INTRODUCTION

Sports are timeless activity ones that human have enjoyed since at least ancient times, as exemplified by the Greek Olympic Games. Indeed, ethnographic and archeological evidence such as cave painting and the accounts of early European explorers, indicate sports may well go back to the very beginning of humankind.

Physical education and the science of athletic performance can trace their roots too long before ancient Greek culture ever begins to glorify the human body & athletic prowess. Expanding our knowledge of personal well-being and athletic performance has been humanity’s quest for centuries. Physical activity is need of the human body & it should not be denied. Modernization and Mechanization prevent involvement in physical activity, but games and sports fulfill this requirement.

At one time in western civilization, during the height of Athenian era in ancient Greece, sports was considered an essential element of the arts & humanity. The enriched fulfilled person was one who continually strove for an integrated balance of physical, mental and spiritual excellence. The body was valued equally with the mind & spirit.

During the present century sports have become a cultural & social phenomenon of great magnitude and complexity. It has penetrated most, if not
all of our social institutions including education, economics arts, politics and international diplomacy etc\(^1\) (John W. Loy, 1978, p. 3)

Sportsman & spectators are very clear about value and significance of sports. That is why the scientific investigation of the performance of sport is playing a vital role in achieving top class performance\(^2\). (A.Buchim, 1975)

Winning laurels at international sports has become a prestigious issue linked with the political system and as such nation vie with others to produce top class sportsman for international competition. For this research is systematically conducted to identify the factors that help in achieving the level of skill, which a player can attain through proper coaching & evaluation\(^3\). (Shukla, 1982)

Modern competitive sports have above & beyond the athletic activities of the past, in terms of their business value, physical ability of the athlete and the level of importance that is placed on success. In the main professional sports, athletes are often multi-million dollar commodities and any hindrance to their performance is a loss of industry.

India known for its fanaticism for sport, started its sports odyssey long back during the great Vedic era of India where sports like hunting, boating,

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\(^1\) John W.loy, Barry D, McPherson & Gerald Kenyon, Sports and Social system(Addison-wesley Publishing co. Inc. 1978)

\(^2\) A. Buchim & Charls, Foundation of Physical Education & sports 7\(^{th}\) Edition 1975.

\(^3\) Vidyacharan Shukla “Message” abstract: International Congress of Sports sciences Patiala(Nov.1982)
swimming, martial art, horse riding, wrestling etc. were played. The young generation is mad behind the game of cricket. In the present era lot is required to give appropriate place to games & sports in the society. However physical activity is the need of the human body & it should not be denied. Modernization and Mechanization prevent involvement in physical activities, but games and sports fulfill this requirement.

The origins of cricket lie somewhere in the Dark Ages - probably after the Roman Empire, almost certainly before the Normans invaded England, and almost certainly somewhere in Northern Europe. All research concedes that the game derived from a very ancient, widespread and uncomplicated pastime by which one player served up an object, be it a small piece of wood or a ball, and another hit it with a suitably fashioned club⁴. (Wikipedia)

How and when this club-ball game developed into one where the hitter defended a target against the thrower was simply not known. Nor is there any evidence as to when points were awarded dependent upon how far the hitter was able to dispatch the missile; nor when helpers joined the two-player contest, thus beginning the evolution into a team game; nor when the defining concept of placing wickets at either end of the pitch was adopted.

Cricket was first played in southern England in the 16th century. By the end of the 18th century, it had developed into the national sports of England. The

expansion of British Empire lead to cricket being played overseas & by mid 19th century the first international matches are being played⁴.

In initial days “Test cricket” was having more craze & where the batsman use to dominate the bowlers. Cricket enters into a new era in 1963 when English counties introduced the limited over variant, as it was sure to produce the result. Limited over cricket was lucrative and the number of matches increased. The first limited over’s international game was played in 1971 between Australia & England at Melbourne Cricket ground. In the 21st century, a new limited over’s form.20-20 has made an immediate impact & made the game more competitive and demanding⁴.

