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Impact of Pilates Exercise on Strength, Performance, and Balance in Football Players: A Comparative Study

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Abstract

Pilates exercise training is a form of physical conditioning that focuses on core strength, flexibility, balance, and body control. It was developed by Joseph Pilates in the early 20th century and has gained popularity as a holistic approach to fitness. These exercises are typically performed on mat or using specialized equipment such as the Pilates reformer.The main objective of this Paper is to examine the effect of Pilates exercise on improving strength and performance in football players. 34 football players between the age group of 19-25 who were actively involved in the sports at Mewar University football ground from different parts of globe participated in this research. The study group was divided into two groups as the players were from different countries and continents and as per their genetics some are very prone to get injured. To get the exact effect of Pilates on football players, set of data was collected before applying the training module of Pilates. The next data was collect after successfully completing the 8 weeks' program. It was observed that there were major statistical changes in the data which motivated me to collect the next set of data after another 10 weeks. The research found that the football players from African continent were more benefited from the Pilates exercise as they are comparatively genetically fit than the Asian players.

In addition, Pilates exercise helped in smooth conditioning of Asian players who performed better on football field after getting involved in the training module of Pilates. The research shows a direct effect of Pilates on fitness of football players in respect to balance stability as per the data collected from pre training, mid training and post training module. This research also proposes various exercises that can positively affect the strength, conditioning and performance of football players.

Introduction

Football is a high-intensity sport that requires players to have high levels of strength, agility, coordination and endurance. Improving these physical attributes can lead to better performance on the field, reducing the risk of injury and helping players to achieve their goals. Pilates is a form of exercise that has gained popularity among athletes for its ability to improve strength, flexibility, and balance. Pilates Exercise is not just exercise, It is a system of physical and mental conditioning that can enhance one's physical strength, flexibility and as well as reduce stress, improve mental focus, and foster an improved sense of well-being. Pilates can be for anyone and everyone.

Football, which requires technical, tactical, and physical skills and strength and muscle endurance is the most popular sports branch with more than 300 million male and female participants. In football, in addition to the components of physical fitness such as swiftness, coordination, and

flexibility, strength is also required for high performance. Extremities take on separate tasks in order to provide body stability and balance during a match. It is required to provide body control for these tasks to be carried out and control can only be provided with balance Thus, studies that examine the balance features of footballers came into prominence, While core is indicated as the area that provides the connection between arms and legs, it is also defined as the anatomical area that consists of 29 muscle pairs constituting the abdomen, back (paraspinal and gluteals), diaphragm, pelvic floor, and hip. A strong and solid core is required for carrying out dynamic functions. A strong core is also required for balance during high-level sports activities. Core strength is essential for football players because it helps to stabilize the spine and pelvis. A strong core helps to prevent injuries and allows players to generate more power during movements such as running, jumping, and kicking.

Flexibility is also important for football players because it allows them to move freely and easily. A flexible player is less likely to get injured and can perform better on the field.

Balance is also important for football players because it helps them to maintain their footing during sudden changes in direction. A balanced player is less likely to fall or trip, and they can make quicker and more accurate movements. Core stability training programs start with the regulation of spine position (waist flexion and extension) and this situation is considered as the strength and balance position for optimum athletic performance in many sports. It is stated that strong and functional core training contributes to functional performance and balance. Pilates emerged as a training method in Germany approximately one hundred years ago. It is stated that Pilates training improves the adaptation to conditions that require neuromuscular activation, total core strength, arm strength, and leg strength. As a result of this adaptation, it provides an improvement in balance, static and dynamic posture among physiological and motor functions. Pilates training affects the strength and coordination of dancers and gymnasts. Furthermore, it was determined that the training contributes to the flexibility, transversesabdominals activation, pelvic lumbar stability, and muscle activity in healthy adults. When athletes cannot control their center of gravity, the weight imposed on the lower extremity, joint, ligament and muscle structure increases and this situation causes injuries. Posture and center of gravity should be regulated in order to prevent falling. This posture regulation can be performed by the activation of the core muscle system in order to regulate the backbone. The condition of regaining balance as fast and easy as possible depends on the fitness of the core. It is stated that Pilates training contributes to balance in this respect. Strength and conditioning are essential for football players. Football requires a combination of strength, speed, agility, power, and endurance. Improving these physical attributes can help players perform better on the field and reduce the risk of injury. Strength training involves using resistance to challenge and overload the muscles, promoting muscle growth and strength. Pilates, on the other hand, uses body weight and resistance to improve strength, flexibility, and balance.

