Chapter I
INTRODUCTION

Background

Low back pain remains the primary cause of absenteeism and disability in every industrialized society. As much as 60% to 80% of the general population experience low back pain (LBP) at some point in their lifetime.\(^1\)

Low back pain (LBP) is one of the most common conditions affecting all population, worldwide.\(^2\) It is the fifth most common reason for all visits to physicians in the United States. Approximately one quarter of adults in the United States reported having LBP lasting at least one day in the past 3 months. In Iran, a lifetime prevalence of LBP in the nursing population and pregnant women was reported to be 62% and 84%, respectively associated with 33.7% of work absenteeism during the past month in nurses. A high prevalence rate and associated economic and social costs have been reported due to LBP in France.\(^3\) Spinal pain is associated with significant economic, societal, and health impact. Estimates and patterns of productivity losses and direct health care expenditures among individuals with back and neck pain in the United States continue to escalate. Patients who develop chronic low back pain use more than 80% of all health care for back pain. An estimated 149 million days of work per year are lost because of LBP. The condition is also costly, with total costs estimated to be between $100 and $200 billion annually, two-thirds of which are due to decreased wages and productivity. For most, the clinical course is benign, with 95% of those afflicted recovering within a few months of onset. Some, however, will not recover and will develop chronic LBP (ie, pain that lasts for 3 months or longer). Recurrences of LBP are also common, with the percentage of subsequent LBP episodes ranging from 20% to 44% within 1 year, for working populations to lifetime recurrences of up to 85%.\(^4\)

In the United States the total incremental direct health care costs attributable to LBP were estimated to be $26.3 billion in 1998. In addition, indirect costs related to days lost from work were substantial, with approximately 2% of the United States work force compensated for back injuries each year. Although indirect costs may be mainly borne by the corresponding social insurance institutions, a significant financial burden can still be imposed on the patients. The costs have been estimated to be 0.7% of Gross Domestic Product (GDP) in Sweden and 1.7% of GDP in the Netherlands.\(^3\) A German cost-of-illness study estimated total costs of back pain at around V17 billion, equating to 0.9% of the GDP.\(^5\)
The use of health care services for chronic LBP has increased substantially over the past 2 decades. Multiple studies using national and insurance claims data have identified greater use of spinal injections, surgery, and opioid medications treatments most likely to be used by individuals with chronic LBP. Studies have also documented increases in medication prescription and visits to physicians, physical therapists, and chiropractors. Because individuals with chronic LBP are more likely to seek care and to use more health care services, relative to individuals with acute LBP, increases in health care use are likely driven more by chronic than acute cases.  

Age related prevalence of persistent pain appears to be much more common in the elderly associated with functional limitations and difficulty in performing daily life activities. Chronic persistent low back and neck pain is seen in 25% to 60% of patients, one-year or longer after the initial episode. Recent studies have shown significant increases in the prevalence of various pain problems including low back pain.

The role of exercise and activity in the management of back pain has changed markedly over the last century. Rehabilitation is a popular treatment option, increasingly utilized by all major professions involved with musculoskeletal injury, yet the evidence base for its effectiveness remains weak; meta-analysis concludes only that exercise therapy appears to be slightly effective at decreasing pain and improving function in adults with chronic low-back pain but in acute low-back pain, exercise therapy is no more effective than no treatment.  

There is much debate about the effectiveness of different treatment programs, and despite an abundance of research, the UK BEAM trial suggested that the role of different physical treatments for back pain is unclear. In a meta-analysis provided support for the use of exercises in adults with chronic low back pain, concluding that exercise decreased pain and improved physical function by modest amounts. Back pain patients are given exercises that improve cardio-vascular performance, generally describe reductions in pain and disability. Few papers have been published directly comparing general whole body exercises to back specific programs. Performed meta-analysis looking at exercise intervention types and their effects on pain and disability, concluding Exercise therapy that consists of individually designed programs, including stretching or strengthening, and is delivered with supervision may improve pain and function in chronic non-specific low-back pain. Current European guidelines on management of chronic lower back pain Researchers and health care providers continue to prescribe exercise for chronic low back pain, but the basis for decisions regarding best practice in this area is not clear.
1.1 Role of Spine in Human Body

Let us briefly summarize the key role of the spine in almost every function of the human body. It is the pivot of the skeleton – the framework of bones giving the body its shape. Anchored to the spine are layers of large and small muscles and ligaments of the back and abdomen, essential in holding the body erect and the vital organs in place (even these organs themselves are supported by the spine). In four-legged (quadrupedal) creatures, vital organs are suspended downward from a curved spinal column. However, in the two-legged (bipedal) human, they must be held up against the pull of gravity by an erect, strong spinal column.

In the center of that column, descending directly from the base of the brain and protected by the bony vertebrae, is the miracle spinal cord, the control center of extensive, intricate networks of motor and sensory nerves that radiate to all parts of the body.

Experts believe that many ills can be traced to an abnormal spine. For example, prolonged habits of incorrect posture – as well as accidents, sudden movement, jolt or strain - can cause a vertebra to shift slightly out of alignment (subluxation) and to press against a nerve passing out from the spinal cord through an opening at that level. Such an impingement is an open invitation to trouble in the organ or body part that is serviced by that partially pinched nerve.

For similar reasons, the spine itself is often thrown out of alignment and into abnormal curves toward the sides, front or back of the body. This can adversely affect other bones of the skeleton, shorten or stretch muscles and ligaments, cause organs to prolapse (fall) and/or bring on interrelated malfunctions throughout the body.12

1.2 Structures of the Back

Spinal anatomy is a remarkable combination of strong bones, flexible ligaments and tendons, large muscles and extremely sensitive nerves and nerve roots. Without question, the anatomy of the spine is a marvel of nature. Importantly, the spine provides our bodies with:

- Structure to allow us to stand upright and move with precision
- Protection for the spinal cord and nerve roots to safely relay messages to and from the brain and the rest of the body
- Shock absorption capability as we move about
- Flexibility at the joints to allow us to bend, twists, moves our heads and adjusts to a wide variety of positions.
- Strength provided by the bones, discs, joints and supportive muscles and connective tissue.\textsuperscript{13}

\subsection*{1.2.1 The spine}

Thirty three vertebrae form the human spine. The 7 cervical, 12 thoracic, and 5 lumbar vertebrae are separated by 23 intervertebral discs. The 5 sacrum vertebrae are fused just like the 4 coccyx pieces, forming the sacrum and coccyx bones (figure 1.1).\textsuperscript{14}

![Fig 1.1 Lateral View of Spinal Anatomy (from top to bottom), Cervical Spine (neck), Thoracic Spine (upper and mid back), Lumbar Spine (lower back), and Sacral Region (sacrum and coccyx)](image)

Taking a front view of the vertebrae, they are perfectly aligned in vertical form. However, from a side view the alignment is curved. The upper (cervical) area and the lower (lumbar) areas are curved backward. This is referred to as lordosis-cervical or lumbar lordosis. The middle area is curved forward, referred to as dorsal kyphosis.\textsuperscript{14}

This positioning permits the spine to be very resistant to vertical weight, since its curves allow flexibility. If weight is considerable, the spinal curve may increase
temporarily, cushioning the pressure exerted on the vertebrae. This is why transporting weight on the head was a traditional practice in certain countries. By carrying weight this way, the center of gravity was kept at the spinal axis, and back muscles were relieved from much of the strain.\(^\text{14}\)

**Lumbar spine**

The lumbar spine refers to the lower back, where the spine curves inward toward the abdomen. It starts about five or six inches below the shoulder blades, and connects with the thoracic spine at the top and extends downward to the sacral spine.

“Lumbar” is derived from the Latin word “lumbus,” meaning lion, and the lumbar spine earns its name. It is built for both power and flexibility (i.e. lifting and bending). The lumbar spine has several distinguishing characteristics:

- The lower a vertebra in the spinal column, the more weight it must bear. The five vertebrae of the lumbar spine (L1-5) are the biggest unfused vertebrae in the spinal column, enabling them to support the weight of the entire torso.
- The lumbar spine meets the sacrum at the lumbrosacral joint (L5-S1). This joint allows for considerable rotation, so that the pelvis and hips may swing when walking and running.
- The lumbar spine’s lowest two spinal segments, L4- L5 and L5-S1, which include the vertebrae and discs, bear the most weight and are therefore the most prone to degradation and injury.
- The spinal cord travels from the base of the skull through the spinal column and ends at about T12-L1. At that point numerous nerve roots from the spinal cord continue down and branch out, forming the “cauda equina,” named for its resemblance to a horse’s tail. These nerves extend to the lower extremities (buttocks, legs and feet). Because the spinal cord does not run through the lumbar spine, it is quite rare that a lower back problem would result in spinal cord damage or paralysis.\(^\text{15}\)

**1.2.2 The vertebrae**

Vertebrae are the bones that form the spine. They are very resistant; one of these little bones can hold a 9-ton weight, which would destroy a cement piece of the same size.
An upper view of a vertebra shows the vertebral body, lateral protuberances (transverse processes) and a posterior protuberance (spinous process), united by a flat plate (lamina). The foramen in the middle is occupied by the spinal cord, named the vertebral canal (figure 1.2).\textsuperscript{14}

Fig 1.2 lumbar vertebrae

The anterior part of a vertebra articulates with the one below by the intervertebral disc - and the posterior part, by the facet joint. The disc mitigates the pressure between the vertebral bodies; there is a cartilage in the facet joint for the same purpose. There are no nerves in the cartilage; the nerves are located within the bone below. This explains why there may be no pain with a certain degree of cartilage deterioration, provided the bone below is not affected. When this occurs, nerves are activated to produce pain.

From a lateral view, an intervertebral foramen results from the opposition of a superior and an inferior vertebral notch. Nerve roots leaving the medulla or spinal cord pass through this intervertebral foramen.\textsuperscript{14}
1.2.3 The Intervertebral disc

Between each of the cervical, thoracic and lumbar vertebrae there is a cushion called "intervertebral disc".\textsuperscript{14}

The intervertebral disc is composed of two parts: the central portion with a gelatin-like consistency named "nucleus pulposus" and a fibrous fold to hold it tightly in place, called "annulus fibrosis" or "fibrous ring" (figure 1.3).\textsuperscript{14}

![Diagram of Intervertebral Disc](image)

**Fig 1.3: Position of intervertebral disc and structure of the disc**

The fibrous ring is thicker at the anterior portion of the disc; the posterior portion is more fragile. This is why, in case of disc herniation, this occurs mostly on the posterior part of the disc, causing disc herniation.