The game underwent major development in the 18th century & became the national sports of England. Bowling evolved around 1760 when bowler began to pitch the ball instead of rolling it towards the batsman. The 19th century saw “Underarm bowling “Replaced by the first roundarm and then overarm bowling⁴.

**Pace bowlers, or fast bowlers** or paceman, rely on speed to get a batsman out. This type of bowler can be further classified according to the speed rate at which they bowl the ball on average. Most pace bowlers are medium-fast to fast in top level cricket. In general, bowlers of this type are described as right arm or left arm "fast", or right arm or left arm "fast-medium", and so on.
Swing bowlers are pace bowlers who, apart from being fast, also use the seam of the ball to make it travel in a curved path through the air. This is further encouraged by systematically polishing one side of the ball while allowing the other side to become roughened and worn. The differing airflow around the two sides will cause the ball to swing in the air, towards the roughened side. By changing the orientation of the ball in his hand, a bowler may therefore, cause the ball to swing into or away from the batsman.

Spin bowlers or spinners impart rotation to the ball to get a batsman out. The spin on the ball makes its movement hard to predict, particularly when it bounces, hence spin bowlers try to deceive batsmen into making a mistake. Speed is not crucial in spin bowling, and spinners tend to bowl in the slow-medium to the medium-slow range, around 45-55 mph. There are two broad categories of spin bowling: wrist spin and finger spin.

Fast bowling some time known as pace bowling is one of the two main approaches i.e. spin and fast bowling. Fast bowling required more of power, strength, & endurance of the player. The primary aim of fast bowling is to bowl cricket ball at high speed and to induce it to bounce off the pitch in erratic fashion or move side way through the air, factors which make it difficult for the batsman to hit the ball cleanly.

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A legend former Australian fast bowler and international bowling coach, Dennis Lillee, stated that “Fast bowling is the toughest job on the cricket field and that a pace bowler had to be stronger than the rest of the team”. Calling fast bowling the toughest job on a cricket field, Lillee stated that a paceman had to be stronger than the rest. "He is like the centre-forward in a football team. No matter how fit you are, you can always get injured. Some withstand the pain more, others succumb. As you get tired, your technique can break down." He believed that trunk strength was vital for paceman and recommended Swiss ball exercise. A fast bowler should be perfectly balanced at the point of delivery. (S.Dinakar, Vol. 24 :: No. 41 :: Oct. 13 - 19, 2001)

Success in the fast bowling is determined by a combination of many factors, one imperative variable being the speed at which the ball is released. A quick ball release speed reduces the time available for the batsman to make a correct decision about the path of the ball, thus increasing the demands on the effector mechanism responsible for executing the exact shot. An optimal fast bowling technique could be defined as one that allows the bowler to bowl fast with relatively low injury risk. (Bartlett RM, 1996)

Cricket is now a day’s becoming a more demanding game. Bowlers are supposed to bowl with as much speed as possible. That requires enough strength

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and stability. The importance of the function of the central core of the body for stabilization and force generation in all sports activities is increasingly recognized. 'Core stability' is seen as being pivotal for an efficient biomechanical function to maximize force generation and minimize joint loads in all types of activities ranging from running to throwing. However, there is less clarity about what exactly constitutes 'the core', either anatomically or physiologically, and physical evaluation of core function is also varied\(^8\). (Kibler WB, 2006)

The importance of function of the central core of the body for stabilization and force generation in all sports activities is increasingly recognized. ‘Core stability’ is seen as being pivotal for the efficient biomechanical function to maximize power generation and minimize joint loads in all types of activities ranging from running to throwing. However, there is less clarity about what exactly constitutes ‘the core’, either anatomically or physiologically, and physical evaluation of core function is also variable.