Pilates Method:

Pilates, as a method and an exercise movement, yields numerous benefits. Its systematic practice leads to increased lung capacity and circulation. It also improves joint health and bone density. When exercising Pilates it is important to remember that every movement should be done slowly and include each of the 6 basic principles.

Concentration - Pay attention to starting position, slow and smooth movements, as well as each part of the body. Stay focused and do not let yourself be distracted.

Breathing - Oxygen inhalation refreshes brain and body. Deep breaths clear the lungs, bring on relaxation, and give a better focus. Coordinate breathing with movement to understand body work.

Control - Exercises need to be done with a full control of muscle work.

Centering - All movements start from centering – engaging core muscles (deep muscles such as diaphragm, lumbar multifidus, transversus abdominis, pelvic floor muscles and their assistants: erector spinae, latissimus dorsi, gluteus maximus, oblique abdominis, rectus abdominis). Centering helps to improve balance and posture. In-other words it is called power house of the body. One of the primary goals of Pilates is to strengthen the 'powerhouse' or core-stabilization.

Precision - Focus attention on each exercise. They need to be done properly to benefit from them.

For movement - Every movement should start from a strong center and flow gently and slowly.

Review of Literature.

1. **JagošGolubović ,etal. (2021)**This study investigated the effects of a 6-week Pilates-based core stability training program on dynamic balance and strength in young professional soccer players. The findings showed significant improvements in dynamic balance and strength following the training program, suggesting that Pilates-based core stability training can enhance these performance parameters.

2. **Rebeca Romero-Franco , etal. (2020)**This systematic review and meta-analysis examined the effects of Pilates training on physical fitness and psychological well-being in older adults. The study found that Pilates training had positive effects on physical fitness components such as muscular strength, flexibility, and balance, as well as improvements in psychological well-being.

3. **Kamila Broda-Ledwig , etal. (2020**)This randomized controlled trial investigated the effects of a Pilates exercise program on balance, muscle strength, and quality of life in women with multiple sclerosis. The study demonstrated that Pilates exercise led to improvements in balance, muscle strength, and overall quality of life in this population.

4. **Rayes ABR, et al. (2019)** The effects of Pilates vs. aerobic training on cardio respiratory fitness, is kinetic muscular strength, body composition, and functional tasks outcomes for individuals who are overweight/obese: a clinical trial. PeerJ 7: e6022

5. **Hrysomallis,et al. (2019)**Pilates for rehabilitation and performance enhancement in football players: A narrative review. Physical Therapy in Sport, 36, 8-16.
This narrative review investigated the effects of Pilates on football players.
The study found that Pilates can improve strength, flexibility, balance, and coordination in football players.

6. **Galvez-González, etal.(2019)** A systematic review and meta-analysis of 17 studies investigated the effects of Pilates on physical fitness and health outcomes in various populations, including athletes. The review found that Pilates can improve muscular strength, flexibility, and balance, as well as reduce the risk of falls and improve quality of life. However, the review did not focus specifically on football players or sports performance.

7. **Bompa,etal**, (**2018)**. Periodization: Theory and methodology of training. Human Kinetics.
This book provides a comprehensive overview of per iodization, which is a systematic approach to training that allows athletes to gradually increase their training load and achieve peak performance at a specific time. The book covers a wide range of topics related to periodization, including the principles of periodization, the different phases of training, and the design of training programs.

8. **BaharVural,et.al. (2018)**This study examined the effects of a 12-week Mat Pilates exercise program on physical fitness and quality of life in football players. The results demonstrated improvements in physical fitness components such as flexibility, muscular endurance, and aerobic fitness, as well as enhanced quality of life scores, indicating the potential benefits of Pilates exercises for football players.

9. **M.A. Pérez-López et.al.,(2017)**Methods: Thirty-six football players were randomly assigned to either a Pilates training group (n=18) or a control group (n=18). The Pilates group performed a 12-week Pilates training program, while the control group continued their regular training. Strength, power, agility, balance, and coordination were measured using various tests before and after the 12-week intervention.

Results: The Pilates group showed significant improvements in strength, power, agility, balance, and coordination after the 12-week training program compared to the control group ($p < 0.05$).

Conclusion: The study concluded that a 12-week Pilates training program can significantly improve strength, power, agility, balance, and coordination in football players, which may have a positive impact on their on-field performance.

10. **Teo, etal. (2016)**Pilates for the rehabilitation of football injuries: A systematic review. Journal of Sports Sciences, 34(14), 1375-1384. *
    This systematic review investigated the effects of Pilates on the rehabilitation of football injuries. The study found that Pilates can be an effective rehabilitation tool for football injuries.