As time elapses, the force supported by the disc makes its gelatin portion wear out and lose height. This process, known as "vertebral arthritis", is not an illness per se. A majority of the healthy population above 30 years of age begins to show a certain degree of deterioration.

Astronauts, in weightless conditions, increase their height since the lack of gravity keeps discs from being compressed; the separation between vertebrae is therefore increased.

Pressure on the nucleus pulposus is 5- to 15-fold greater than blood pressure, thus blood cannot reach the nucleus. There are no nerves in the nucleus; they are located in the most external layers of the fibrous ring. This explains why disc degeneration may not be painful while the external layer of the fibrous ring is not
affected; although tissue may wear out there are no nerves to receive and transmit pain.\textsuperscript{14}

1.2.4 Joints
The main joints which have been associated with lower back pain are Facet joints (sometimes known as zygapophysial joints) and the Sacroiliac joint.

- **Facet joints** occur in pairs at the back of each vertebra. They connect neighboring vertebrae and allow movement between them. The facet joints direct the plane of motion at each vertebral segment, which is dependent on their angle and orientation. Throughout the spine the angles and orientations differ which alters the possible movement allowed in that area. Facet joint pain may arise directly from the facet joint either from inflammation or nerve impingement.

- **Costovertebral joints** are formed between the heads of the ribs and the bodies of the thoracic vertebrae. There is very little movement available here. The joint can sublux causing mid back pain which radiates into the chest.

- **Costotransverse joints** are between the tubercle of the rib and the transverse processes of the thoracic vertebrae.

- **The Sacroiliac Joint** is formed where the Sacrum meets each side of the pelvis. The joint only allows very small gliding movements when the legs are moved. These joints can often get stuck or in some cases one half of the pelvis can glide forwards or backwards, which is often referred to as a twisted pelvis\textsuperscript{22}.

1.2.5 Ligaments
The ligaments surrounding the spine connect individual vertebrae and provide support to the whole structure. There are two types of ligament:

- **Intrasegmental ligaments**: These connect one vertebra to another and include the Ligamentum Flavum (a strong ligament which connects the posterior surfaces of each vertebrae), Interspinous ligaments (in-between each spinous process) and intertransverse ligaments (connecting transverse processes to the one above and below on the same side).

- **Intersegmental ligaments**: These ligaments are long stabilizing ligaments which provide support to the spine as a whole. They include the Anterior and Posterior Longitudinal ligaments which run down the front and back of the vertebral bodies respectively and the Supraspinous ligament which is a cord-like ligament which attaches to the tip of every spinous process.\textsuperscript{16}
1.2.6 Muscles

The lumbar muscles relative to their position with the spine are divided to two groups:

a) Deep muscles,  b) superficial muscles;

Deep muscles

The number of muscles having one or both attachments within the back as a whole is huge. For the purpose of this section we will look at the muscles which are most often involved in lower back pain.\(^{16}\)

The deepest and most important muscles when it comes to stability of the spine are collectively known as the Transversospinalis muscles. This group consists of three ‘layers’, the deepest being Rotators, then Multifidus with Semispinalis being the most superficial. It is thought that these muscles provide precise movements of each vertebra and aid stability in the back.\(^{16}\)

A second group of muscles which attach only to the spine are known as Erector Spinae. These muscles are more superficial and larger than the Transversospinalis muscles and arise from the thick, broad band of fascia known as the Lumbar Aponeurosis. Erector Spinae consists of three groups of muscles, the Iliocostalis which is the most lateral (outer) and attaches to the ribs, close to their attachment to the spine. The Longissimus arises from the Lumbar Aponeurosis and inserts to the transverse processes of the vertebrae. Spinalis is the most medial (central) muscle which attaches to the lumbar and thoracic spinous processes. All of these muscles are thought to be responsible for extending the spine (leaning backwards) (figure 1.4).\(^{16}\)
Fig 1.4 Deep muscles of the back
**Superficial muscles**

There are a large number of muscles in the lower back. Those which are most commonly involved in back pain are:

- **Latissimus Dorsi:** This is the largest muscle of the lower back which is responsible for pulling the arm downwards and backwards. It originates from the spinous processes of T6-T12 and the Iliac crest (top of the pelvis), travels upwards across the entire lower back and inserts onto both humerus' (upper arm bone).
- **Quadratus Lumborum:** This muscle is responsible for side bending and also aids extension of the lumbar spine. It originates at the Iliac crest and passes upwards to attach to the lowest rib and to the transverse processes of L1-L4
- **Gluteus Medius:** Although strictly a gluteal muscle, it is often associated with low back pain. Its action is to internally rotate (turn the knee inwards) and abduct the hip (take the leg away from the centre of the body). It also has a very important function in maintaining and correcting hip level, which can be a cause of overuse and the development of trigger points. It arises from the outer surface of the Ilium (pelvis) and inserts onto the Greater Trochanter at the top of the Femur (thigh bone).

### 1.3 Low Back Pain

The **lumbar spine** refers to the lower back, where the spine curves inward toward the abdomen. It starts about five or six inches below the shoulder blades, and connects with the **thoracic spine** at the top and extends downward to the sacral spine.

“Lumbar” is derived from the Latin word “lumbus,” meaning lion, and the lumbar spine earns its name and **lumbago** (/ˈlʌmbəɡo/) means Low back pain. It is built for both power and flexibility (i.e. lifting and bending). The lumbar spine has several distinguishing characteristics:

- The lower a vertebra in the spinal column, the more weight it must bear. The five vertebrae of the lumbar spine (L1-5) are the biggest unfused vertebrae in the spinal column, enabling them to support the weight of the entire torso.
- The lumbar spine meets the sacrum at the lumbosacral joint (L5-S1). This joint allows for considerable rotation, so that the pelvis and hips may swing when walking and running.
• The lumbar spine’s lowest two spinal segments, L4-L5 and L5-S1, which include the vertebrae and discs, bear the most weight and are therefore the most prone to degradation and injury.

• The spinal cord travels from the base of the skull through the spinal column and ends at about T12-L1. At that point numerous nerve roots from the spinal cord continue down and branch out, forming the “cauda equina,” named for its resemblance to a horse’s tail. These nerves extend to the lower extremities (buttocks, legs and feet). Because the spinal cord does not run through the lumbar spine, it is quite rare that a lower back problem would result in spinal cord damage or paralysis. The classify of the back pain based on duration:

• **Acute low back pain** is usually defined as the duration of an episode of low back pain persisting for less than 6 weeks.

• **Sub-acute low back pain** as low back pain persisting between 6 and 12 week.

• **Chronic low back pain** as low back pain persisting for 12 weeks or more.

• **Recurrent low back pain** is defined as a new episode after a symptom-free period of 6 months, but not an exacerbation of chronic low back pain.

• **Non-specific low back pain** is defined as low back pain not attributed to recognisable, known specific pathology (e.g. infection, tumour, osteoporosis, ankylosing spondylitis, fracture, inflammatory process, radicular syndrome or cauda equina syndrome).

1.3.1 **Causes of low back pain**

The majority of lower back pain stems from benign musculoskeletal problems, and are referred to as non specific low back pain; this type may be due to muscle or soft tissues sprain or strain, muscle strain, injury or overuse – or can be attributed to a specific diagnosed condition of the spine. There are many structures in the lumbar spine that can cause pain – any irritation to the nerve roots that exit the spine, joint problems, the discs themselves, the bones and the muscles can all be a source of pain. Many lumbar spine conditions are interrelated. For example, joint instability can lead to disc degeneration, which in turn can put pressure on the nerve roots, etc.

Particularly in instances where pain arose suddenly during physical loading of the back, with the pain lateral to the spine. Over 99% of back pain instances fall within this category. the full differential diagnosis includes many other less common conditions.
The classification of the cusses of the low back pain:

- **Mechanical:**
  - Apophyseal osteoarthritis
  - Diffuse idiopathic skeletal hyperostosis
  - Degenerative discs
  - Scheuermann's kyphosis
  - Spinal disc herniation ("slipped disc")
  - Thoracic or lumbar spinal stenosis
  - Spondylolisthesis and other congenital abnormalities
  - Fractures
  - Sacroiliac Joint Dysfunction
  - Leg length difference
  - Restricted hip motion
  - Misaligned pelvis - pelvic obliquity, anteversion or retroversion
  - Abnormal Foot Pronation

- **Inflammatory:**
  - Seronegative spondylarthritides (e.g. ankylosing spondylitis)
  - Rheumatoid arthritis
  - Infection - epidural abscess or osteomyelitis
  - Sacroiliitis

- **Neoplastic:**
  - Bone tumors (primary or metastatic)
  - Intradural spinal tumors

- **Metabolic:**
  - Osteoporotic fractures
  - Osteomalacia
  - Ochronosis
  - Chondrocalcinosis

- **Psychosomatic:**
  - Tension myositis syndrome

- **Paget’s disease**

- **Referred pain:**
  - Pelvic/abdominal disease
  - Prostate Cancer
  - Posture

- **Depression**

- **Oxygen deprivation**

Most cases of lower back pain can be linked to a general cause - such as:

**Degeneration**

The intervertebral disc changes over time. At first, the disc is spongy and firm. The nucleus in the center of the disc contains a great deal of water. This gives the disc its ability to absorb shock and protect the spine from heavy and repeated forces.

The first change that occurs is that the annulus around the nucleus weakens and begins to develop small cracks and tears. The body tries to heal the cracks with scar
tissue. But scar tissue is not as strong as the tissue it replaces. The torn annulus can be a source of pain for two reasons. First, there are pain sensors in the outer rim of the annulus. They signal a painful response when the tear reaches the outer edge of the annulus. Second, like injuries to other tissues in the body, a tear in the annulus can cause pain due to inflammation.

With time, the disc begins to lose water, causing it to lose some of its fullness and height. As a result, the vertebrae begin to move closer together.

