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EFFECTIVENESS OF SWISS BALL EXERCISE VERSUS FLOOR EXERCISE ON CORE MUSCLE ENDURANCE IN ATHLETES

K. Manikandan[1*], Priya Kumari
[1]*Assistant Professor, Department of Sports and Exercise Science, School of Allied Health Science, REVA University, Bangalore, Karnataka*
[2]*Associate Professor, Satyabhama College of Physiotherapy, Chennai*
[*]*Corresponding Author*

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ABSTRACT

Introduction: *Core muscles serve as a critical bridge for force transfer between the upper and lower limbs, playing a vital role in body stabilization and force generation during sports activities. The core is visualized as a box comprising the abdominal muscles (front), para-spinals and gluteus muscles (back), diaphragm (roof), and pelvic floor and hip girdle musculature (bottom). Within this structure, the inner unit (transverse abdominals, multifidus, pelvic floor and hip musculature) provides internal stability, while the outer unit (rectus abdominals, external and internal obliques) facilitates movement and external stability. Effective core performance requires coordination of these muscles to maintain posture, balance and functional movement.*

Methodology: *This true experimental, comparative study employed random sampling via the lottery method, involving 30 male athletes aged 17-24. Conducted over four weeks at Jawaharlal Nehru Stadium, the study utilized the McGill Torso Muscular Endurance Test Battery (trunk flexor, lateral flexors (right and left), and extensor endurance tests) to measure core muscle endurance. Tools used included a Swiss ball, mat, high couch, board or step, stopwatch, and rope. Participants were divided into three groups: Group A (Floor Exercise), Group B (Swiss Ball Exercise), and Group C (Control Group).*

Procedure: *Pre-assessments were conducted using the McGill Torso Endurance Test Battery. Over four weeks, Group A performed floor exercises, Group B performed Swiss ball exercises, and Group C received no specific exercise intervention. Post-assessments followed, comparing pre- and post-test results to determine the effectiveness of each exercise regimen on core muscle endurance.*

Discussion and Results: *All groups showed significant improvement ($p < 0.05$) in core muscle endurance. Inter-group analysis revealed that Group B (Swiss Ball Exercise) had more significant improvements in all measures (flexor, extensor, right and left lateral flexion) compared to Group A (Floor Exercise) and Group C (Control Group). The unstable surface of the Swiss ball increased muscle recruitment and spinal stabilization, providing a dynamic training environment that enhanced core muscle performance.*

Conclusion: *Intra-group analysis indicated that all three groups improved core muscle endurance. However, inter-group analysis demonstrated that Swiss Ball exercises were more effective than floor exercises and no intervention in enhancing core muscle endurance.*

KEYWORDS: *Core Muscle Endurance, Swiss Ball Exercises, Floor Exercises, Athletes*

INTRODUCTION

The Core muscles act as a bridge between upper limbs and lower limbs and the force is transferred from the core often called the powerhouse of the limbs. Core muscles have been suggested not only to protect the spine from excessive force, but also to play an important role in body stabilization and force generation during sporting activities. Core plays an important role in stabilizing lower extremity and knee movement during activities. (1)

The core muscles can be visualized as a box, consisting of several key muscle groups that work together to provide stability and strength to the body's trunk. At the front of this box are the abdominal muscles, while the back is supported by the para-spinals and gluteus muscles. The diaphragm forms the roof of the box, and the pelvic floor along with the hip girdle musculature create the bottom. (2,3,4)

Within this core structure, there are two distinct units: the inner unit and the outer unit. The inner unit is composed of the transverse abdominals, multifidus, and the pelvic floor and hip musculature. These muscles are crucial for maintaining internal stability and support. On the other hand, the outer unit includes the rectus abdominals and both the external and internal oblique muscles. These muscles are primarily responsible for movement and external stability. Together, the inner and outer units of the core work synergistically to maintain posture, balance, and overall functional movement. (5)

A good core performance should co-ordinate all these muscles as one working unit. The inner unit musculature system provides the necessary joint stabilization for the spine. The outerunit musculature system provides aids in movement and function. The outer unit muscles of basically prime movers of the core muscles and extremities. Core muscular endurance is the ability of an isolated muscle group to perform

