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# Impact of core muscle training on explosive strength for school going state level participants

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**Abstract**
Purpose of the present study was to investigate the impact of core muscle training on explosive strength. Thirty male school going state level participants (age 15.93±1.55, height1.58±0.10, body weight47.35±8.66) were divided into a control (n=15) and an experimental (n=15) group. Participants were assessed before and after the training program on standing broad jump for explosive strength. The experimental group performed core muscle training thrice a week for six weeks. Data analysis explored a significant effect of core muscle training on explosive strength in experimental group ($p<0.01$).

**Keywords:** Core muscle training, explosive strength, standing broad jump

## Introduction
The word "core" has been accustomed talk over with the lumbo pelvic-hip-complex [1] that involves deeper muscles, like the internal oblique, transverses abdomens, transverse ospinal(multi fidus, rotetors, semi spinals), quardratus lumborum, and posas major and minor, and super facial muscles, like the muscle abdominis, external oblique, erector spine, latissimus dorsi, gluteus maximus gluteus medius, hamstrings, and rectus femories [2].
Core stability and balance are important for better performance in the majority sports and activities. This can be thanks to the 3 dimensional nature of the many sporting movements that demands that athletes should have sensible strength with in the hip and trunk muscles to supply effective core stability. Some sports need sensible balance, some force production, others body symmetry; however all of those successively need a stable core [3].
An individual's core stability and core strength are very important when an individual's center of gravity is stirred outside the bottom of support (e.g. during several sporting movements). The individual after has to build postural changes to stop a loss of balance and to reposition the centre of gravity back at intervals the bottom of support [4]. The acceleration or deceleration of body segments throughout sports performance is decided by the power of the core musculature to regulate the higher and lower extremities [5]. Thus the core will be considered because the kinetic link between the lower and higher extremities and is important in effective force transfer through the body [6, 7].
During any active movement, the core muscles act together. Some decrease to effectuate movement, while the rest contract and operate to supply stability, prolong to rein the movement, or convey signals to the brain relating the movements and locations of the muscles and bones. When particular core muscles are feeble or exhausted, the nervous system comes forward and enables other muscles. This alternation causes unusual strain on the joints, lessens power, and brings up the risk of injury [8].
Primary muscles involve in core muscle are the pelvic floor muscle, trasversus abdominis, multifidus, internal and external obliques, rectus abdominis, erector spine. The lumber muscles, quadratus lumbo rum, deep rotators as well as cervical muscles, rectus capitus anterior and lateral is, longus coli may also be considered members of the core group [9].
Secondary core muscles consist the latissimus dorsi, gluteus maximus, and trapezius.

## Methodology
For present study 30 male subjects of class eight to twelve school going state level participants in different discipline were selected, 21 from kho-kho and 9 from athletics.

All of them are residing in Dhupguri, District of Jalpaiguri, West Bengal. They were randomly selected and divided into two groups, i.e., group-A (n=15) served as experimental group and group- B (n=15) served as control group. Mean age of the subjects were 15.93±1.55yr. Mean height were1.58±0.10cm and mean body weight were 47.35±8.66kg.
All participants were experienced in performing core exercises both static and dynamic and they were completely fit prior to the testing and did not report any feelings of pain while performing the tests. Pre- test data on explosive strength were collected at the end of the regular training session and continued by the training schedule of the present study and at the end of training schedule the post- test data were collected before the beginning of the next regular training session. During the research work they did not participate in any kind of other trainings. Core exercise programme of the training runs for six weeks. Experimental group was involved in the core exercise programme thrice a week, and the control group did not participate in any kind of training programmes. Test, re-test method were used for this present study.
Explosive strength: Explosive strength is the ability to exert maximal force in minimal time.

Explosive strength was assessed by standing broad jump. Subject was asked to square on the takeoff board together with his feet parallel to each other. From this position the subject was asked to require a preliminary movement by flexing his knees and swinging his arms attainable. The measurement of the jump was made from border of the takeoff board to the closest imprint created by the subject in landing. 3 trials were permissible in succession and also the distance of all the jumps were measured to the closest centimeter. The best performance out of 3 trials was taken in to account.

**Detailed programme for core training**
The treatment was administered on experimental group for the period of six weeks, thrice in a week which control group did not get any kind of training. Duration of Each session lasted for 30-50 minutes and the load was increased gradually after every two weeks.
An exercise programme for 6 weeks on following listed core muscle exercises had been planned comprising-jogging, jumping, throwing, stretching, resistance exercises etc.

**Table 1:** Core training plan for 6 weeks

| Exercise | Week 1-2 | | Week 3-4 | | Week 5-6 | |
|---|---|---|---|---|---|---|
| | Repetitions | Sets | Repetitions | Sets | Repetitions | Sets |
| Forward bridge | 30 sec. hold | 2 | 60 sec. hold | 2 | 90 sec. hold | 2 |
| Side bridge | 20 sec. hold for left and 20 sec. hold for right | 2 | 40 sec. hold for left and 40 sec. hold for right | 2 | 60 sec. hold for left and 60 sec. hold for right | 2 |
| Brid dog | 3 sec. hold,10 for left and 10 for right | 3 | 3 sec. hold,15 for left and 15 for right | 3 | 3 sec hold,20 for left and 20 for right | 3 |
| Leg raises | 10 sec. hold | 3 | 15 sec. hold | 3 | 20 sec. hold | 3 |
| One leg squat | 30 sec hold, 5 for left and 5 for right | 3 | 30 sec hold, 10 for left and 10 for right | 3 | 30 sec hold, 15 for left and 15 for right | 3 |
| Overhead squat | 10 (5 kg) in number | 3 | 15(5kg) | 3 | 20 (5kg) | 3 |
| Sit-twist | 10 (2 kg) in number | 3 | 15 (2kg) in number | 3 | 20 (2kg) in number | 3 |

**Details of Core muscle exercises**
**Forward bridge**
Hold a straight body position supported on elbows and toes. Contract the abdominal muscle and hold back in neutral position.