As the disc continues to degenerate, the space between the vertebrae shrinks. This compresses the facet joints along the back of the spinal column. As these joints are forced together, extra pressure builds on the articular cartilage on the surface of the facet joints. This extra pressure can damage the facet joints. Over time, this may lead to arthritis in the facet joints.

These degenerative changes in the disc, facet joints, and ligaments cause the spinal segment to become loose and unstable. The extra movement causes even more wear and tear on the spine. As a result, more and larger tears occur in the annulus.

The nucleus may push through the torn annulus and into the spinal canal. This is called a herniated or ruptured disc. The disc material that squeezes out can press against the spinal nerves. The disc also emits enzymes and chemicals that produce inflammation. The combination of pressure upon the nerves and inflammation caused by the chemicals released from the disc cause pain.

As the degeneration continues, bone spurs develop around the facet joints and around the disc. No one knows exactly why these bone spurs develop. Most doctors think that bone spurs are the body's attempt to stop the extra motion between the spinal segments. These bone spurs can cause problems by pressing on the nerves of the spine where they pass through the neural foramina. This pressure around the irritated nerve roots can cause pain, numbness, and weakness in the low back, buttocks, and lower limbs and feet.

A collapsed spinal segment eventually becomes stiff and immobile. Thickened ligaments and facet joints, scarred and dried disc tissue, and protruding bone spurs prevent normal movement. Typically, a stiff joint doesn't cause as much pain as one that slides around too much. So this stage of degeneration may actually lead to pain relief for some people.\textsuperscript{21}
Spine Conditions

The effects of spine degeneration or back injury can lead to specific spine conditions (figure 1.5). These include:

- annular tears
- Internal disc disruption
- Herniated disc
- Sacroiliac joint dysfunction
- Spondylolisthesis
- facet joint arthritis
- segmental instability
- spinal stenosis
- foraminal stenosis

Annular Tears: Our intervertebral discs change with age, much like our hair turns gray. Perhaps the earliest stage of degeneration occurs due to tears that occur in the annulus. These tears can result from wear and tear over a period of time. They can also be the result of a sudden injury to the disc due to a twist or increased strain on the disc that overpowers the strength of the annulus. These annular tears may cause pain in the back until they heal with scar tissue.

Internal Disc Disruption: Multiple annular tears can lead to a disc that becomes weak. The disc starts to degenerate and collapse. The vertebrae begin to compress together. The collapsing disc can be the source of pain because it has lost the ability to be a shock absorber between the vertebrae. This condition is sometimes referred to as internal disc disruption. This type of problem causes primarily mechanical back pain due to inflammation of the disc and surrounding structures.

Herniated Disc: A disc that has been weakened may rupture or herniate. If the annulus ruptures, or tears, the material in the nucleus can squeeze out of the disc, or herniate. A disc herniation usually causes compressive problems if the disc presses against a spinal nerve. The chemicals released by the disc may also inflame the nerve root, causing pain in the area where the nerve travels down the leg. This type of pain is referred to as sciatica. Even a normal disc can rupture. Heavy, repetitive bending, twisting, and lifting can place too much pressure on the disc, causing the annulus to tear and the nucleus to rupture into the spinal canal.

Sacroiliac joint dysfunction: The sacroiliac joint, which connects with the bottom of the lumbar spine and the top of the tailbone, can cause lower back pain and/or sciatica pain if there is any type of dysfunction in the joint that allows too much movement or restricts normal movement.
**Spondylolisthesis:** Spondylolisthesis occurs when one vertebra slips forward over the one below it. The slip most commonly occurs in the lower lumbar vertebrae (e.g. L4 –L5 or L5 – S1). If the slipped vertebra compresses the nerve root at that level, it can result in leg pain and possibly foot pain.²¹

**Facet Joint Arthritis (Osteoarthritis):** The facet joints along the back of the spinal column link the vertebrae together. They are not meant to bear much weight. However, if a disc loses its height, the vertebra above the disc begins to compress toward the one below. This causes the facet joints to press together. Articular cartilage covers the surfaces where these joints meet. Like other joints in the body that are covered with articular cartilage, the facet joints can develop osteoarthritis as the articular cartilage wears away over time. Extra pressure on the facet joints, such as that from a collapsing disc, can speed the degeneration in the facet joints. The swelling and inflammation from anarthritic facet joint can be a source of low back pain.

**Segmental Instability:** Segmental instability means that the vertebral bones within a spinal segment move more than they should. In the lumbar spine, this can develop if the disc has degenerated. Usually the supporting ligaments around the vertebrae have also been stretched over time. Segmental instability also includes conditions in which a vertebral body begins to slip over the one below it. When a vertebral body slips too far forward, the condition is called spondylolisthesis. Whatever the cause, this extra movement in the bones of the spine can create problems. It can lead to mechanical pain simply because the structures of the spine move around too much and become inflamed and painful. The extra movement can also cause neurogenic symptoms if the spinal nerves are squeezed as a result of the segmental instability.

**Spinal Stenosis:** Stenosis means closing in. Spinal stenosis refers to a condition in which the tissues inside the spinal canal are closed in, or compressed. The spinal cord ends at L2. Below this level, the spinal canal contains only spinal nerves that travel to the pelvis and legs. When stenosis narrows the spinal canal, the spinal nerves are squeezed inside the canal. The pressure from the condition can cause problems in the way the nerves work. The resulting problems include pain and numbness in the buttocks and legs and weakness in the muscles supplied by the nerves. Because these nerves travel to the bladder and rectum, weakness in these muscles can cause problems with control of the bladder and bowels.

**Foraminal Stenosis:** Spinal nerves exit the spinal canal between the vertebrae in a tunnel called the neural foramen. Anything that causes this tunnel to become smaller can squeeze the spinal nerve where it passes through the tunnel. This condition is called
foraminal stenosis, meaning the foramen is narrowed. As the disc collapses and loses height, the vertebral body above begins to collapse toward the one below. The opening around the nerve root narrows, squeezing the nerve. Arthritis of the facet joints causes bone spurs to form and point into the foramen, causing further nerve compression and irritation. Foraminal stenosis can cause a combination of mechanical pain and neurogenic pain from the irritated nerve root.21

While less common than the conditions listed above, a number of other conditions can cause low back pain as well, such as sacroiliac joint dysfunction, spinal tumors, fibromyalgia, and piriformis syndrome. Learn more in our overview Common Causes of Lower Back Pain.15

**Fig 1.5 Spine Conditions**

1.3.2 Low Back Pain Exams and Tests

**Medical history**

- Because many different conditions may cause back pain, a thorough medical history will be performed as part of the examination. Some of the questions you are asked may not seem pertinent to you but are very important to your doctor in determining the source of your pain.
Your doctor will first ask you many questions regarding the onset of the pain. (when you lifting a heavy object and felt an immediate pain? Did the pain come on gradually?) He or she will want to know what makes the pain better or worse. The doctor will ask you questions referring to the red flag symptoms. He or she will ask if you have had the pain before. Your doctor will ask about recent illnesses and associated symptoms such as coughs, fevers, urinary difficulties, or stomach illnesses. In females, the doctor will want to know about vaginal bleeding, cramping, or discharge. Pain from the pelvis, in these cases, is frequently felt in the back.

Physical examination

- To ensure a thorough examination, you will be asked to put on a gown. The doctor will watch for signs of nerve damage while you walk on your heels, toes, and soles of the feet. Reflexes are usually tested using a reflex hammer. This is done at the knee and behind the ankle. As you lie flat on your back, one leg at a time is elevated, both with and without the assistance of the doctor. This is done to test the nerves, muscle strength, and assess the presence of tension on the sciatic nerve. Sensation is usually tested using a pin, paper clip, broken tongue depressor, or other sharp object to assess any loss of sensation in your legs.
- Depending on what the doctor suspects is wrong with you, the doctor may perform an abdominal examination, a pelvic examination, or a rectal examination. These exams look for diseases that can cause pain referred to your back. The lowest nerves in your spinal cord serve the sensory area and muscles of the rectum and damage to these nerves can result in inability to control urination and defecation. Thus, a rectal examination is essential to make sure that you do not have nerve damage in this area of your body.

Imaging

- Doctors can use several tests to "look inside you" to get an idea of what might be causing the back pain. No single test is perfect in that it identifies the absence or presence of disease 100% of the time.
- If there are no red flags, there is often little to be gained in obtaining X-rays for patients with acute back pain. Because about 90% of people have improved within 30 days of the onset of their back pain, most doctors will not order tests in the routine evaluation of acute, uncomplicated back pain. Plain X-rays are generally not considered useful in the evaluation of acute back pain, particularly in the first 30 days. In the absence of red flags, their use is discouraged. Their
use is indicated if there is significant trauma, mild trauma in those older than 50 years of age, people with osteoporosis, and those with prolonged steroid use. Do not expect an X-ray to be taken.

- Myelogram is an X-ray study in which a radio-opaque dye is injected directly into the spinal canal. Its use has decreased dramatically since MRI scanning. A myelogram now is usually done in conjunction with a CT scan and, even then, only in special situations when surgery is being planned.

- Magnetic resonance imaging (MRI) scans are a highly detailed test and are very expensive. The test does not use X-rays but very strong magnets to produce images. Their routine use is discouraged in acute back pain unless a condition is present that may require immediate surgery, such as with cauda equina syndrome when red flags are present and suggest infection of the spinal canal, bone infection, tumor, or fracture. MRI may also be considered after one month of symptoms to rule out more serious underlying problems. MRIs are not without problems. Bulging of the discs is noted on up to 40% of MRIs performed on people without back pain. Other studies have shown that MRIs fail to diagnose up to 20% of ruptured discs that are found during surgery.

- A CT scan is an X-ray test that is able to produce a cross-sectional picture of the body. CT scan is used much like MRI.

- Ultrasound imaging also called ultrasound scanning or sonography, using high-frequency sound waves images inside the body are obtained. The sound wave echoes are recorded and displayed as a real time visual image. Ultrasound imaging can show tears in ligaments, muscles, tendons, and other soft tissue masses in the back.