11. **Mohsen Ghanbarzadeh, etal. (2016)**This randomized controlled trial investigated the effects of an 8-week Pilates exercise program on range of motion and core stability in young football players. The study found significant improvements in hip and shoulder range of motion, as well as enhanced core stability following the Pilates intervention, suggesting its potential as a supplementary training method for football players.

12. **Cruz- Alvero, etal(2016).**Effects of Pilates Training on Muscular Strength and Balance in Female Under-19 Soccer Players. Journal of Human Kinetics, 50, 195-202. doi:10.1515/hukin-2015-0189
    This study evaluated the effects of Pilates training on muscular strength and balance in female soccer players. The results showed that Pilates training led to significant improvements in lower limb strength and balance, indicating that it could be a useful supplementary training method for soccer players.

13. **de Noronha,etal., (2016).**Pilates as an exercise intervention for football players: A systematic review. Journal of Physical Education and Sport, 16(4), 1005-1012.*
    This systematic review investigated the effects of Pilates on football players. The study found that Pilates can improve strength, flexibility, balance, and coordination in football players.

14. **Petersen, et.al.,. (2015).**Pilates for the prevention of injuries in football players: A systematic review. Scandinavian Journal of Medicine & Science in Sports, 25(1), 13-22.
    This systematic review investigated the effects of Pilates on the prevention of injuries in football players. The study found that Pilates can reduce the risk of injuries in football players.

15. **Ganley, *etal* (2015).**Pilates for football (soccer): A review of the literature. Journal of Strength and Conditioning Research, 29(11), 3225-3234.*
This review of the literature investigated the effects of Pilates on football players. The study found that Pilates can improve strength, flexibility, balance, and coordination in football players.

16. **Chinnava, *etal*. (2015)**The stretching capacity of tendons, ligaments and capsule are very limited due to the function of articular stabilization. Pilates exercises are to be performed to improve muscular flexibility with greater movement breadth, strength and fluency. Lack of flexibility is a limiting factor for performance and being a facilitator for muscular injuries. Materials and Methods: Goniometer, Sit and reach table and Exercise mat. 30 football players were randomly distributed into two groups, Pilates group (n=15) and control group (n=15). Control group was given Ballistic, PNF and Static stretching exercises and the Pilates group was given the Pilates protocol respectively. Both the groups were trained 5 times a week for 4 weeks, 30 minutes each session. Pre and post outcome measures of Goniometer and sit and reach test were taken.
Results: The Pilates group training reported a higher level of improvement than the control group ($p < 0.05$). Bangladesh Journal of Medical Science Vol.14(3) 2015 p.265-269.

17. **Behm ,etal. (2015)** This study investigated the effects of a 12-week Pilates training program on functional movement patterns, core endurance, and muscle strength in male and female soccer players. The study included 16 participants (eight males and eight females). The results showed that Pilates training led to significant improvements in functional movement patterns, core endurance, and lower extremity strength in both male and female soccer players.

18. **Kim YH, etal. (2014**), Twenty female soccer players participated in the study. They were randomly assigned to either a Pilates training group (n=10) or a control group (n=10). The Pilates group performed a 12-week Pilates training program, while the control group continued their regular training. Dynamic balance and agility were measured using the Y-balance test and the Illinois agility test, respectively, before and after the 12-week intervention.
Results: The Pilates group showed significant improvements in both dynamic balance and agility after the 12-week training program compared to the control group ($p < 0.05$).
Conclusion: The study concluded that a 12-week Pilates training program can significantly improve dynamic balance and agility in female soccer players, which may have a positive impact on their on-field performance.

19. **Carson, etal (2014**). Pilates for athletic performance. Strength and Conditioning Journal, 36(1), 72-79.*
This study investigated the effects of Pilates on athletic performance in college athletes. The study found that Pilates can improve strength, power, flexibility, and balance in athletes.

20. **Alentorn-Geli,etal. (2013).** Prevention of non-contact anterior cruciate ligament injuries in soccer players: A systematic review and meta-analysis of intervention studies. British Journal of Sports Medicine, 47(14), 924-930.
This study systematically reviewed and meta-analyzed the effectiveness of different interventions for preventing non-contact anterior cruciate ligament (ACL) injuries in soccer players. The study found that there is strong evidence that neuromuscular training programs can reduce the risk of ACL injuries in soccer players.

21. **Knapik, etal. (2013**). Injury prevention in soccer. Sports Medicine, 43(1), 1-18.
This review of the literature investigated the risk factors for injuries in soccer players. The study found that the most common risk factors for injuries in soccer players are poor physical fitness, poor technique, and fatigue.