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repeated contractions over a period of time with the intensity of activity being moderate. Endurance is one of the basic elements of muscular performance that has a great relevance to activity of daily living like lifting and bending as wellas sports related performance. Poor core endurance trunk muscles may induce strain over the lumbar spine and hence result in low back ache. Core muscular endurance is the ability of an isolated muscle group to perform repeated contractions over a period of time with the intensity of activity being moderate. Endurance is one of the basic elements of muscular performance that has a great relevance to activity of daily living like lifting and bending as well as sports related performance. Poor core endurance trunk muscles may induce strain over the lumbar spine and hence result in low back ache. (6,7,8)

METHODOLOGY

The study was designed as a true experimental, comparative study, utilizing random sampling through the lottery method. A total of 30 subjects participated, with the study conducted over a duration of four weeks at the Jawaharlal Nehru Stadium. Participants were selected based on specific inclusion and exclusion criteria. The inclusion criteria required subjects to be male athletes within the age group of 17 to 24 years. Exclusion criteria included any history of recent spinal or abdominal surgery, recent fractures, or any other systemic illnesses. (9). This study did not include female athletes due to the difficulty in obtaining a sufficient sample size and because certain physiological conditions may prevent them from completing the four-week session.

The primary outcome measure for the study was the McGill Torso Muscular Endurance Test Battery, which includes the trunk flexor endurance test, trunk lateral flexion endurance test (both right and left sides), and trunk extensor endurance test. These tests were used to evaluate the endurance of core muscles. Various tools were utilized throughout the study, including a Swiss ball, mat, high couch, board or step, stopwatch, and rope. These tools facilitated the execution and measurement of the endurance tests to determine the effectiveness of the core muscles among the subjects. (10,11,12)

PROCEDURE

The study included 30 athletes who met both the inclusion and exclusion criteria. These athletes were divided into three groups: Group A (Floor Exercise), Group B (Swiss Ball Exercise), and Group C (Control Group). Each group contained an equal number of participants. Group A performed floor exercises, Group B performed Swiss ball exercises, and Group C served as the control group with no specific exercise intervention. The McGill Torso Endurance Test Battery was used to assess core muscle endurance. Pre-assessments were conducted, followed by a four-week intervention period. Post-assessments were then carried out, and the pre- and post-test results were compared to determine which group showed the most significant improvement in core muscle endurance. (13)

The Swiss Ball Exercise regimen included Swiss ball bridges, Swiss ball crunches, Swiss ball push-ups, Swiss ball planks, and Swiss ball hamstring curls. These exercises were performed in three sets with repetitions of 10, 12, and 15, and each repetition was hold for 15 seconds. The Floor Exercise regimen consisted of curl-ups on the floor, planks, bridges, prone cobra, and quadruped position exercises. These exercises were also performed in three sets with repetitions of 10, 12, and 15, and each repetition was hold for 15 seconds. By comparing the pre- and post-test results, the study aimed to identify which exercise group (floor exercises or Swiss ball exercises) was more effective in improving core muscle endurance. (14,15,16)

DISCUSSION AND RESULTS

In all the group the p-value is(o.ooo) less than 0.05, so we reject the null hypothesis. Hence, the evidence is sufficient to say there is a significant improvement from pre and post value of outcome measure in all three groups. The inter-group analysis clearly showed that the group-B [Swiss ball exercise] is effective than group-A [floor exercise] and group-C [control group] in terms of improvement in all four measures flexor, extensor, lateral flexion [right and left] n of core muscles endurance. (17,18,19)

This study aimed at comparing the effect of Swiss ball exercise vs floor exercise with control group on core muscles endurance in long distance athletes. After the four week of intervention there was a significant change seen in group-A and group-B when compared to control group in pre and post values, this was because group-A performing core exercise on floor and group-B performing core exercise on Swiss ball. Control group or group-C performing our daily practice. (20,21)

