of 150 elite athletes. Isomed 2000 isokinetic dynamometer was used to assess peripheral muscle strength. | Isomed2000 Isokinetic dynamometer, digital spirometer, Maximum inspiratory pressure (MIP) and maximal expiratory pressure (MEP) tests | Physical characteristics and sports years of a total of 150 athletes, 84 male (56%) and 66 female (44%). (r= -0.268/ 0.813, P<0.05 ) (Table | There was a strong relationship between muscle strength of knee flex-or and extensor muscles and respiratory function. |

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| Aziz Güçlüöver, Melike TaşbilekYoncalık,Hüseyin Fatih Şen& İrem | Journal of Education and Learning | Examination of Physical and Physiological Parameters of National Level Boxers at Age | In this study, it is aimed to examine the physical and physiological fitness parameters of tiny national boxers between11–13 years of age. | IC-Kırıkkale Provincial Directorate of Youth and Sports boxing club depending Turkey Boxing Federation, | 12 boxing athletes between11–13 years of age in the tiny national category in Kırıkkale province, to investigate the physical and physiological | Bruce protocol, Body Composition Analyzer BC-418, Pulmonary functions (FVC, FEV1, | The negatively relationships at significant were determined between oxygen consumption capacity and body composition | The existing of that there were the negatively relationships between the highness of maximal oxygen use capacity and basal metabolic |

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| NurŞahin2019 | | Range of11–13 | | male, age11-13EC-female, illness, from not that location | Fitness parameters | FEV1/FVC and VC) measurement, Haris-Benedictformula | variables(VO2)max; body fat percentage at the level of(FM), r = -696,p=0.05, lean body mass (FFM),r = -666, p= 0.05;body mass index(BMI), r = -763, p = 0.01)(Table | rate and body composition components |
| FilomenaMazzeo,Domenico TafuriandPietro Montesano 2020 | Sport Science | Respiratory endurance, pulmonary drugs and sport performance: An analysis in as ample of amateur soccer athletes | To investigate the relationships between respiratory structuring and proper functioning, and the development of respiratory resistance without the use of respiratory drugs in a group of | IC- senior male soccer amateur football league players, with different education levels to the sports performance factors (technical, tactical, physical, and psychological) EC-females, healthy but not footballers, illness, injury | 2 groups (A control and B with lowest indexes), and verified attendance at scheduled, weekly and supplemental training sessions for six months. The data processed allowed to | Spirometry, Benchmarks Cooper Test, calculation of theVO2max, Motor tests | The maximum oxygen consumption (VO2max in ml/kg/min)with the formulaVO2max = -10,25 + (0,022 xmt) | This study showed that the VO2 max indices calculated with results data from pulmonary tests can be compared without comes of resistance-specif |

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| | | | twenty senior male soccer amateur football league players. | | calculate theVO2 max inconsideration of the characteristics of mixed energy expenditure of the football discipline. | | | ic training. |
| Daniel A. Hackett 2020 | Sports | Lung Function and Respiratory Muscle Adaptations of Endurance- and Strength-Trained Males | The aim of the study was to examine whether differences in lung function and respiratory muscle strength exist between trainers predominately. | IC-powerlifting/Olympic weightlifting, or known bodybuilding competition EC-illness, injury, healthy athletes but are not powerlifter | 46 males participated in this study, consisting of 24 strength-trained and 22 endurance-trained participants. Testing involved measures of lung function, respiratory | Student's t-test, bench press, squat, and deadlift, Medgraphics pulmonary function testing system, whole-body | Endurance-trained compared strength-trained group had greater absolute VO2max(L·min−1) (p< 0.002) and VO2 max (ml·kg−1·min−1)(p <0.001). | The strength-trained group, but not the endurance-trained group, showed a substantial relationship between respiratory |

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| | | | | Overweight lifter. | VO2 max,1RM, and body composition. | DEXA scanner, microrpmscreen (non-invasive mouth-pressure manometer), CyclingVO2 MaxTest The | Strength-trained group, the benchpress 1 RM was 115.2± 19.5 kg (1.4kg/kg BM), the squat1RM was 166.0±31.6kg (2.0 kg/kg BM), and the dead lift 1RM was 185.9± 34.3 kg (2.2kg/kg BM). | Endurance and relative VO2max. |
| Fuat YÜKSEL, Nevin Aysel GÜZEL, Betül TAŞPINAR, Aslı BALABAN 2020 | Turkish Journal of Physiotherapy and Rehabilitation | Relationship between trunk muscle endurance, Pulmonary function, and respiratory muscle strength in healthy individuals | To examine the relationship between pulmonary function, respiratory muscle strength, and trunk | IC- no chronic disease and aged 18-40years. EC- history of cardiopulmonary and neurological diseases, pregnancy, morbid obesity, and major surgery. | 60 volunteer and healthy individuals whose ages 20 and 36 years. Trunk muscle endurance of the subjects was evaluated using the | Prone bridge, sidebridge, flexor endurance, and Sorensen tests, | Forced vital capacity (%FVC) and prone bridge (r=0.395, p=0.002), flexor endurance (r=0.256, p=0.049), and Sorensen (r=0.255, | Pulmonary function and respiratory muscle strength areassociated with the endurance of the trunk muscles. |