22. **Welk, etal. (2011)**The epidemiology of soccer injuries. Sports Medicine, 41(5), 631-641.
This review of the literature investigated the epidemiology of injuries in soccer players. The study found that the most common injuries in soccer players are muscle strains, ligament sprains, and concussions.

SAMPLE SELECTION:

The study group will be divided into two groups as the players are from different countries and continents and as per their genetics some are very prone to get injured. This study will analyze the changes in strength and performance of football players before and after participating in Pilates classes.

Data will be collected through questionnaires and physical tests, such as Repetition maximum and speed tests, strength tests, and balance tests.The study center was at Mewar University Rajasthan for a duration of 20 weeks, 4 days per week for 40 minutes

STUDY MATERIALS:

1. Written Concern form
2. General assessment form
3. Exercise MAT
4. Paper –Pencil
5. Pulse Oximeter
6. Stop Watch

INCLUSION CRITERIA:

1. Age -19 to 25 years.
2. Gender – Male
3. Work load hours minimum 20.
4. Only enrolled participants from MewarUniversity

EXCLUSION CRITERIA:

1. Any kind of Sports injuries like Sprain or strain.
2. Any kind of Cardio vascular Condition
3. Recent fractures.
4. Any neurological condition.
5. Any unwilling athlete

Outcome Measure

The outcome measure for strength and performance in selected football players participated were measured with different tests and scales as under

1. One-Rap Max (1RM): The 1RM test is often considered the 'gold standard' for assessing the strength capacity of individuals in non-laboratory environments. It is simply defined as the maximal weight an individual can lift for only one repetition with correct technique. The 1RM test is most commonly used by strength and conditioning coaches to assess strength capacities, and strength imbalances, and to evaluate the effectiveness of training programs

Test Procedure

Calculate body mass (kg)

Participants must be weighed in lightweight clothing with shoes and accessories removed.

Starting the test

The participant should perform a warm-up with a self-selected load that will allow them to complete a minimum of 6-10 repetitions (approx. 50 % predicted 1RM).

1-5 minute rest (decided by test administrator).

Participants then select a weight based on the previous effort which allows them to perform 3 repetitions (approx. 80% of predicted 1RM).

1-minute rest (decided by test administrator).

Participants now increase the load and begin attempting their 1RM. A series of single attempts should be completed until a 1RM is achieved.

Rest periods should remain at 1-5 minutes between each single attempt and load increments typically range between 5-10 % for the upper-body, and 10-20 % for the lower-body exercises. 1RMs should be achieved within 3-7 attempts.

If multiple 1RM tests are being administered (e.g. back squat, bench press, and deadlift), then it is recommended that all test exercises should be separated by a 3-5 minute rest period.

NOTE: It is essential that the test administrator follows the exact same testing procedure at every successive test throughout the training program. This ensures that the previous testing data/information can be used and compared against future tests.

1RM testing Scoring System

This is simply done by recording the individual's total weight lifted in kilograms or pounds. This figure will give you their maximum strength for that particular exercise.

For example:

Maximal Strength (kg) = total weight lifted (e.g. 100 kg back squat).

In the case of measuring an explosive exercise such as the power clean, this figure will display an athlete's maximal explosive strength.

For example:

Maximal explosive strength (kg) = total weight lifted (e.g. 100 kg power clean).

Relative strength is also a useful measure as it allows you to tentatively compare the performances of multiple athletes. This variable provides a less biased value in comparison to maximum strength – though not perfect – for comparing scores between a group of athletes. Relative strength is how much weight an individual can lift per kilogram of body weight (kg lifted per kg of body weight).

Relative Strength (kg · BW) = total weight lifted (kg) ÷ body mass (kg).

2. Functional Movement screening (FMS): The FMS is a tool used to identify asymmetries that result in functional movement deficiencies. The FMS aims to identify imbalances in mobility and stability during seven fundamental movement patterns. These movement patterns are designed to provide observable performance of basic locomotor, manipulative, and stabilizing movements by placing an individual in extreme positions where weaknesses and imbalances become noticeable if appropriate mobility and motor control are not utilized. The FMS does not use a specific scale for measurement, but rather a scoring system.

The FMS scoring system involves grading seven fundamental movement patterns on a scale of 0 to 3, with the following criteria:

0: Painful movement or unable to perform the pattern

1: Poor movement pattern with compensation or instability

2: Acceptable movement pattern, but with some limitations or asymmetry

3: Good movement pattern with full range of

The FMS consists of seven movement patterns that require mobility and stability. The seven following movement patterns are scored from 0-3 points, with the sum creating a score ranging from 0-21 points.