In June 2016, Osama Ragaa Abdelraouf, states during physical activity, the trunk musculature provides both mobility and stability to the lumbo-pelvic region. Changes in trunk specific activity in form of weakness or insufficient motor control, typically observed in individuals with LBP may lead to increased dysfunction and suboptimal athletic performance. In 2015 Dr. K. Sai Sudha et al, core stability is an important factor in all sports persons especially in cricketers to prevent the risk of injuries. Barati et al. that the core endurance is important to spinal stability during prolonged activity or exercise. Koblbauer et al, suggest that the positive relationship exists between core endurance and running kinematics. Tong et al, indicates that the high intensity maximum run might induce the core muscle fatigue. Therefore, improving core endurance may benefit running performance. In 2019, kwong- chung hung. It states the 8 weeks of core training improved the core endurance as well as running economy. (22,23,24,25)

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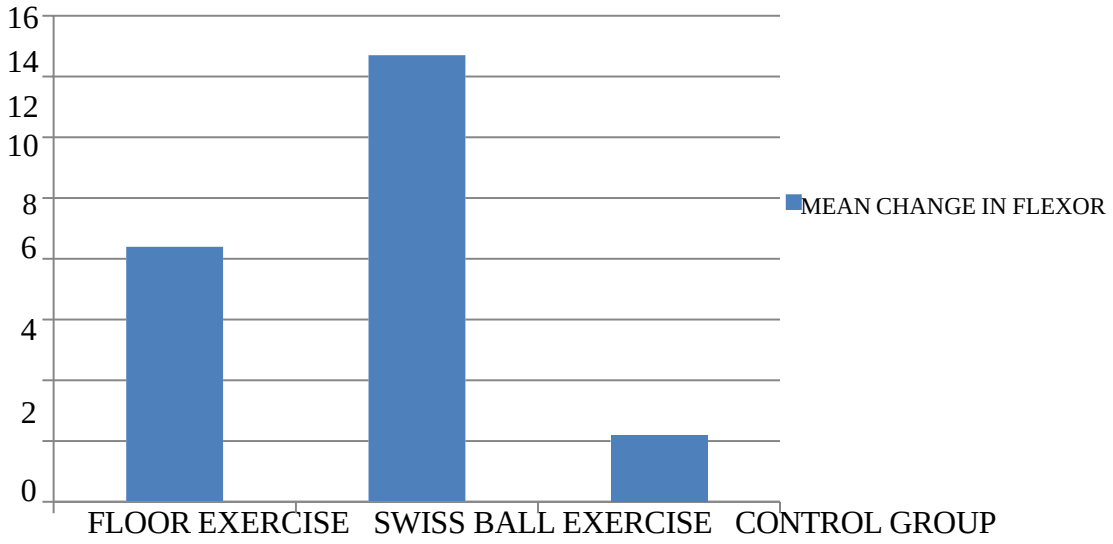
MEAN CHANGE IN FLEXOR (GROUP A, B, & C) GRAPH-1

Post-Hoc-Test	Mean	Diff	SE	T-Value	P-Value
A-Flexor Diff	8.40	-6.30	1.24	-5.07	0.000
B-FlexorDiff	14.70				
A-FlexorDiff	8.40	6.20	1.24	4.99	0.000
C-Flexor Diff	2.20				
B-FlexorDiff	14.70	12.50	1.24	10.07	0.000
C-Flexor Diff	2.20				



Graph-1

MEAN CHANGE IN EXTENSOR (GROUP A, B, & C) GRAPH-2

Post-Hoc-Test	Mean	Diff	SE	T-Value	P-Value
A-Extensor diff	10.30	-4.00	1.06	-3.76	0.001
B-Extensordiff	10.40				
A-Extensordiff	10.30	7.90	1.06	7.43	0.000
C-Extensor diff	2.40				
B-Extensordiff	14.30	11.90	1.06	11.19	0.000
C-Extensor diff	2.40				