**Side Bridge**
Lie on one side, ensuring top hip is positioned above the bottom hip. Push up until there is a straight body line through feet, hips, and head.

**Brid dog**
Position hands below shoulders and knees below hips. Position back in neutral, extended one leg backwards and raise the opposite arm until level with back. Ensure back does not extend and shoulders and pelvis do not till sideways. Bring leg and arm back to start position and swap sides.

**Leg raises**
Lie on back with knees extended on floor. Place back in neutral position and lift both legs straight up keeping legs extended. Hold with hips flexed to 90º, then return slowly to start position.

**One leg squats**
Standing with back in neutral and hands on hips. Flex left knee to 90º so foot is off floor and balancing on right leg.
Keeping head looking forward and hips straight, flex the right hip and knee. Squat as low as possible, hold and return to straight position, remain balanced on right leg and repeat.

**Overhead squat**
Using 5kg weight lifting bar, place hands shoulder width apart on bar. Raise the bar above head and straighten arms. Feet shoulder with apart, squat down as low as possible while maintaining balance, keeping bar, head and back vertical straighten legs and repeat.

**Sit-twist**
Sit up with knees bent and lean back at 45º. Feet off floor, keeping back in neutral, using a 2 kg medicine ball, twist waist and shoulders to one side with ball held out in front of the subject. Return to forward and repeat.

**Statistical analysis**
To compare and find out the effect of core training "t" test was applied. Descriptive statistics was also used for summarizing numerical data to make them more easily interpretable. The level of significance was fixed at 0.01 and 0.05 level of confidence.

**Results**
Average age of the experimental group was 15.67±1.45 and height was 1.56±0.11, average weight for experimental group was 45.87±9.02 (table 2).

**Table 2:** Group-An Experimental Group

| | Age | Height | Weight |
|---|---|---|---|
| Average | 15.67 | 1.56 | 45.87 |
| SD | 1.45 | 0.11 | 9.02 |

Average age, height and weight of the control group were 16.20±1.66, 1.59±0.10 and 48.33±8.3 (table 3).

**Table 3:** Group-B Control Group

| | Age | Height | Weight |
|---|---|---|---|
| Average | 16.20 | 1.59 | 48.83 |
| SD | 1.66 | 0.10 | 8.31 |

Standing broad jump pre-test score for experimental group was 2.11±0.29 (table 4), pre-test result for control group in standing broad jump was2.14±0. 15(table 5). Post test result of standing broad jump for experimental group was 2.20±0.28 and for the control group it was 2.14±0.14. The result shows that significant in the level of 0.01 improvement happened in experimental group after giving a 6 week core muscle training. And post test result of control group noticed was not significant.

**Table 4:** Pre- test and post- test value of experimental group-A

| Gr. A Boys | Pre | Post |
|---|---|---|
| Mean | 2.11 | 2.20 |
| SD | 0.29 | 0.28 |
| Observations | 15 | 15 |
| DF | 14 | |
| t Stat | 3.91* | |
| t at 0.01 | 2.98 | |
| t at 0.05 | 2.14 | |

*Sig. at 0.0

**Table 5:** Pre- test and post- test value of control group B

| Gr. B. Boys | Pre | Post |
|---|---|---|
| Mean | 2.14 | 2.14 |
| SD | 0.15 | 0.14 |
| Observations | 15 | 15 |
| DF | 14 | |
| t Stat | $0.81^{NS}$ | |
| t at 0.01 | 2.98 | |
| t at 0.05 | 2.14 | |

NS = Not Significant

**Discussion of the result**

Main findings from these studies were significant improvement in explosive strength of school going state level participants. And the findings showed the quality of the core muscle training design.

In this study, the training program was design to improve muscular strength level focusing on explosive strength. We used a balanced training load and methodology.

It is our belief that the positive result found in the present study may be related, though in a subjective and empirical way, to the athletes adherence to the training program. Its unusual design and diversified structure may have contributed to improve performance and to the maintenance of high level of motivation. Furthermore, we believe that such a program greatly contributes to motor learning with positive repercussions on future motor behavior.

Supportively, it is worth reporting the absence of injury during this core muscle training program. This is also an advantage of the proposed program, confirming that core muscle training in school going participants helps to prevent and reduce injury risk when properly designed and competently supervised [10,11].

Experimental group performer's demonstrate significant correlation between tests and re-test as compared to control group performers. These results provide the basis for future research, but do not provide answers to many of the unknown questions concerning the improvement in different age groups and player's development of explosive strength through core muscle training. Additional research should focus on specific sports and actual sports performance outcomes. The body of literature concerning athletic performance specifically explosive strength continues to evolve, but many essential questions remain unanswered.

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