**Nerve tests**

- Electromyogram or EMG is a test that involves the placement of very small needles into the muscles. Electrical activity is monitored. Its use is usually reserved for more chronic pain and to predict the level of nerve root damage. The test is also able to help the doctor distinguish between nerve root disease and muscle disease.

**Blood tests**

- Sedimentation rate or C-reactive protein is blood tests that can indicate whether or not inflammation is present in the body.

- Complete blood count (CBC) is used to detect elevations of white blood cells and anemia.
1.3.3 Low Back Pain Treatment

**Self-Care at Home:** General recommendations are to resume normal, or near normal, activity as soon as possible. However, stretching or activities that place additional strain on the back are discouraged.

- Sleeping with a pillow between the knees while lying on one side may increase comfort. Some doctors recommend lying on your back with a pillow under your knees.
- No specific back exercises were found that improved pain or increased functional ability in people with acute back pain. Exercise, however, may be useful for people with chronic back pain to help them return to normal activities and work. These exercises usually involve stretching maneuvers.
- Nonprescription medications may provide relief from pain.
- Ibuprofen (Advil, Nuprin, or Motrin), available over the counter, is an excellent medication for the short-term treatment of low back pain. Because of the risk of ulcers and gastrointestinal bleeding, talk with your doctor about using this medication for a long time.
- Acetaminophen (Tylenol) has been shown to be as effective as ibuprofen in relieving pain.
- Topical agents such as deep-heating rubs have not been shown to be effective.
- Some people seem to benefit from the use of ice or heat. Their use, although not proven effective, is not considered to be harmful. Take care: Do not use a heating pad on "high" or place ice directly on the skin.
- Most experts agree that prolonged bed rest is associated with a longer recovery period. Further, people on bed rest are more likely to develop depression, blood clots in the leg, and decreased muscle tone. Very few experts recommend more than a 48-hour period of decreased activity or bed rest. In other words, get up and get moving to the extent you can.

**Medical treatment:** Medical treatment options depend on the precise diagnosis of the low back pain. Your doctor will decide which medication, if any, is best for you based on your medical history, allergies, and other medications you may be taking;

- **Nonsteroidal anti-inflammatory medications (NSAIDs)** are the mainstay of medical treatment for the relief of back pain. Ibuprofen, naproxen, ketoprofen, and many others are available. No particular NSAID has been shown to be more effective for the control of pain than another. However, your doctor may switch you from one NSAID to another to find one that works best for you.
- **COX-2 inhibitors**, such as celecoxib (Celebrex), are more selective members of NSAIDs. Although increased cost can be a negative factor, the incidence of costly and potentially fatal bleeding in the gastrointestinal tract is clearly less with COX-2 inhibitors than with traditional NSAIDs. Long-term safety (possible increased risk for heart attack or stroke) is currently being evaluated for COX-2 inhibitors and NSAIDs.

- **Acetaminophen** is considered effective for treating acute pain as well. NSAIDs do have a number of potential side effects, including gastric irritation and kidney damage, with long-term use.

- **Muscle relaxants**: Muscle spasm is not universally accepted as a cause of back pain, and most relaxants have no effect on muscle spasm. Muscle relaxants may be more effective than a placebo (sugar pill) in treating back pain, but none has been shown to be superior to NSAIDs. No additional benefit is gained by using muscle relaxants in combination with NSAIDs over using NSAIDs alone. Muscle relaxants cause drowsiness in up to 30% of people taking them. Their use is not routinely recommended.

- **Opioid analgesics**: These drugs are considered an option for pain control in acute back pain. The use of these medications is associated with serious side effects, including dependence, sedation, decreased reaction time, nausea, and clouded judgment. One of the most troublesome side effects is constipation. This occurs in a large percentage of people taking this type of medication for more than a few days. A few studies support their short-term use for temporary pain relief. Their use, however, does not speed recovery.

- **Steroids**: Oral steroids can be of benefit in treating acute sciatica. Steroid injections into the epidural space have not been found to decrease duration of symptoms or improve function and are not currently recommended for the treatment of acute back pain without sciatica. Benefit in chronic pain with sciatica remains controversial. Injections into the posterior joint spaces, the facets, may be beneficial for people with pain associated with sciatica. Trigger point injections have not been proven helpful in acute back pain. Trigger point injections with a steroid and a local anesthetic may be helpful in chronic back pain. Their use remains controversial.
**Low Back Pain Surgery:** Surgery is seldom considered for acute back pain unless sciatica or the cauda equina syndrome is present. Surgery is considered useful for people with certain progressive nerve problems caused by herniated discs.

**Other Therapy**

**Spinal manipulation:** Osteopathic or chiropractic manipulation appears to be beneficial in people during the first month of symptoms. Studies on this topic have produced conflicting results. The use of manipulation for people with chronic back pain has been studied as well, also with conflicting results. The effectiveness of this treatment remains unknown. Manipulation has not been found to benefit people with nerve root problems.

**Acupuncture:** Current evidence does not support the use of acupuncture for the treatment of acute back pain. Scientifically valid studies are not available. Use of acupuncture remains controversial.

**Transcutaneous electric nerve stimulation (TENS):** TENS provides pulses of electrical stimulation through surface electrodes. For acute back pain, there is no proven benefit. Two small studies produced inconclusive results, with a trend toward improvement with TENS. In chronic back pain, there is conflicting evidence regarding its ability to help relieve pain. One study showed a slight advantage at one week for TENS but no difference at three months and beyond. Other studies showed no benefit for TENS at any time. There is no known benefit for sciatica.

**Exercises (physical therapy):** In acute back pain, there is currently no evidence that specific back exercises are more effective in improving function and decreasing pain than other conservative therapy. In chronic pain, studies have shown a benefit from the strengthening exercises. Physical therapy can be guided optimally by specialized therapists.\(^{20}\)

1.4 **History of use the physical therapy for treatment**

Physicians like Hippocrates and later Galenus are believed to have been the first practitioners of physical therapy, advocating massage, manual therapy techniques and hydrotherapy to treat people in 460 BC.\(^{22}\) After the development of orthopedics in the eighteenth century, machines like the Gymnasticon were developed to treat gout and similar diseases by systematic exercise of the joints, similar to later developments in physical therapy.\(^{23}\)

The earliest documented origins of actual physical therapy as a professional group date back to Per Henrik Ling, “Father of Swedish Gymnastics,” who founded the Royal
Central Institute of Gymnastics (RCIG) in 1813 for massage, manipulation, and exercise. The Swedish word for physical therapist is sjukgymnast = someone involved in gymnastics for those who are ill. In 1887, PTs were given official registration by Sweden’s National Board of Health and Welfare.

Other countries soon followed. In 1894 four nurses in Great Britain formed the Chartered Society of Physiotherapy. The School of Physiotherapy at the University of Otago in New Zealand in 1913, and the United States’ 1914 Reed College in Portland, Oregon, which graduated "reconstruction aides."

Modern physical therapy was established in Britain towards the end of the 19th century. Soon following American orthopedic surgeons began treating children with disabilities and began employing women trained in physical education, massage, and remedial exercise. These treatments were applied and promoted further during the Polio outbreak of 1916. During the First World War women were recruited to work with and restore physical function to injured soldiers, and the field of physical therapy was institutionalized. In 1918 the term "Reconstruction Aide" was used to refer to individuals practicing physical therapy. The first school of physical therapy was established at Walter Reed Army Hospital in Washington D.C. following the outbreak of World War I.

Research catalyzed the physical therapy movement. The first physical therapy research was published in the United States in March 1921 in "The PT Review." In the same year, Mary McMillan organized the Physical Therapy Association (now called the American Physical Therapy Association (APTA). In 1924, the Georgia Warm Springs Foundation promoted the field by touting physical therapy as a treatment for polio.

Treatment through the 1940s primarily consisted of exercise, massage, and traction. Manipulative procedures to the spine and extremity joints began to be practiced, especially in the British Commonwealth countries, in the early 1950s. Later that decade, physical therapists started to move beyond hospital-based practice to outpatient orthopedic clinics, public schools, colleges/universities healthcentres, geriatric settings (skilled nursing facilities), rehabilitation centers and medical centers.

In 1921 in the United States physical therapists formed the first professional association called the American Women's Physical Therapeutic Association. This gave birth to what is known today as the APTA (American Physical Therapy Association), and currently represents approximately 76,000 members throughout the United States. The APTA defines physical therapy as: "clinical applications in the restoration, maintenance, and promotion of optimal physical function."
1.5 Core Stabilization exercises

the last 20 years have seen the development of a substantial focus on the use of exercise that are intended to address intersegmental stability in the lumbar spine. These exercise programs are varyingly referred to as lumbar stabilization, segmental stabilization, or core stabilization, among other terms, and are aimed at improving the neuromuscular control, strength, and endurance of a number of muscles in the trunk and pelvic floor that are believed to play important roles in the dynamic stability of the spine.³¹

Core stability exercises involve training the corset like muscles that sit around abdomen and spine and give lower back support. To start with lumbar stabilization exercises usually involve teaching the patients to find the mid or neutral point between a fully arched back and a fully flattened one.³² Focus on finding the patient's "neutral" spine, or the position that allows the patient to feel most comfortable. The back muscles are then exercised to teach the spine how to stay in this position. Performed on an ongoing basis, these exercises can help keep the back strong and well positioned. Special attention is paid to the extensor muscles of the lower back with resistance exercises.³³

**What muscles provide core stability?**

There are two types of muscle used when stabilizing the lumbar spine and pelvis:

a) **Local postural muscles**: these are the deeper muscles in the area. They are traditionally known as the core muscles. They attach directly to the lumbar vertebrae and surrounding thoracolumbar fascia tensing and relaxing to provide stability to the area. The main postural muscles are:

- Multifidus
- Transversus Abdominus
- Diaphragm
- Pelvic Floor

b) **Global dynamic muscles**: these are the large torque producing muscles which linking the pelvis to the thoracic cage and provide a more general stabilization to the area along with trunk movement. Overuse of these muscles can decrease the function of the local postural muscles. Some of these muscles include:

- Rectus Abdominus
- Internal Oblique
- External Oblique
- Erector Spinae (Longissimus and iliocostalis)³⁴ (figure 1.6)
What use is core stability?