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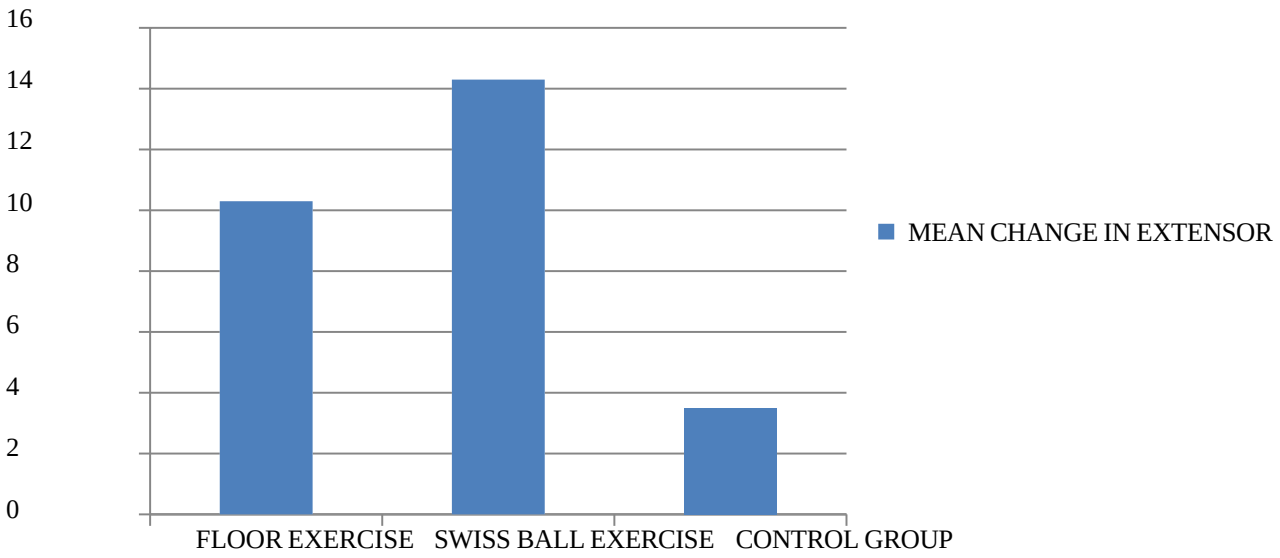
MEAN CHANGE IN EXTENSOR



GRAPH-2

MEAN CHANGE IN RIGHT SIDE LATERAL FLEXION (GROUP A, B, &C) GRAPH-3

Post-Hoc-Test	Mean	Diff	SE	T-Value	P-Value
A-right side Lateral flexion	8.40	-9.10	1.25	-7.27	0.000
B- right side Lateral flexion	17.50				
A- right side Lateral flexion	8.40	5.80	1.25	4.64	0.000
C- right Side Lateral flexion	2.60				
B- right side Lateral flexion	17.50	14.90	1.25	11.91	0.000
C- right Side Lateral flexion	2.60				

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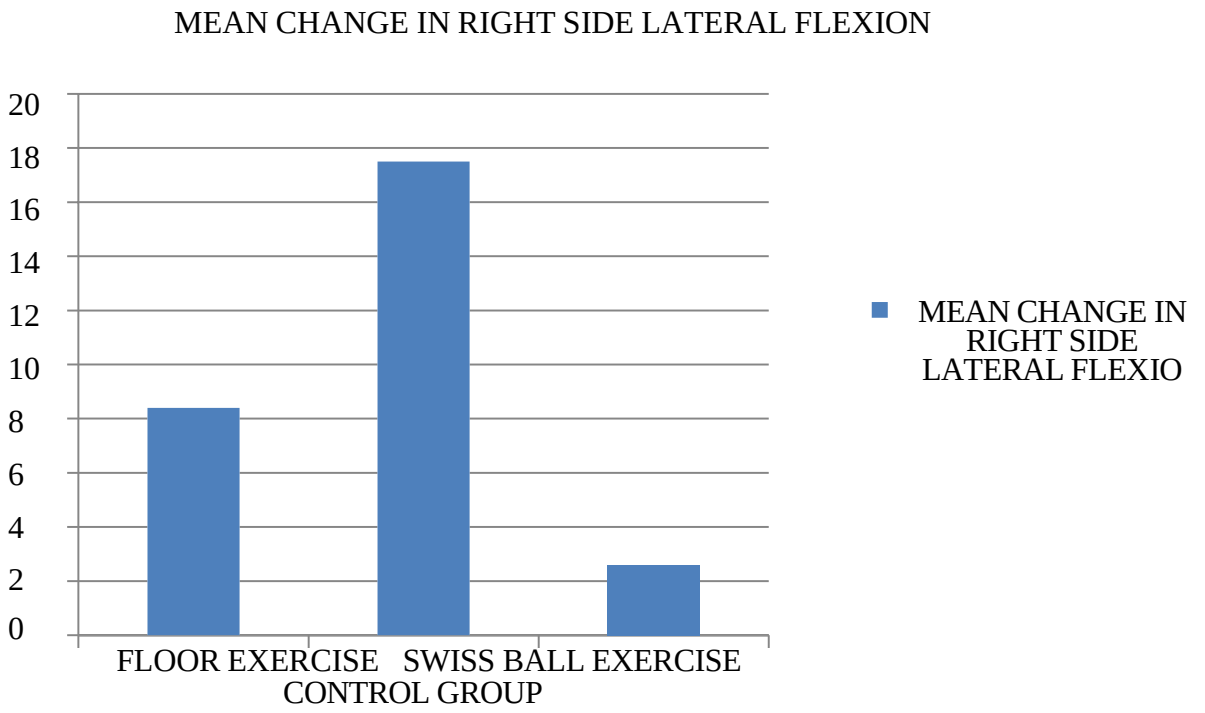