In a recent article on speed in young athletes by (Grazzo, 2004)\(^9\) it was said that speed camps and speed-based training programs are currently among the most popular and trendy activities within the youth sports industry. He said, “The core musculature is comprised of all muscles (major and minor) from

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\(^8\) Kibler W.B.,Press J, Sciascia A, The role of core stability in atheletic function (Journal of sports medicine in 2006, 189-198)  
\(^9\) Brian J. Grazzo in developingathletics.com 2004
just below the pelvis to right around the scapula. All of these muscles need to be conditioned in order to maximize the potential speed of the young athlete. 

*Speed requires core stability.*”

'Core stability' is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion to the terminal segment in integrated athletic activities. Core muscle activity is best understood as the pre-programmed integration of local, single-joint muscles and multi-joint muscles to provide stability and produce motion. This results in proximal stability for distal mobility, a proximal to distal patterning of the generation of force, and the creation of interactive moments that move and protect distal joints. Evaluation of the core should be dynamic, and include evaluation of the specific functions (trunk control over the planted leg) and directions of motions (three-planar activity)\(^8\). (Kibler WB, 2006)

All movements of the body either originate in or are coupled through the trunk, and this coupling action is created by an active and strong core. This becomes vital when the goal is high-level athletic performance since, without adequate core strength and stability of the lumbar spine, the athlete will not be
able to apply properly extremity strength\textsuperscript{10}. (Akhuthota V, 2004). (Hedrick, 2000)\textsuperscript{11}

Stability of the lumbar spine requires both passive stiffness, through the osseous and ligamentous structures, and active stiffness, through muscles. Spinal instability occurs when either of these components is disturbed. The effect becomes particularly important in overhead athletes because that stability acts as a torque-counter torque of diagonally related muscles during throwing (Akhuthota V, 2004)\textsuperscript{8}.

A strong core is critical because the force is transferred most efficiently through the body in a straight line. When the trunk is poorly developed, the result is poor posture, which can lead to less efficient movements. Such athletes will not be able to maximize their counter torque, often dissipating energy through jerky uncoordinated movement. (Hedrick, 2000)\textsuperscript{11}.

The core muscles should be approached as a three-dimensional system, concerned with support, the anticipation of unexpected loads, and to ensuring sufficient stiffness in any degree of freedom of the joint. Motor control activation and endurance are essential to Achieving core stability under all possible conditions for performance and injury avoidance. The importance of

\textsuperscript{10} Akhuthota V, Nadur S F, Core strengthening 2004 (Archive of Physical medicine & rehabilitation 86-92)
\textsuperscript{11} Hedrick, Training of trunk for improved athletic performance (Strength and conditioning journal 2000, p 50-61)
coordinated muscle activity in athletic function cannot be underestimated. (McGill SM, 2003)\textsuperscript{12}.

Core muscle strength and endurance is a key contributor to the stability of the lumbar spine (Panjabi, 1992, Jull and Richardson 2000, Arakoski 2001, McGill 2003, Akuthota 2004). Furthermore, the literature suggests that lumbar stability has an effect on an individual’s bowling performance (Young JL, 1996).\textsuperscript{13}

In addition Bartlett et al., (1996) suggested that studies were needed to establish a relationship between segmental dynamics, in particular between muscle strength of the lower back and core region and bowling performance and incidence of injury. This study therefore seeks to establish whether a relationship exists between core stability and bowling performance and back injury. (Bartlett RM, 1996)\textsuperscript{14}

A well-developed core is vital when the goal is high-level athletic performance as all movements either originate or are coupled through the trunk (Hedrick, 2000)\textsuperscript{15}. A well-developed core allows for improved force output, increased neuromuscular efficiency and the decreased incidence of overuse.

\textsuperscript{12} McGill S.M., Grenier S, Kavcic N, Cholewicki J “ Condition of Muscle activity to assure stability of lumbar spine” (Journal of electromyography and kinesiology 2003, P. 353-359)


\textsuperscript{15} Hedrik , Taraining the trunk for improved athletic performance (Journal of strength and conditioning 2000, p. 50-61)
injuries. It also enhances an athlete’s ability to utilize the musculature of the upper and lower body, which allows for more efficient, accurate and robust movements. This is because the force is transferred most efficiently through the body in a straight line. An athlete with a poorly developed core as well as poor posture will not be able to utilize fully their bodies potential power, often wasting energy through jerky, uncoordinated and extraneous movements.