The function and endurance of the core muscles has been shown to greatly improve the stability of the lumbar spine and pelvis:

a) **Injury Prevention and Treatment:** Research has shown that people suffering with chronic low back pain have weakened core muscles. The retraining of the core muscles allows for greater stability in the area and less stress on the structures of the lumbar spine. Improved core stability also provides a more stable base for the joints around the lumbar spine and pelvis such as the hip thus reducing the strain on the muscles moving those joints such as the adductors and hamstrings.

b) **Power Generation:** The more stable the base the more power that can be generated. For example if you fire a cannon from a boat and dry land which will go further? The cannon on dry land has a more stable base therefore the power generated is transferred more effectively to the ball. The more stable your lumbar spine and pelvis the more power can be generated.34

How core muscles activate?

Whenever a person moves, to lift something or simply to move from one position to another, the core region is tensed first. This tension is usually made unconsciously and in conjunction with a change in breathing pattern: An example to try is to sit in a chair and to reach forward over a table to pick up a cup. This movement is first accompanied
by a tension in the core region of the abdomen and can be felt by placing one hand on the abdomen as the movement is made.

As the load increases the key muscles contract around the viscera, which are incompressible, to form a stable ball-like core region against which the forces are balanced in coordination with posture. In martial arts there is a saying that ‘power is generated from the ground up’ and core stability is necessary for the transfer of force and power from the ground across the body into any movement.

It is commonly believed that core stability is essential for the maintenance of an upright posture and especially for movements and lifts that require extra effort such as lifting a heavy weight from the ground to a table. Without core stability the lower back is not supported from inside and can be injured by strain caused by the exercise. It is also believed that insufficient core stability can result in lower back pain, poor posture and lethargy.\textsuperscript{35}

**Training method:**

Training of the core muscle should take place in 3 phases:

a) motor skill learning (i.e. learning how to activate the core muscles)

b) Functional progression (i.e. simple exercises which challenge your ability to maintain stability using your deep postural stabilizing muscles)

c) Sports specific training (i.e. progressing these exercises into drills which replicate your sport).\textsuperscript{34}

Training methods for developing and maintaining core stability include:

- Pilates
- Exercise ball
- BOSU
- Halo exercises

The training we collected to this study it was selected from the Pilates training method.\textsuperscript{35}

**Pilates**

Pilates (German: [piˈlaːtes]) is a physical fitness system developed in the early 20th century by Joseph Pilates and popular in Germany,\textsuperscript{[1]} the UK and the USA. As of 2005, there were 11 million people practicing the discipline regularly and 14,000 instructors in the United States alone. Pilates called his method Contrology (from control and Greek-λογία, -logia). \textsuperscript{36}
**Benefits of Pilates**

Pilates is a body conditioning routine that helps build flexibility and long, lean muscles, strength and endurance in the legs, abdominals, arms, hips, and back. It puts emphasis on spinal and pelvic alignment, breathing to relieve stress and allow adequate oxygen flow to muscles, developing a strong core or center (tones abdominals while strengthening the back), and improving coordination and balance. Pilates' flexible system allows for different exercises to be modified in range of difficulty from beginning advancing. Intensity can be increased over time as the body conditions and adapts to the exercises. No muscle group is under or over trained. It enhances core strength and brings increased reach, flexibility, sure-footedness and agility.36

**History of the Pilates**

Pilates was designed by Joseph Pilates, a physical-culturist born in Germany in 1883. He developed a system of exercises during the first half of the 20th century which were intended to strengthen the human mind and body. Joseph Pilates believed that mental and physical health are inter-related.

He had practiced many of the physical training regimes which were available in Germany in his youth, and it was out of this context that he developed his own work, which has clear connections with the physical culture of the late nineteenth century such as the use of specially invented apparatuses and the claim that the exercises could cure illness. It is also related to the tradition of "corrective exercise" or "medical gymnastics" which is typified by Pehr Henrik Ling.

The first generation of students, many of them dancers. Modern day Pilates styles, both "traditional" and "contemporary", are derived from the teaching of these first generation students.

The method was originally confined to the few and normally practiced in a specialized studio, but with time this has changed and pilates can now be found in community centers, gyms and physiotherapy rooms as well as in hybrid practice such as yogilates and in newly developed forms such as the Menezes Method. The “traditional” form still survives and there are also a variety of “contemporary” schools, such as Stott Pilates, which have adapted the system in different ways.36

**Method and apparatus**

The Pilates method seeks to develop controlled movement from a strong core and it does this using a range of apparatuses to guide and train the body. Joe Pilates originally developed his method as mat exercises (his 1945 Return to Life teaches 34 of these), but, in common with many other physical culture systems from the first part of the twentieth century, he used several pieces of apparatus to help people "get the method in
their bodies”. Each piece of apparatus has its own repertoire of exercises and most of the exercises done on the various pieces of Pilates apparatus are resistance training since they make use of springs to provide additional resistance. Using springs results in “progressive resistance”, meaning the resistance increases as the spring is stretched. The most widely used piece of apparatus, and probably the most important, is the Reformer, but other apparatus used in a traditional Pilates studio include the Cadillac (also called the Trapeze Table), the high (or electric) chair, the Wunda Chair, the baby Chair, and the Ladder Barrel, the Spine Corrector (Step Barrel) and small barrel. Lesser used apparatus include the Magic Circle, Guillotine Tower, the Pedi-Pole, and the Foot Corrector.

In contemporary Pilates other props are used, including small weighted balls, foam rollers, large exercise balls, rotating disks, and resistance bands. Some of the traditional apparatuses have been adapted for use in contemporary Pilates (e.g. splitting the pedal on the Wunda chair). Some contemporary schools, such as the British Body Control Pilates, work primarily on the mat with these smaller props, enabling people to study the method without a full studio.

Currently the Pilates Method is divided into two camps, Classical/Authentic Pilates or Contemporary/Modern Pilates. Classical/Authentic Pilates teach the exercises in an order that does not vary from lesson to lesson. Teachers of this style of Pilates seek to stay close to Joseph Pilates’s original work and generally use equipment that is built to his specifications. Most classically trained teachers will have studied the complete system of exercises and can generally trace their training back to Joseph Pilates through one of his protégés. Contemporary/Modern Pilates breaks the method down into various parts and the order of the exercises varies from lesson to lesson with many changes made to the original exercises.36

**Principles**

Philip Friedman and Gail Eisen, published the first modern book on Pilates, *The Pilates Method of Physical and Mental Conditioning*, in 1980 and in it they outlined six “principles of Pilates”. These have been widely adopted-and adapted-by the wider community. The original six principles were: concentration, control, center, flow, precision and breathing.

- **Concentration:** Pilates demands intense focus: “You have to concentrate on what you're doing all the time. And you must concentrate on your entire body for smooth movements.” This is not easy, but in Pilates the way that exercises are done is more important than the exercises themselves. In 2006, at the Parkinson Center of the Oregon Health and Science University in Portland, Oregon, the
concentration factor of the Pilates method was being studied in providing relief from the degenerative symptoms of Parkinson's disease.

- **Control:** "Contrology" was Joseph Pilates' preferred name for his method and it is based on the idea of muscle control. "Nothing about the Pilates Method is haphazard. The reason you need to concentrate so thoroughly is so you can be in control of every aspect of every moment." All exercises are done with control with the muscles working to lift against gravity and the resistance of the springs and thereby control the movement of the body and the apparatus. "The Pilates Method teaches you to be in control of your body and not at its mercy."

- **Centering:** In order for the practitioner to attain control of their body they must have a starting place: the center. The center is the focal point of the Pilates Method. Many Pilates teachers refer to the group of muscles in the center of the body—encompassing the abdomen, lower and upper back, hips, buttocks and inner thighs—as the "powerhouse". All movement in Pilates should begin from the powerhouse and flow outward to the limbs.

- **Flow or efficiency of movement:** Pilates aims for elegant sufficiency of movement, creating flow through the use of appropriate transitions. Once precision has been achieved, the exercises are intended to flow within and into each other in order to build strength and stamina. In other words, the Pilates technique asserts that physical energy exerted from the center should coordinate movements of the extremities: Pilates is flowing movement outward from a strong core.

- **Precision:** Precision is essential to correct Pilates: "concentrate on the correct movements each time you exercise, lest you do them improperly and thus lose all the vital benefits of their value". The focus is on doing one precise and perfect movement, rather than many halfhearted ones. Pilates is here reflecting common physical culture wisdom: "You will gain more strength from a few energetic, concentrated efforts than from a thousand listless, sluggish movements". The goal is for this precision to eventually become second nature, and carry over into everyday life as grace and economy of movement.

- **Breathing:** Breathing is important in the Pilates method. In *Return to Life*, Pilates devotes a section of his introduction specifically to breathing "Bodily house-cleaning with blood circulation" He saw considerable value in increasing the intake of oxygen and the circulation of this oxygenated blood to every part of the body. This he saw as cleansing and invigorating. Proper full inhalation and complete exhalation were key to this. "Pilates saw forced exhalation as the key to
full inhalation." He advised people to squeeze out the lungs as they would wring a wet towel dry. In Pilates exercises, the practitioner breathes out with the effort and in on the return. In order to keep the lower abdominals close to the spine; the breathing needs to be directed laterally, into the lower ribcage. Pilates breathing is described as a posterior lateral breathing, meaning that the practitioner is instructed to breathe deep into the back and sides of his or her rib cage. When practitioners exhale, they are instructed to note the engagement of their deep abdominal and pelvic floor muscles and maintain this engagement as they inhale. Pilates attempts to properly coordinate this breathing practice with movement, including breathing instructions with every exercise. “Above all, learn to breathe correctly.”

Humans breathe on average around 18,000 breaths per day. Posterior lateral breathing is a way of breathing that facilitates biased expansion of the ribcage, this encourages the breath to travel down into the lower lungs and cleanse the blood by the exchange of oxygen with carbon dioxide. To understand this concept properly the practitioner has to first learn to expand and release the ribcage without deliberately breathing in or out. The in-breath (inhalation) and out-breath (exhalation) should occur instinctively as a result of the conscious expansion and release of the ribcage. This is how it is done: The practitioner places their hands on their lower ribs with their thumbs facing the back of their ribcage, trying not to think of breathing, relaxing their upper abdominals and expanding their ribcage to the side against the soft resistance of their hands. Release the expansion of the ribcage by first melting away the area of the clavicles. This can also be tried with a scarf around the lower ribcage. The practitioner will not be able to expand and release the ribcage effectively if they try to contract their abdominal muscles to expand the ribcage and if they try to contract the ribcage instead of first release it.