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| | | | muscle endurance. | | prone bridge, side bridge, flexor endurance, and Sorensen tests. | | p=0.049) tests. Like wise, | |
| Mimi Fitriana,Tan Yan Xin 2020 | Journal of Education and Social Sciences | The Athlete Performance Management: An Impact Of Self-Integrity, Family Supports And Social Media | The purpose of this study was to find out the performance management of badminton players in Malaysia from their self-integrated strategy with the coach, suppo | IC-national badminton players, Malaysian, 18yearsold and above EC-illness | 3 selected players, ages ranging from17 to 25 years, using a purposive sampling procedure. Thematic Analysis enabled the identification of key components of performance management. | Face-to-face interview, PERMA model | The finding from the three research questions was identified across the following themes: close relationship, open-minded, attitude, goals and beliefs, parental involvement and support, motivation, positive emotional impact, determin | The current study further proposes the development of a systematic strategy as module to represent the quality of athletes' performance management based on the findings of the research. |

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| | | | rts from family and influence of the social media. | | | | ation, self-motivation | |

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| | | | | | | | and self-confidence. | |
| Akan Bayrakdar, Hilal Kilinç Boz, Ömer Işildar 2020 | Turkish Journal of Sport and Exercise | The Investigation Of The Effect Of Static And Dynamic Core Training On the Performance On Football Players | This study was carried out to investigate the effect of static and dynamic core training on the performance of football Players. | IC-Football player, 3+experience EC-illness, injury | Total 30subjects. 1st static group, 2nd dynamic group and 3rd control group.10 subjects each group repeated 6 exercises for 9 weeks, and the level of difficulty increased gradually. The number of repetitions of the exercises started between 10-15 repetitions and advanced to the level of 20-25 repetitions at the end of the 9th week. | Push-up test, Plank test, Sit-up test, Waist-hip circumference and waist/hip ratio . Measurements, Back isometric endurance test, 30 ms peed, Leg lift test, Long jump by standing, Vertical jump, Arrowhead agility, 505 Agility test, stadiometer | 3 groups participating in the study were respectively1.58±0.08; 45.85±9.76; 18.19±is3, 14't.For | Static and dynamic core training. Applied to football players is thought to contribute to the improvement of performance . |

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| Daniel Tang Kuok Ho2021 | Journal of Specific Sport Science | A Review of the Association between Environmental Factors and Athletic Performance | Association between Environmental Factors and Athletic | IC-Athletes EC-Any deformity and disorder | Athletic performance is influenced by internal factors like athleticability and external factors like physical environment. | Wind, altitude, pollution, temperature | Environmental factors comprise typically temperature, pollution, altitude and wind, all of which exert effect on athletic performance to a certain extent. | This study contributes to the understanding of the intricate relations between athletics and their environment. |
| Ferdi Gokhan Can, SebnemAvci 2021 | Sports Medicine Journal /Medicina Sportivâ | Correlation of core stabilization, respiratory functions and injury risk in | The aim of this study was to investigate the correlation between core stabilization, respiratory functions and risk of injury of | IC-referees affiliated with the TFF from Bolu province and between the | 34 referees whose mean age was 21.1±3.8 Years participated in this study. Demographic data and physical | Functional Movement Screening score left lateral flexion-repeat | 1. Corestabilization and respiratory functions (0.348<r<0.587, p<0.05), risk of injury (0.344<r<0.6 | Findings showed that referees who had better core stabilization and higher Respiratory functions |

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| Football referees living in Boluprovince, Turkey. | football referees working in Boluprovince in Turkey. | ages of 18-35 EC-illness, Any deformity and disorder | characteristics. International Physical Activity Questionnaire-Short Form was used. | test, spirometer, Pressure Biofeedback Unit, Playertek Global Positioning System and Functional Movement Screening | 96, $p<0.05$), Running performances ($0.348<r<0.548$, $p<0.05$). 2. Running performances and respiratory functions ($0.356<r<0.511$, $p<0.05$)and risk of injury ($0.342<r<0.548$, $p<0.05$). | Performed increased running performance and reduced risk of injury. |