If the lumbar muscular component has not been trained to function optimally, this can lead to weakness and reduced movement capabilities. Over time, this can lead to impaired athletic performance, injury and pain (Hedrick, 2000). Motion is not an isolated event that occurs in one direction. A body movement is a complex activity involving agonist and antagonist structures that work together to create motion and to stabilize the body in all three directional planes. Hence an athlete’s core must be strong, flexible and unimpeded in its movement in order to achieve maximum performance (Abelson, 2004).

A conceptual & detailed biomechanical explanation is required to know about the primary stabilizing method of the human spine. Several models for the stabilizing system have been proposed by several researchers among that a well-exceptioned model was given by Panjabi. according to that spinal stabilization consist of three main systems. (Panjabi, 1992)

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17 Panjabi , the stabilizing system of spine part I, function, dysfunction, adaptation and enhancement, (Journal of spinal disorders,1992, p.383-389)
1. The Active system- all muscles & tendons surrounding the spinal column that can apply forces to spinal column consist the active system i.e. lumbar multifidus.

2. Passive system – The vertebrae intervertebral disc, and ligaments.

3. Neural system – The nerves & CNS

The proper function of stabilizing system is to provide sufficient stability to the spine to match with the varying stability demand due to changes in spinal posture and static & dynamic forces/load.

Muscles can be broadly divided into two categories, local and global muscles (Bergmark, 1989). The local muscle system includes deep muscles that are attached to the lumbar vertebrae and are capable of directly controlling the stiffness of the lumbar segment. In contrast, the global muscle system encompasses larger and more superficial muscles of trunk. Their role is to move the spine and to control larger external loads, which occur with normal daily functions.

Biomechanical research has demonstrated that deep, local muscles are essential for controlling, protecting and supporting the joints. The muscles of local synergy, which are important for the lumbo-pelvic region, include the segmental lumbar multifidus, the transverse abdominis, the pelvic floor and the diaphragm.

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18 Bergmark, Stability of the lumbar spine, A study in mechanical engineering (Acta orthop scand suppl, p.1-54)
For the lumbar region, it has been proposed that the multifidus can contribute to stability via control of lordosis, allowing equal distribution of forces (Aspden, 1992). Contraction of poly segmental multifidus fascicle can restore the lumbar lordosis. Recent studies have confirmed this finding, the compressive load bearing capacity of the passive thoraco-lumbar spine was significantly enhanced by pelvic rotation caused by minimal muscle forces in the sagittal plane (Keifer et al). When local muscles were examined in the model multifidus was found to contribute 80% of required activity (Keifer et al, 1998). To maintain the spinal curves require a balance between & integration of local, monoarticular & global muscles (Kiefer A, 1997).

A more clinical relevant description of this segmental stabilization theory & evidence to support the differing function of local versus global musculature has been presented by O’Sullivan et al. They describe the function local musculature (lumbar multifidus) as one of stabilizer of the lumbar spine with little respect to the movement direction, magnitude or velocity. Local stabilizing musculature activation occurs automatically in a preparatory manner prior to movement. Failure of this preparatory stabilizing mechanism is identified as a primary cause of persistence low back pain. (O’Sullivan P, 1997).

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Literature that developed from and is supportive of segmental stabilization model has generated following:-

1. The lumbar multifidus muscle function is to provide segmental stability & movement guidance between segments. Although lumbar multifidus has been identified as an opposite rotator & lumbar extensor in classic kinesiology .its role as a segmental stabilizer has more recently been described. Research has shown it to be active during lumbar spine flexion as well, indicating its eccentric stabilizing effect.