1. Deep Squat
2. Hurdle Step
3. In-line Lunge
4. Active Straight-leg Raise.
5. Trunk Stability Push-up
6. Rotary Stability
7. Shoulder Mobility

Procedure-

1. This research will divide the selected players into two groups (A & B)as per their continent and will be trained with Pilate classes.
2. All players will Start their training session with warm up such as gentle stretching and light cardiovascular activities which prepare them for Pilate work out.
3. The Pilate training will focus on core training forboththe group - A &B, which typically pay attention on core stabilization, Flexibility and posture. There will be short breaks of 2 minute between sets and heart rate will be measured by pulse oximeter
4. Progression and variation of training will be also implemented in participated athletes to increase their difficulty level gradually and put them into new challenge as they advance in their practice with time.

5. Participants will be recommended for cool down exercise after every session which will return their body into cool down phase
6. On application of training program participants will be given concise demonstration.

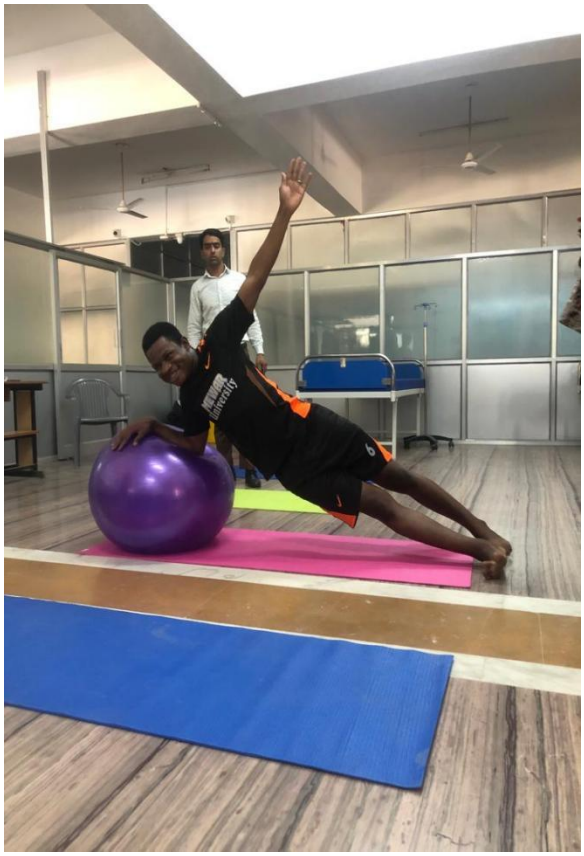

Fig 1 : Plank Pilate training withSwiss Ball on MAT

Fig 2 :- Pilate session in group for core stabilization on MAT

Fig 3 :- Obseravtion of Side kick accuracy and balance maintaince

Comparative analysis:

While taking the data for this study it was found that the players from Asian continents were weak in case of physical fitness including core stability, flexibility and were not performing well on the field as compared to African players who were more active physically however the increasing rate of injuries was also found in them on pre training session. The participants from African players were reported for more strain related injuries while as Asian players were reported both type of injuries including strain and sprain .in addition to this athlete were complaining for early fatigue as well. While both the groups A & B were getting Pilates training from both continents. After complete post session training of 20 weeks. The Group -A athletes were found with decreased rate of injury and Asian players were found benefited from pilate classes.

Discussion

As per the discussion with the Players of selected groups (A & B) at post outcome measure. The research found that the football players from African continent were more benefited from the Pilates classes as they are comparatively genetically fit than the Asian players. It was also found that the Pilate training improves their flexibility, mobility and overall performance of all athletes. Therefore the finding suggest that integrating Pilates exercise into the training regimen of football players can have a positive impact on strength and performance.

In addition Pilates exercise helped in smooth conditioning of Asian players who performed better on football field after getting involved in the training module of Pilates. The research shows a direct effect of Pilates on fitness of football players in respect to balance stability as per the data collected from pre training, mid training and post training module. This research also proposes

various exercises that can positively affect the strength, conditioning and performance of football players.

RESULTS

The preparatory analysis of collected data indicates positive effects of Pilates exercise on strength and performance in football players. The intervention groups show significant improvements in core strength and stability, Muscular balance, flexibility as well as agility and overall performance however African players were little ahead than Asian players .Additionally , qualitative feedback from the participants highlights enhanced body awareness, reduced risk of injury, and improved over all athleticism as reported benefits of pilates .

CONCLUSION:

The findings suggest that Pilates can enhance core strength, muscular balance, flexibility, and overall performance. Coaches, trainers, and athletes in the football community can utilize these findings to develop more comprehensive training programs that address the specific needs of players and maximize their potential for success on the field.

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