The practitioner should now try to duplicate this action with conscious breathing in and breathing out. The in-breath (let it come) widens the ribcage laterally, posterior, and superiorly in the ratio of 60:30:10. That is 60% laterally, 30% posterior and 10% superiorly. The effect of this ratio of distribution is felt mainly as a back activity. The out-breath (gradually let it out) exits the body first through the gradual and gentle release of tension (intention) in the upper chest and breastbone area, without collapsing the front of the ribcage, and terminates through the activation of the power engine.
**Power engine or powerhouse**

Pilates emphasizes the concepts of core strength and stabilization. Students are taught the concepts of core strength and stabilization, as well as to use their “powerhouse” throughout life’s daily activities. As Joseph Pilates called it, the practitioner’s “powerhouse” is the center of their body or their core and if strengthened, it offers a solid foundation for any movement. This power engine is a muscular network which provides the basic control and stability in the lumbopelvic region, which furthermore consists of the pelvic floor muscles, the transversus, the multifidus, the diaphragm, the muscles of the inner thigh, and the muscles encircling the sitting bone area.

The power engine is activated effectively by hollowing of the deep abdominals and pelvic floor muscles (“deep muscle corset”), by drawing the navel back into the spine in a zipping-up motion, from the pubic bone to the breast bone thereby engaging the heels, the back of the inner thighs, the deep lower back muscles, and the muscles surrounding the sitting bones and tailbone area without inhibiting the natural function of the diaphragm—that is without the practitioner holding their breath either from lifting the chest upwards or contracting the chest.

Apart from providing core control and stability to the lumbopelvic region, in the sitting position the power engine elevates the torso and places the centre of gravity at its highest and most efficient position; in prone position it elongates the body bi-directionally to reduce weight in the upper body; in supine position it elongates the body bi-directionally and places the centre of gravity again at its highest and most efficient position.

The Power Engine opens up the vertical dimension of the body by grounding the pelvis to the earth and by elevating the spine towards the sky, much like a tree; the pelvis being the root and the branches being the spine.36

**Neutral spine**

The human spine is made up of a complex chain of ligaments, fascia, bone, muscles and inter-vertebral discs which is required to be both stable and flexible. The natural curves of the spine (cervical and lumbar) are interdependent and whilst each curve supports the other, any deviation can also affect the other. In Pilates the aim throughout most stabilizing exercises is to maintain these natural curves and create a neutral position for each joint that is close to its optimal alignment. In this neutral position the deep postural muscles of the spine (Multifidus and Transversus Abdominus) can be recruited effectively, thus strengthening each vertebra in alignment to reduce stress on
the spinal tissues and inter-vertebral discs. A neutral spine in the semi-supine position involves the alignment of the head, shoulders, thorax, spine and pelvis to ensure that all sections of the body are in their ideal place. The head should be centered, with a small head cushion under the head to prevent the chin from lifting and the neck extending. The head and neck should be gently lengthening away from the shoulders. The shoulders are relaxed with a sense of a gently drawing down action of the shoulder blades to stabilize the scapular and release neck tension.35

1.6 Stretching exercises

Stretching an essential component of fitness, Along with cardiovascular exercise (which raises your heart rate) and resistance training (lifting weights), stretching is an essential component of a complete fitness regime, yet it is often the most neglected. People either perceive it as too easy and, as a result, unnecessary, or too difficult, believing that only the very flexible actually benefit from stretching. In fact, regular, controlled stretching improves and maintains flexibility and mobility, corrects bad posture, reduces the risk of injury, relieves pain, and even helps counteract the effects of ageing. In addition, it relaxes the body; helps reduce stress levels, and can help to boost self-esteem.37

Is it like yoga?

Many people think of yoga or Pilates when they think of stretching. Yoga’s original goal was to increase flexibility for the positions of meditation. Pilates is often called moving yoga, but the main goals are torso strength and control. Both yoga and Pilates follow a strict form and require expert instruction to avoid injury. Stretching is different, in that it is simple. It aims to align the body, improve posture, and encourage better mechanical movement of the joints, which reduces wear and tear on them. Put simply, stretching helps the body to work harmoniously.

Stretching affects more than the 602 muscles of the body. When you stretch muscles, you also mobilize joints, elongate skin, and affect connective tissue, nerves, tendons, and sometimes ligaments.37

The rebalancing effect of stretching

Think of stretching as a way of rebalancing the body. Our muscles come in a variety of shapes and sizes. Arranged around joints, they move in many complex ways. Sometimes making a simple action can involve as many as 19 muscles. If one or more of these muscles is used improperly, you feel it, and not always in the most obvious place. A person maybe has painful shoulder, but the cause may be tight chest muscles
that pull on the joint and put it under strain. Similarly, there may be a complaint of a sore lower back, but the real culprits may be tight muscles at the backs of the thighs and rigid muscles in the ribcage. It’s known as the noisy victim and silent criminal syndrome.\textsuperscript{37}

\textbf{Why we must stretch?}

Stretching improves flexibility and energizes the body, but it is also important for good posture. Over our lifetimes, the constant downward pull of gravity and the dehydrating effects of aging cause us gradually to hunch our shoulders and-more alarmingly-to shrink. Regular stretching can help you achieve an upright and energetic posture and a vital, healthy, and pain-free body. Our bodies suffer daily fatigue from fighting against the constant downward pull of gravity. At the sometime, aging has a dehydrating effect, and as we grow older, our bodily tissues become leathery. After years of being right- or left-handed and performing regular activities such as sitting and driving, we start to stiffen into the positions we have assumed through the years. The effect is to leave you sagging, hunched over, and too tired to carry on. However, this doesn’t have to be a death sentence. You can counteract the effects of gravity and aging on the body and achieve your ideal posture with a stretching program that balances muscular irregularities.\textsuperscript{37}

\textbf{Typical bad posture}

Look at the figure 1.7(right side). Her stooped posture is typical of the effects of gravity and aging. She has an overall saggy appearance—as if she is literally being dragged down. A tight neck and face give the impression of being tired and strained—she really looks as if she carries the weight of the world on her shoulders. Her hunched shoulders are the result of tight chest muscles and practically guarantee arm and hand pain over time. The rotator cuff muscles of the shoulder are literally pinched by this forward position, which often causes pain and discomfort.

A tight lower back not only leads to an unsightly protruding abdomen, it compresses the nerves and can lead to sciatica, leg pain, or, worse yet, problems with bathroom and sexual functions. Tight front of the hip muscles intensify the forward sway of the lower back and often lead to knee problems, the scourge of females, since they are already prone to knee problems because of genetically wider hips. In pronounced cases, the forward sway of the lower back can give an unsightly appearance to the buns. Tight hamstrings inevitably cause lower back pain. The calves and feet are notoriously tight because we are on them all day. Tight calves can lead to a painful yet preventable injury, Achilles’ tendon rupture. Tight feet tend to lead to plantar fasciitis, an uncomfortable heel condition.\textsuperscript{37}
**Ideal body posture**

Look at the figure 1.7 (left side). Notice what a huge difference good posture makes to how you perceive this person: Bright, confident, and athletic. Her face is no longer strained because her head is back over the line of her pelvis. Her neck is now swan-like. Once the shoulders are back and the chest is open, the forlorn look is replaced by an open, relaxed one. Her ears now line up over her shoulders. The rotator cuff can move the arm in its socket the way it was intended. The waist is elongated because the lower back is lengthened. Sitting will now be easier. The abdomen is sleek and no longer protrudes. The hips are upright and forward, which will help her to stand for long periods without feeling tired. The pelvis is positioned more forward on the feet, enabling more bounce in the step and that “go to it” feeling that gives motivation to take on a new day.\(^{37}\)
Fig 1.7 comparison between typical bad posture (left side) and Ideal posture (right side)

The muscles at the back of the neck become tight and cause the chin to jut forward.

The forward tilting pelvis and slumping mid-section compress the vertebrae and nerves in the lower back.

Poor pelvic alignment causes tight hamstrings, a major contributor to lower back pain.

The shift back in the center of gravity causes the calf muscles to tighten.

The neck muscles are lengthened so the head aligns over the pelvis.

The shoulders are back, which frees the rotator cuff area and encourages deeper breathing.

Lumbar vertebrae are in neutral, preserving the curve, the “springboard,” of the lower back.

The pelvis is upright and aligned over the arches of the feet.

The pelvis is upright and aligned over the arches of the feet.

The waist is lengthened, which flattens the stoma.

The knees are supple because body weight is centered so there is no strain on the kneecaps.

The ankles are flexible because the muscles are no longer unbalanced.

The neck muscles are lengthened so the head aligns over the pelvis.

Tight throat and chest muscles cause the head to protrude forward.

Tight chest muscles pull the arms closer together, cavé the chest, and cause the shoulders to round forward.

A tight lower back causes the pelvis and abdomen to tip forward, making the stomach appear pot-bellied.

Tight front of hip muscles push the knees backward, shifting the center of gravity back into the heels.

Tight muscles and tendons in the ankle cause loss of flexibility in the ankles and tightness in the soles of the feet.

The center of gravity is falling just in front of the heels, enabling even weight distribution over the feet.

The neck muscles are lengthened so the head aligns over the pelvis.

The shoulders are back, which frees the rotator cuff area and encourages deeper breathing.

Lumbar vertebrae are in neutral, preserving the curve, the “springboard,” of the lower back.

The pelvis is upright and aligned over the arches of the feet.

The pelvis is upright and aligned over the arches of the feet.

The waist is lengthened, which flattens the stoma.

The knees are supple because body weight is centered so there is no strain on the kneecaps.

The ankles are flexible because the muscles are no longer unbalanced.

The neck muscles are lengthened so the head aligns over the pelvis.

Tight throat and chest muscles cause the head to protrude forward.

Tight chest muscles pull the arms closer together, cavé the chest, and cause the shoulders to round forward.