MEAN CHANGE IN LEFT SIDE LATERAL FLEXION (GROUP A, B, &C) GRAPH-4

Post-Hoc-Test	Mean	Diff	Se	T-Value	P-Value
A-Left side Lateral flexion	12.80	-1.80	1.68	-1.07	0.294
B- Left sideLateral flexion	14.60				
A- Left side Lateral flexion	12.80	10.20	1.68	6.06	0.000
C- Left side Lateral flexion	2.60				
B- Left sideLateral flexion	14.60	12.00	1.68	7.13	0.000
C- Left side Lateral flexion	2.60				

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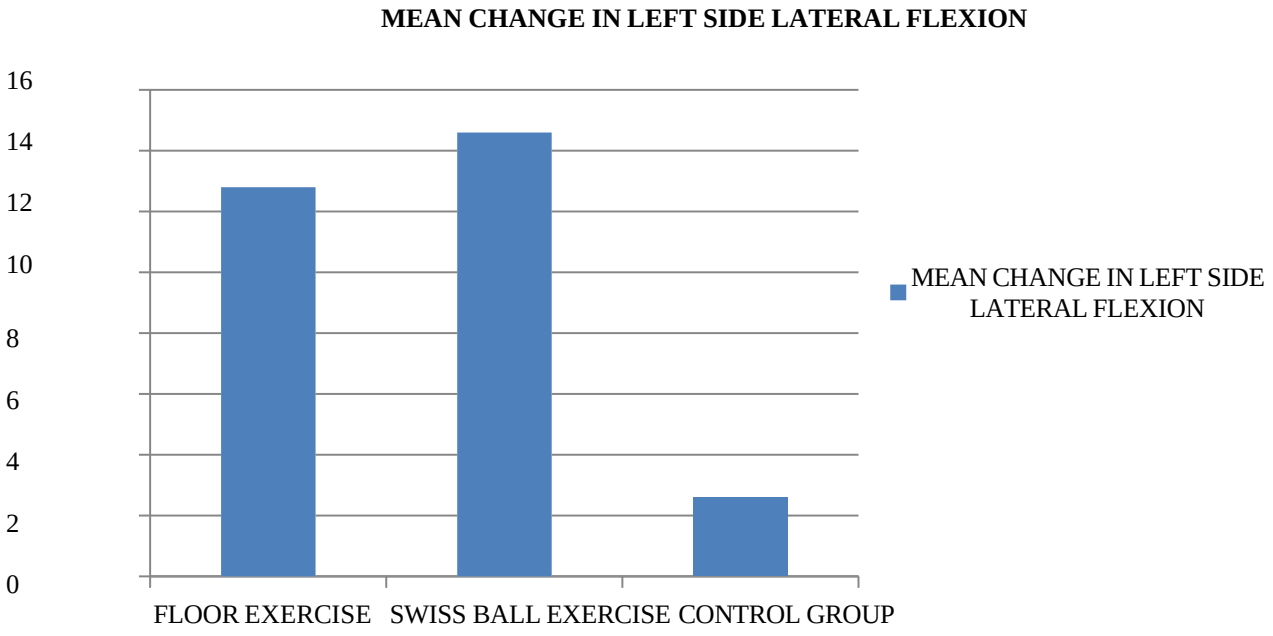

GRAPH-4

A total of 30 athletes were assessed as planned. After a four week of protocol period,the athletes in floor exercise and Swiss ball exercise as well as control group shows improvement in all outcome measures.
Graph-1 shows improvement between pre and post value of floor exercise group.