2. Lumbar multifidus atrophy & dysfunction has been linked with various aspect of LBP. Lumbar multifidus atrophy-

   - Is present in up to 80% of the subject with LBP as measured by MRI scans.
   - Is selective to one lumbar segment & is ipsilateral to the painful side.
   - Is associated with failed back syndrome & demonstrated morphological changes as detected by biopsy studies.
   - Does not come to normal spontaneously after resolution of LBP.
   - Is associated with reoccurrence of LBP after one and three years following the acute episode.
• Can be accurately measured by (CSA) clinically utilizing Ultrasound imaging as compared to MRI scan.

• Can reversed to normal with selective therapeutic exercise intervention utilizing RTUS as bio feedback

Biomechanics of Fast and Fast/Medium Bowling

Success in fast bowling is determined by a combination of many factors, one paramount variable being the speed at which the ball is released. A quick ball release speed reduces the time available for the batsmen to make correct decisions about the path of the ball, thus increasing the demands on the effectors mechanism responsible for executing the right shot (Bartlett RM, 1996).²¹

For the purposes of this review, the action of bowling is divided into the four distinct stages-

• Run-up,
• The pre-delivery stride,
• The delivery stride and
• The follow-through.

Figure-1

Figure-2

(www.google.com/images/bowling action)
**Run-up:-**

This stage commences when the bowler walks or jogs over his approach marker, gradually increasing speed on his approach to the wicket, and ends as he leaps into the air at the start of the pre-delivery stride in preparation for the back foot to strike the ground, which marks the commencement of the delivery stride (Bartlett *et al.*, 1996). Elliot and Foster (1984) considered that the run-up speed should be sufficient to produce as high a linear velocity of the body as possible for ball release, but also must allow the correct delivery technique to be adopted. They also demonstrated that due to considerable differences in modes of delivery and run-up speeds that the percentage contribution of the run-up to ball release speed will vary between bowlers. (Elliot BC, 1984)\(^{22}\)

**Pre-delivery stride:-**

This stage separates the run-up from the delivery stride and begins, for a right-handed bowler, with a jump off the left foot and is completed as the bowler lands on the right or back foot. During this stride, with the shoulders pointing down the wicket, the right foot passes in front of the left with the right foot turning to land parallel to the bowling crease. No data is available with regards the pre-delivery stride and ball release speeds, however, studies have shown that this stride is longer than an average stride (Bartlett RM, 1996). This is caused by the apparent necessity to decelerate in the final stride and was

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probably associated with the need to ‘gather’ for the final thrust. (Davis K, 1976)²³.

Figure-3
Phase 1: Pre Delivery Stride (PDS)
Phase 2: Mid bound (MB)
Phase 3: Back Foot Contact (BFC)
Phase 4: Front Foot Contact (FFC)
Phase 5: Ball Release (BR)
Phase 6: Follow Through (FT)

As this is considered the most technical stage of the bowling action, the delivery stride will be outlined according to three key events: the back foot strike, front foot strike and ball release (Bartlett et al., 1996).

**Back foot strike:**

At the start of the delivery stride, the bowler’s weight is on the previously planted back foot with the body leaning away from the batsman. According to Bartlett et al., 1996, this leaning back of the trunk may serve the purpose of increasing the acceleration path of the implement ball.
Figure-5 Back foot strike

**Front foot strike:**

As the delivery stride proceeds, the front foot strikes the ground. The values for peak vertical impact force from previous force-platform studies has been found to be between 3.8 and 6.4 times body weight with anterior-posterior braking forces around two times body weight (Bartlett *et al.*, 1996). Implications of this have mostly been recorded in terms of injury potential, with few relationships to ball release speed or the bowling technique being reported.
Figure-6 Front foot strike

**Ball release:-**

The laws of cricket limit the action of the bowling arm to circumduction of the upper arm about the glenohumeral joint and the extension and flexion of the wrist and finger joints (though it is recognised that the wrist could also abduct and adduct, the radio-ulnar joints could supinate/pronate and the carpal joints can move) [Bartlett *et al.*, 1996]. The circumduction of the upper arm with the elbow either fully extended or at least a constant angle starts from a position close to the hip joint. Initiation of upper arm circumduction usually occurs between back foot and front foot strikes. The literature suggests that the degree of circumduction between front foot strike and ball release varies and
that it is dependent not only on the position of the arm at release, but also on its position as the front foot lands (Bartlett et al., 1996).