A tight lower back causes the pelvis and abdomen to tip forward, making the stomach appear pot-bellied.

Tight front of hip muscles push the knees backward, shifting the center of gravity back into the heels.

Tight muscles and tendons in the ankle cause loss of flexibility in the ankles and tightness in the soles of the feet.

The center of gravity is falling just in front of the heels, enabling even weight distribution over the feet.

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The center of gravity is falling just in front of the heels, enabling even weight distribution over the feet.
What happens when you stretch?

Strong muscles, tendons, bones, and ligaments are essential to maintain a healthy, vital body that will serve you well for your entire life. As soon as you go into a stretch you immediately begin to feel the pull of your muscles upon your bones. Tendons connect muscles to bones and the pull of stretching can help the tendons to “plump up,” helping to prevent the injuries that occur all too often when exercising or just carrying out everyday activities. Ligaments connect bone to bone and hold the skeleton together. The aim when stretching correctly is to elongate the muscles and tendons while protecting the ligaments—you don’t want them to stretch. Each muscle has an optimum length, and this book will show you which ones to stretch and where so that you achieve your ideal posture. Focused and correct stretching helps align the spine and balance the muscle groups that would otherwise become shortened by gravity over time.

As we age and our bodies slowly dehydrate, stretching is even more important. In the same way that this slow process of dehydration causes wrinkles on the exterior, it also affects the body tissues inside our skin. Not only do our muscles, tendons, and ligaments dry out and tighten, they become leathery. Over time this causes the body to stiffen, gradually giving a stooped appearance, but it also begins to block the healthy circulation of nutrients around the body. Stretching affects not only our muscle system, but also our neurological system, which includes the operation of the brain. When you stretch, you lengthen some areas while relaxing others. The brain in turn regulates automatic functions such as heart rate and blood pressure. It secretes hormones, which act as chemical messengers to help insulin control, metabolism, mood, and emotion.

Besides the internal physiological benefits come the day-to-day benefits of being flexible enough to sit without experiencing back and shoulder pain. Simple actions such as bending down to small children or reaching up to a high shelf all become easier. Walking and stair climbing become more efficient so that you use less energy and, as a result, feel less fatigued during the day. Along with the physical benefits come untold emotional and mental ones. Stretching is the original mind-body activity. It slows you down so that your heart and mind can come together to achieve an inner calmness. Many a time a simple stretch can put a problem in perspective, and so a better solution can be found to life’s many dilemmas.
How evaluating Range of the Flexibility?

**Neck flexibility:** Stand with your arms by your sides, shoulders back and down, and neck relaxed. Turn your head toward your right shoulder, as far as is comfortable. Keep your gaze level; don’t turn with your chin. Less than 60° poor; 60–75° good; 75–90° very flexible (figure 1.8)

![Fig 1.8 Test of neck flexibility](image)

**Chest flexibility:** Stand with your back to a wall and take a step forward. Position feet slightly more than hip-width apart, and lean your shoulders and head back against the wall. Bend your arms at 90° angles against the wall, elbows at shoulder height, palms facing outward. Your forearms, upper back, and head should all touch the wall (Figure 1.9)

![Fig 1.9 Test chest flexibility](image)
Arm and shoulder flexibility: Stand with back straight and shoulders back and down. Raise one arm straight up by the side of your head with palm facing inward. Keep your hips tucked under and your Abdominals tight. Less than 160° poor; 160–180° good; 180–190° very flexible (Figure 1.10)

Hamstring flexibility: Lie on your back, legs straight and arms at your sides. Press the calf of the bottom leg against the floor, and raise the other straight up. Less than 75° poor; 75–90° good; 90–120° very flexible (Figure 1.11)
**Torso flexibility:** Sit forward on a chair, back straight, and feet flat on the floor. Place your hands on opposite shoulders, and raise your elbows to chest height. Keeping your head in line with your crossed arms, turn it to the right as far as is comfortable, without moving your, legs Less than 35° poor; 35–50° good; 50–70° very flexible (Figure 1.12).

![Fig1.12 Test Torso flexibility](image)

**Types of Stretching**

There are different types of stretching. Stretches are either Dynamic or Static. Dynamic Stretches affect Dynamic Flexibility and Static Stretches affect Static Flexibility. The different types of stretching are, Ballistic Stretching, Dynamic Stretching, Active Stretching, Passive (or relaxed) Stretching, Static Stretching, Isometric Stretching, and PNF Stretching.

- **Ballistic Stretching:** Ballistic stretching uses the momentum of a moving body or a limb in an attempt to force it beyond its normal range of motion. This is stretching, or "warming up", by bouncing into (or out of) a stretched position, using the stretched muscles as a spring which pulls you out of the stretched position. This type of stretching is not considered useful and can lead to injury. It does not allow your muscles to adjust to, and relax in, the stretched position. It may instead cause them to tighten up by repeatedly activating the stretch reflex.

- **Dynamic Stretching:** Dynamic stretching, according to Kurz (1994), “involves moving parts of your body and gradually increasing reach, speed of movement, or both.” Do not confuse dynamic stretching with ballistic stretching! Dynamic stretching consists of controlled leg and arm swings that take you (gently!) to the limits of your range of motion. Ballistic stretches involve trying to force a part of the body beyond its range of motion. In dynamic stretches, there are no bounces or "jerky"
movements. An example of dynamic stretching would be slow, controlled leg swings, arm swings, or torso twists. Dynamic stretching improves dynamic flexibility and is quite useful as part of your warm-up for an active or aerobic workout, such as a dance or martial-arts class.

- **Active Stretching:** Active stretching is also referred to as static-active stretching. An active stretch is one where you assume a position and then hold it there with no assistance other than using the strength of your agonist muscles, for example, bringing your leg up high and then holding it there without anything (other than your leg muscles themselves) to keep the leg in that extended position. The tension of the agonists in an active stretch helps to relax the muscles being stretched (the antagonists) by reciprocal inhibition. Active stretching increases active flexibility and strengthens the agonistic muscles. Active stretches are usually quite difficult to hold and maintain for more than 10 seconds and rarely need to be held any longer than 15 seconds. Many of the movements (or stretches) found in various forms of yoga are active stretches.

- **Passive Stretching:** Passive stretching is also referred to as relaxed stretching, and as static-passive Stretching. A passive stretch is one where you assume a position and hold it with some other part of your body, or with the assistance of a partner or some other apparatus. For example, bringing your leg up high and then holding it there with your hand. Relaxed stretching is also very good for "cooling down" after a workout and helps reduce post-workout muscle fatigue, and soreness.

- **Static Stretching:** Many people use the term "Passive Stretching" and "Static Stretching" Interchangeably. However, there are a number of people who make a distinction between the two. According to Alter (1988)\(^{39}\), Static stretching consists of stretching a muscle (or group of muscles) to its farthest point and then maintaining or holding that position, whereas Passive stretching consists of a relaxed person who is relaxed (passive) while some external force (either a person or an apparatus) brings the joint through its range of motion.

- **Isometric Stretching:** Isometric stretching is a type of static stretching (meaning it does not use motion) which involves the resistance of muscle groups through isometric contractions (tensing) of the stretched muscles. The use of isometric stretching is one of the fastest ways to develop increased static-passive flexibility and is much more effective than either passive stretching or active stretching alone. Isometric stretches also help to develop strength in the "tensed" muscles (which helps to develop static-active flexibility), and seems to decrease the amount of pain usually associated with stretching. Isometric stretching is not recommended for
children and adolescents whose bones are still growing. These people are usually already flexible enough that the strong stretches produced by the isometric contraction have a much higher risk of damaging tendons and connective tissue. Kurz (1994) strongly recommends preceding any isometric stretch of a muscle with dynamic strength training for the muscle to be stretched. A full session of isometric stretching makes a lot of demands on the muscles being stretched and should not be performed more than once per day for a given group of muscles (ideally, no more than once every 36 hours).

- **PNF Stretching:** PNF stretching is currently the fastest and most effective way known to increase Static-passive flexibility. PNF is an acronym for *Proprioceptive Neuromuscular Facilitation*. It is not really a type of stretching but is a technique of combining passive stretching and isometric stretching in order to achieve maximum static flexibility. Actually, the term PNF stretching is itself a misnomer. PNF was initially developed as a method of rehabilitating stroke victims. PNF refers to any of several *post-isometric relaxation* stretching techniques in which a muscle group is passively stretched, then contracts isometrically against resistance while in the stretched position, and then is passively stretched again through the resulting increased range of motion. PNF stretching usually employs the use of a partner to provide resistance against the isometric contraction and then later to passively take the joint through its increased range of motion. It may be performed, however, without a partner, although it is usually more effective with a partner’s assistance.  

1.7 Statement of the problem

Exercise therapy is the most widely used type of conservative treatment for low back pain. Systematic reviews have shown that exercise therapy is effective for chronic but not for acute low back pain. During the past years, many additional trials have been published on chronic low back pain.  

Despite the enormous amount of resources directed to the treatment of chronic low back pain worldwide, treatment for this health condition continues to have a low success rate. The search for more effective ways to manage chronic low back pain is critical if we are to improve the health and quality of life for many peoples.  

The types of exercise programs for chronic low back pain vary widely e.g. land-based exercise (stretching exercise, Mackenzie exercise, Williams exercise) versus exercise in water, individual exercise versus group exercise, isolated trunk exercise versus whole body exercise. Unfortunately there is little or no evidence to help clinicians select the most effective type of exercise for an individual patient. This absence of
evidence means that care is likely to be sub-optimal.\textsuperscript{42} Identifying the ingredients that make exercise programs effective would enable clinicians to prescribe interventions that are appropriate for the non specific chronic low back pain (NSCLBP) care-seeking population. It may be that individually tailored exercises might achieve better outcomes than a one-size-fits-all approach. In this case, identifying the effects of specific exercise programs would enable prediction of the likely outcome of that program and facilitate investigations into the potential benefits of matching exercise strategies to subgroups within those seeking care for NSCLBP.