Graph-2 shows the improvement between pre and post value of Swiss ball exercise group.
Graph-3 shows the mild improvement between pre and post value control group

In Graph-1, Graph-2 and Graph-3 are shows the intra group analysis by the means of paired samples t-test.

Graph-4,5,6 and 7 shows the inter group analysis between Group-A, Group-B and Group-C by the means of one-way AN0VA.

MEAN CHANGE IN FLEXOR

According to the multiple-comparison test, group-A is significantly different fromgroup-B (t=-5.07, p< 0.05), group-A is significantly different from group-C(t=4.99, p<0.05), and group-B is significantly different from group-C (t=10.07,p<0.05).On the whole the group-B is effective than group-A and control group in terms of improvement in flexors

MEAN CHANGE IN EXTENSOR

According to the multiple-comparison test, group-A is significantly different fromgroup-B (t=-3.76,P<0.005), group-A is significantly different from group- C(t=7.43,P<0.05), and group-B is significantly different from group-C (t=11.19,p<0.05).On the whole the group-B is effective than group-A and control group in terms of improvement in extensor.

MEAN CHANGE IN RIGHT SIDE LATERAL FLEXION

According to the multiple-comparison test, group-A is significantly different fromgroup-B (t=-7.27, p< 0.05), group-A is significantly different from group-C(t=4.64, p<0.05), and group-B is significantly different from group-C (t=11.91,p<0.05).On the whole the group-B is effective than group-A and control group in terms of improvement in right side lateral flexion

MEAN CHANGE IN LEFT SIDE LATERAL FLEXION

According to the multiple-comparison test, group-A is significantly different from group-B (t=-1.07, p< 0.05), group-A is significantly different from group-C(t=6.06, p<0.05), and group-B is significantly different from group-C (t=7.13,p<0.05).On the whole the group-B is effective than group-A and control group in terms of improvement in left side lateral flexion.
*Group-A performing floor exercise
*Group-B performing Swiss ball exercise
*Group-C control group

According to statistical analysis group-A [Swiss ball exercise] is very effective in improving core muscles endurance when compared to group-B [floor exercise] and group-C [control group] because performing core exercise in Swiss ball like unstable surface increases the muscular activity of core muscles. The major benefit of unstable surface is the ability to recruit more muscles units to perform without the need to increase the total load. It can also be due to the increase the perturbation on Swiss ball, more control of center of gravity with a limited base of support, due to reduced contact area performing activity on Swiss ball is more vertical position when compared to floor, thus more muscle recruitment is required to

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produce spinal stabilization. Swiss ball exercise provides dynamic training environment which challenge the nervous system and improving the ability to react to a changing base of support, that's way it improves the nervous system function that result in improve functional core muscles performance.

The technique behind Swiss ball training is to concentrate and shift the weight to maintain thestability on the ball, which will not occur in other exercise. (26,27)

CONCLUSION

1. The intra-group analysis showed that the three groups [A, B, C] are effective in terms of improvement in flexor, extensor, lateral flexion [right and left] scores of core muscles endurance.
2. However, the inter-group analysis clearly showed that the group-B [Swiss ball exercise] is effective than group-A [floor exercise] and group-C [control group] in terms of improvement in all four measures flexor, extensor, lateral flexion [right and left] of core muscles endurance. (28)(29)

LIMITATION

1. Sample size is small.
2. Duration of the study is short [only 4 weeks].
3. Only males are taken in this study.
4. Other factors like running performance, balancing training was not considered.
5. Only core muscles are identified in outcome measure test, there is no supporting muscle identification like gluteus, hamstrings.
6. Only college students are taken in this study.

RECOMMENDATION

1. The confounding parameters like running performance, balancing can be considered.
2. In this study only male athletes were taken, so female athletes can be considered.
3. Further study can be done to identify long term effects of this study.
4. Different type of sports game can be considered.
5. Large size samples were recommended.
6. Further studies can be done with different age group (30)

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