Figure-7 Ball release

**Follow-through:-**

Limited data is available on the follow-through, as most analyses stop shortly after ball release. It was suggested by Bartlett *et al.*, (1996) that the bowler should ensure that the bowling arm follows through down the outside of the left thigh allowing a gradual reduction in the bowlers speed and that the first stride of the follow-through should be behind the line of the ball, before running off the wicket for a further 2-3 strides.
Concept of core stability

Core stability is in essence “a description of the muscular control required around the lumbar spine to maintain functional stability” (Akhuthota V, Core strengthening, 2004)\(^{24}\). (Wisbey-Roth, Grading and progressing a dysfunction specific core stability program, 1996)\(^{25}\). Defined core stability as the optimal alignment and control of the spine and pelvis region to ensure efficient transfer of momentum and summation of forces across the segment, resulting in greater precision and safety of dynamic activity. (Wisbey-Roth, 1996) Core stability results from highly coordinated muscle activation patterns involving many muscles, which provide support and control of the joints, and that the

\(^{24}\) Akhuthota V, Nadur S F, Core strengthening 2004 (Archive of Physical medicine & rehabilitation 86-92)
\(^{25}\) Wisbey Roth T. Grading and progressing a dysfunction specific core stability program 1996
recruitment patterns must continually change, depending on the task. (Jull G, 1993)26

According to the Lee (2001) model of integrated joint function, adequate approximation of the joint surfaces must be the result of all forces acting across the joint if stability is to be insured. Consequently, the ability to effectively transfer load through joints is dynamic and requires integrated functioning of the body’s neuromusculoskeletal system.

The first component, firm closure comprises intact bones, joints and ligaments. In a stable joint with closely fitting articular surfaces no extra forces are needed to maintain the state of the system, given the actual load situation (Lee, 2001). To analyze stiffness the zones of motion available to every joint must be considered including, the neutral and the elastic zone’s. The neutral zone is a small range of movement near the joint’s neutral position where minimal resistance is given by the osteo ligamentous structures. The elastic zone is the part of the motion from the end of the neutral zone up to the physiological limit. The size of the neutral zone may increase with injury, articular degeneration and/or weakness of the stabilizing musculature (Panjabi, 1992).

The second component according to Lee (2001) is called force closure and relies on the optimal function of the muscles which includes the ability to contract tonically in a sustained manner. Force closure reduces the size of the neutral zone and thus there is control between the two joint surfaces. Several ligaments, muscles and fascial systems contribute to the force closure of the pelvis. The inner unit consists of the muscles of the pelvic floor, TA, multifidus and the diaphragm also known as the local stabilizers. The outer unit consists of several slings or systems of muscles (global stabilizers and mobilizers) that are anatomically connected and functionally related. When muscles contract, they produce a force that spreads beyond the origin and insertion of the active muscle. This force is transmitted to the muscles, tendons, fascia, ligaments, capsules and bones that lie both in series and in parallel to the active muscle. In this manner, forces are produced quite distant from the origin of the initial muscle contraction.

The third component, motor control, is the ability of the muscles to perform in a co-ordinated manner such that the resultant force is adequate compression through the articular structures at an optimal point (tailored), in other words the timing of specific muscle action and release. Superb motor skills require co-ordination of muscle activity such that stability is ensured, and loads are transferred effortlessly. The last component is that of neural control (emotions and awareness), which ultimately orchestrates the pattern of motor
control. This requires constant accurate afferent input from the mechanoreceptors in the joint and surrounding soft tissues, appropriate interpretation of the afferent input and a suitable motor response (Lee, 2001).