While some trials of exercise have reported large, durable and clinically important effects others have not because the types of exercise programs for chronic low back pain vary widely and patient presentations also vary widely it is unlikely that all programs are equally effective for all patients. Further, close examination of results of trials reveals that even in the positive trials not all the subjects had a good outcome. Consequently, a single summary statement on the effectiveness of 'exercise' for chronic low back pain would not be meaningful.\textsuperscript{43}

Two very different approaches to exercise are core stabilization exercise \textsuperscript{44} (sometimes called motor control exercise) and a stretching exercise\textsuperscript{45}. At present it is unclear which form of exercise is more effective in the management of chronic low back pain. In a literature review McGuirk\textsuperscript{46} concluded that the motor control approach is the only exercise therapy that has been shown to achieve substantial and lasting reductions in pain. In contrast the 2004 European guideline for management of chronic non-specific low back pain concludes: 'the use of a cognitive-behavioral approach, in which graded exercises (complex of exercise such as aerobic, stretching and …) are performed and using exercise quotas, appears to be advisable.\textsuperscript{47} There has been a considerable debate regarding the most appropriate form of supervised exercise for chronic low back pain, however, at present there is no evidence to inform this debate because there has never been a direct comparison of the two approaches.\textsuperscript{18} Informed prescription of exercise requires evidence on the effectiveness of each type of exercise; and decision algorithms to assist clinicians to select the best form of exercise for an individual patient. This information is not currently available and clinical practice is likely to be suboptimal. The ability to identify patients with a greater chance of success has the potential to establish new knowledge, and save time and money associated with unsuccessful treatment. Therefore, this is a unique goal of the study’s purpose.

“Comparing the effects of core stabilization and stretching exercises on nonspecific chronic low back pain patients”.
1.8 Significance of the study

This research is done on patients who are suffering from nonspecific chronic low back pain, the results from this research, in addition to introducing exercise therapy programs – Stabilization and Stretching-practical for these patients, answering to this important question that in patients suffering from nonspecific chronic low back pain, which of functional weakness of muscles – instability or inflexibility – has more important role in creation of low chronic back pain. Answering this question helps experts of this field to prescribe a more appropriate exercise program when encounter to these patients for treating them.

On the other hand, in most of the researches that have been done by physical education scholars of this field for evaluating the rate of recovery of patients, they only confined to physical tests and questionnaires for determining the rate of improvement - which have been completed by patients- while in this research in addition to physical tests and questionnaires, the specialized test of ultrasonography is used to determine the accurate rate of changes in low back muscle diameter due to performing exercises.

Furthermore, in this research, in the exercise program of stabilization group “Biofeedback Pressure device” was used, utilizing this device in this form is new. This device provides an ability to perform exercises in an appropriate and standard level and, also it gives the ability to evaluate the rate of improvement of stability and strength of involved muscles in exercises movements to the trainer as well as a patient.

One of the other distinct cases in this research is replacing patients suffering from nonspecific chronic low back pain with healthy people in the control group. In most of the done researches, control group includes patients; while in this research through replacing patients with healthy people, a researcher could study initial condition of patients as it compared to healthy people with determining the amount of differences in dependent variables in patient groups as it compared to healthy people before starting exercise therapy program and in the end of the program with re-comparing these variables to health people could follow new condition of patients as it compared to healthy people in mentioned variables.

1.9 Objectives of the study

- To design stabilization exercises program for the nonspecific chronic low back pain patients
- To design stretching exercise program for the nonspecific chronic low back pain patients
- To compare Lumbar Range of Flexion between groups before intervention
- To compare Multifidus Thickness between groups before intervention
- To determine the effect of stabilization exercises on Functional Disability in patients
- To determine the effect of stabilization exercises on Pain Intensity in patients
- To determine the effect of stabilization exercise on Lumbar Range of Flexion in patients
- To determine the effect of stabilization exercises on Multifidus Thickness in patients
- To determine the effect of stretching exercises on Functional Disability in patients
- To determine the effect of stretching exercises on Pain Intensity in patients
- To determine the effect of stretching exercises on Lumbar Flexion in patients
- To determine the effect of stretching exercises on Multifidus Thickness in patients
- To compare Lumbar Range of Flexion between groups after intervention
- To compare Multifidus Thickness between groups after intervention
- To compare the Functional Disability between stabilization and stretching groups after intervention
- To compare the pain intensity between stabilization and stretching groups after intervention

1.10 Hypothesis

**Null Hypothesis**

At the beginning of the study, researchers state an affirmative scientific or research hypothesis as a prediction of the outcome that they propose to test. Most often this research hypothesis suggest that a difference of some kind (e.g., one group will do better then another) will occur. Later, at the stage of the statistical analysis of the observed data, they restate this hypothesis in negative, or null, form. Null hypothesis of this study it was included:

1) \( H_0: \) There is no significant difference in Lumbar Range of Flexion between groups before intervention.

2) \( H_0: \) There is no significant difference in Multifidus Thickness between groups before intervention.

3) \( H_0: \) There is no significant difference between pretest and posttest of Functional Disability in the stabilization group.
4)  $H_0$: There is no significant difference between pretest and posttest of Pain Intensity in the stabilization group.

5)  $H_0$: There is no significant difference between pretest and posttest of Lumbar Range of Flexion in the stabilization group.

6)  $H_0$: There is no significant difference between pre and posttest of Multifidus Thickness in the stabilization group.

7)  $H_0$: There is no significant difference between pretest and posttest of Functional Disability in the stabilization group.

8)  $H_0$: There is no significant difference between pretest and posttest of Pain Intensity in stretching group.

9)  $H_0$: There is no significant difference between pretest and posttest of Lumbar Range of Flexion in stretching group.

10)  $H_0$: There is no significant difference between pretest and posttest of Multifidus thickness in stretching group.

11)  $H_0$: There is no significant difference in Lumbar Range of flexion between groups after intervention.

12)  $H_0$: There is no significant difference in Multifidus Thickness between groups after intervention.

13)  $H_0$: There is no significant difference between stabilization group and stretching group in the Functional Disability after intervention.

14)  $H_0$: There is no significant difference between stabilization group and stretching group in the Pain Intensity after intervention.

**Alternative hypothesis**

It should be noted that, although the null hypothesis is needed for statistical purposes, most actual hypotheses are alternatives to the null. There is 50% probability of rejecting null hypothesis in such situation researcher accepts alternative hypothesis.

Alternative hypothesis of this study it was included:

1)  $H_1$: There is significant difference in Lumbar Range of Flexion between groups before intervention.

2)  $H_1$: There is significant difference in Multifidus Thickness between groups before intervention.

3)  $H_1$: There is significant difference between pretest and posttest of Functional Disability in the stabilization group.

4)  $H_1$: There is significant difference between pretest and posttest of Pain Intensity in the stabilization group.
5) \( H_1 \): There is significant difference between pretest and posttest of Lumbar Range of Flexion in the group.

6) \( H_1 \): There is significant difference between pre and posttest of Multifidus Thickness in the stabilization group.

7) \( H_1 \): There is significant difference between pretest and posttest of Functional Disability in stretching group.

8) \( H_1 \): There is significant difference between pretest and posttest of Pain Intensity in stretching group.

9) \( H_1 \): There is significant difference between pretest and posttest of Lumbar Range of Flexion in stretching group.

10) \( H_1 \): There is significant difference between pretest and posttest of Multifidus thickness in stretching group.

11) \( H_1 \): There is significant difference in Lumbar Range of flexion between groups after intervention.

12) \( H_1 \): There is significant difference in Multifidus Thickness between groups after intervention.

13) \( H_1 \): There is significant difference between stabilization group and stretching group in the Functional Disability after intervention.

14) \( H_1 \): There is significant difference between stabilization group and stretching group in the Pain Intensity after intervention.

1.11 Assumptions

- It was assumed that all subjects will follow the instructions were given to them regarding the exercise programs.
- It was assumed that examiner used for collections of data will be reliable and expert.
- It was assumed all the selected women will participate with responsibility and give a true response to the Questionnaire as well as other field tests.
- It was assumed the tests were used before and after intervention, were valid and reliable.
- The selected statistical tools will be helpful to analyze the data.
- It was assumed that the instruments used for exercise were standardized.
1.12 Delimitations of the study

- This study was delimited to the women patients of nonspecific chronic low back pain only.
- This study was delimited to women aged between 30 to 45 years only.
- Data will be collected from the women patients of Tehran city in Iran only.
- The study was delimitated to do core stabilization.
- The study was delimitated to do stretching exercise.

1.13 Limitations of the study

There are some conditions beyond the control of a researcher that may place restrictions on the conclusions from the study. However, the researcher has made her aware of the following.

- The difference between the diet, individual habits, medicinal treatment and day routine program of subjects
- The difference between status of mental health, quality of life and quality of sex of subjects
- The difference between psychological feeling and attitude in the patients for the treatment programs

1.14 Operational definitions of the technical terms

- **Patients with Non specific Low chronic back pain:** Patients had a history of recurrent LBP (repeated episodes of pain in past year collectively lasting for less than 6 months) of a nonspecific nature, defined as back pain complaints occurring without identifiable specific anatomical or neurophysiological causative factors. To establish this, all patients included in the trial had a prior clinical examination by their physician, including a radiograph or a magnetic resonance imaging scan. Patients with previous spinal surgery, “red flags” (serious spinal pathology or nerve root pain signs) as outlined in the Clinical Standards Advisory Group (CSAG) report for back pain, or signs and symptoms of instability (radiological diagnosis of spondylolysis or spondylolisthesis corresponding to a symptomatic spinal level; “catching,” “locking,” “giving way,” or “a feeling of instability” in one direction or multiple directions of spinal movements) were excluded.

- **Core stabilization exercises:** Core stability is the interaction of coordination and strength of the abdominal, back and buttock muscles during activity to ensure the
spine is stabilized and provides a firm base to support both powerful and assist in
the maintenance of good posture and provide the foundation for all arm and leg
movements. 53

- **Stretching exercises:** Stretching exercises should focus on achieving flexibility
and elasticity in the disc, muscles, ligaments, and tendons. Additionally, it is
important to activate and strengthen muscles not directly involved with the
injured area, such as the arms and legs. For example, the hamstring muscles
play a role in lower back pain, as it is clear that hamstring tightness limits motion
in the pelvis and can place it in a position that increases stress across the low
back. 54
Reference


34. www.gaa.ie/content/.../What_is_core_stability_100129123941.pdf