The lumbar multifidus (LM) and TA muscles, in particular have been shown to have the greatest contribution to the control of the neutral zone (Panjabi, 1992 and Richardson, 1995). (HJ Wilke, 1995) In a biomechanical study demonstrated that the LM provided more than two-thirds of the stiffness increase at the L4-L5 segment. Results of a study by Hodges (2003) indicate that elevated intra-abdominal pressure and contraction of the diaphragm and TA provide a mechanical contribution to the control of spinal intervertebral stiffness or stabilization particularly with regards to the drawing in of the abdominal wall. (P Hodges, 2003)

Literature suggests that optimal core muscle strength, control and endurance working synergistically with the rest of the neuro-musculoskeletal system are necessary for lumbar spine stability (Panjabi, 1992, Jull and Richardson, 2000, Arakoski, 2001, Lee, 2001, McGill, 2003, Akuthota, 2004). Further literature suggests that lumbar stability has an effect on bowling speed (Young et al., 1996). Besides Bartlett et al., (1996) suggests that studies are needed to establish a relationship between segmental dynamics and bowling speed. This study, therefore seeks to establish whether a relationship exists between core stability and bowling speed.
The importance of muscular system in stabilizing the lumbar spine cannot be underestimated, a point well illustrated by the recent study that support quantitative data on the stabilizing effects of muscles on the mechanics of the spine.

**Delimitation**

1. This study was delimited to the male fast bowlers who were playing competitive cricket.
2. This study was further delimited to bowling speed, throwing capacity, prone hold test, core strength and incidence of back pain.
3. This study was delimited to the bowlers of age group 16-21 years.

**Limitation**

1. For male bowler’s factors like daily routine, lifestyle, weight, height, bowling pattern etc. which might affect the study is considered as the limitation of study.
2. Regarding back pain only player’s response is considered as a limitation of the study.
3. This study was limited to the club / district level bowlers.
4. This study was confined to the small sample size.

**Significance of study**
1. It may bring to light the contribution of core stability training on the performance of fast bowlers.

2. Finding might help the coaches and players to constitute or modify the training programs for the bowlers to enhance the performance.

3. It may contribute to helping in avoiding the incidence of low back pain in bowlers.

4. The finding of the study may give the basic guideline to coaches and players to formulate effective training program for the various type of bowlers.

5. We would be able to inform athletes of a correct and necessary training program for their core stabilizers, thus reducing the possibility of injury and increasing the level of their performance and duration of their sports career.

**Need for study**

The factors that affect lumbar stability have been an area of extensive research. The clinical application of this research in the form of lumbar stabilization exercise programs:

1. Will be useful as a common treatment of low back pain in fast bowlers.

2. Will also be useful for athletes to improve performance and

3. Will be helpful for the general public to prevent injuries and promote health

**Aims of the study**

The aim of this study is to establish a relationship between core muscle and its effect on the performance of the fast bowlers in cricket.
1. To determine the relationship between core strength and bowling speed.

2. To determine the relationship between core strength and throwing capacity.

3. This study will be helpful in establishing a baseline data about how the core muscle strength will affect the performance in term of throwing capacity, bowling speed and accuracy of the fast bowlers.

4. This study will also be useful in determining the effect of core stability exercise in the prevention of the low back injuries in the fast bowlers.

5. This study will also be useful in determining the effect of core stability exercise on the endurance of core muscles.

**Hypotheses:**

1. There will be a significant increase in bowling speed in bowlers with core stability training.

2. There will be a significant improvement in the throwing power of the fast bowlers with core stability exercises.

3. There will be a significant increase in the strength of core muscles with core stability exercises.

4. There will be significant decrease incidences of low back pain among the bowlers who underwent core stability training.

5. There will be a significant improvement in prone hold among the fast bowlers with core stability training.