Your back is a complex structure and it is often difficult to make an accurate diagnosis as to the exact cause of the pain. Back pain is therefore a symptom rather than a disease on its own. Most back pain is musculoskeletal in origin although pain that arises from other organs may be felt in the back. Many intra-abdominal disorders can cause pain that is referred to the back. Other causes of lower back pain include degeneration of intervertebral discs, herniation (or bulging) of discs, prolapsed discs, sciatica (where the back pain travels to the buttock, leg and foot), osteoporosis, vertebral fractures, osteomyelitis, sacroiliitis or even tumours. If you suffer from any form of lower back problems, you should consult your doctor or physiotherapist.

Musculoskeletal lower back pain is the most common and can be triggered by everyday activities at home or at work. It is widely caused by prolonged sitting, poor posture, twisting awkwardly or incorrect lifting techniques. The purpose of this article is not to offer any diagnosis or treatment of your lower back condition, but simply to make you aware of the importance of strengthening your core to protect your spine, purely from the perspective of an exercise professional and a back pain sufferer in the past.

**Common causes of musculoskeletal lower back pain**

- Seating position: individuals who sit down for a prolonged period with their head down and shoulders protected whilst working on computers are a recipe for postural disaster.
- Being overweight: Abdominal obesity shifts the centre of gravity forward, which in turn leads to an increased chance of postural deviation, such as excessive lordotic lumbar curve. Such deviations lead to faulty loading patterns which increase the strain on the spine and the associated joints. Losing weight means less stress on joints, tendons and muscles. Furthermore, being overweight is often associated with being sedentary, which can limit the strength and flexibility of the back, making it more susceptible to injury.
- Core dysfunction.

**The core**
The core is often misunderstood as being only the rectus abdominis, commonly known as the ‘six-pack’, and the erector spinae – the group of muscles (spinalis, longissimus and iliocostalis) running from the sacrum to the base of the skull. The function of these muscles is to maintain an upright posture and perform lateral flexion.
Core simply means the ability of your trunk to support the effort and forces from your arms and legs. This allows your muscles and joints to perform in their safest, strongest and most effective positions.

In order to fully understand what the core is, we need to look at the anatomy of the stabilising ligaments and muscles of the spine.

- Interspinous ligaments connect each spinous process to the one immediately above or below, together with the posterior longitudinal ligament, preventing excess spinal flexion.
- Intertransverse ligaments connect each transverse process to the one immediately above or below. These ligaments run on either side of the spine and help to prevent excess lateral flexion.
- Anterior longitudinal ligaments connect each vertebral body together and run anteriorly along the spine, preventing excessive spinal extension.
- Posterior longitudinal ligaments run along the posterior aspect of the spine and underneath the spinous processes, helping to prevent excessive spinal flexion.

These passive structures are much weaker than muscles and can therefore only withstand a small amount of force. The muscular system is therefore primarily responsible for maintaining core stability and posture.

The muscles of the spine
There are three layers of muscles: deep, middle and outer. The coordinated action of these muscles determines the level of safe and effective core function.

The deep muscles of the spine (position sense muscles)
The movements of the spine and limbs can be divided into two categories: physiological and accessory. Examples of gross physiological movements include flexion and extension of the torso, running, jumping and lifting. Accessory movements occur alongside physiological movements but take place within each vertebral segment. To control these intricate accessory motions, there are a number of smaller, deeper muscles in close proximity to the spine that connect one vertebral segment to another:

- Interspinalis attach between the spinous processes of the vertebrae. They help to bring about spinal extension and control the smaller movements between vertebrae.
- Rotators attach from the spinous process of one vertebra to the transverse process of the vertebra immediate below. They help to bring about rotation between spinal segments and help to control the smaller movements between vertebrae.
- Intertransversarii attach between the transverse processes of the vertebrae. They help to bring about lateral flexion and control smaller movements between vertebrae.

The middle muscle layer (the inner unit)
This layer lies within the core and helps to provide stability and to create intra-abdominal pressure that stabilises the spine during movement. This layer includes:

- **Diaphragm** – a respiratory muscle that contracts downward and helps create intra-abdominal pressure to help stabilise the spine.
- **Pelvic floor** – a group of muscles at the base of the pelvis to hold the organs.
- **Transversus abdominis (TvA)** – forms a belt or corset around the trunk region and lies deep to the rectus abdominis. It functions by drawing the waist in, compressing the abdominal contents and increasing intra-abdominal pressure to stabilise the spine.
- **Multifidus** (in the lumbar region) – a series of smaller muscles that connect the spinous processes to the transverse processes of the spine. They help to provide rotation and extension of the spine and to hold the lumbar segments in an extended position.

These muscles co-contract to increase the intra-abdominal pressure, thus creating a non-compressible cylinder where the spine is stabilised and forms the working foundation from which the limbs can function satisfactorily and safely. The intra-abdominal cylinder has the diaphragm at the top, the pelvic floor muscles are at the bottom and the transversus abdominis (TvA) forming the surrounding walls; the multifidus muscles positioned posteriorly.

It has been shown that activation of the inner unit muscles occurs prior to the involvement of the extremities and that faulty inner unit recruitment increases the likelihood of lower back dysfunction.

**The outer muscle layer (outer unit, global muscles)**

It is primarily responsible for the large bodily movements (flexion, extension, rotation of the spine etcetera) but also stabilises the spine by creating tension across the trunk for external support.

This unit includes:
- Erector spinae
- Latissimus dorsi
- Rectus abdominis
- External obliques
- Gluteals
- Adductors
Types of muscle fibres
Slow-twitch (type 1) fibres – these aerobic fibres are used for endurance type of activities. They are loaded with myoglobin and mitochondria and therefore use oxygen and fat as their main fuel source for contraction. These fibres contract smoothly and do not generate as much force but are more resistant to fatigue.

Fast-twitch (type 2) fibres (A&B) – these are powerful but quick to fatigue. These are anaerobic glycolytic fibres using glucose in the absence of oxygen for energy.

Integrated core function
If the muscles of the core do not contract in the right order, or the deeper core muscles lack strength, it can lead to an over reliance on large, global muscles (such as rectus abdominis) lying more superficially. Using these global, outer unit muscles to stabilise the trunk can create muscle spasms of the inner unit, as they have been inactivated or dysfunctional, and this is a common cause of lower back pain.

The inner core muscles are for endurance activities and are predominantly made up of type 1 slow-twitch fibres while the outer muscles are predominately made up of type 2 fast-twitch fibres.

It is commonplace for stabilising and mobilising muscles to be trained in the reverse role from what they are designed for. For instance, the rectus abdominis is predominately a type 2 fast-twitch muscle and is normally active in strength and explosive tasks, such as running and jumping. It is, however, also used in exercises such as sit-ups that are performed repetitively in an endurance type capacity. The rectus abdominis is mainly responsible for this action, which effectively results in fast-twitch muscles taking on the role of slow-twitch muscles. This often weakens the deeper stabiliser muscles, such as the transversus abdominis. The rectus abdominis tries to perform both stabilising and mobilising roles, thus ‘switching off’ the deeper core muscles, leading to back pain or injury as optimal stabilisation of the spine is not performed.

Length-tension relationships of muscles
Spending an excessive amount of time in a seated position can affect the length-tension relationships of muscles which can ultimately lead to reduction in core muscle activation and lack of neural stimulation to these muscles. Therefore, even relatively light loads placed upon these muscles exceed their ability to cope as they have been ‘inactive’ for so long.

Muscle length-tension is the relationship between the length of a muscle fibre and the force that it produces at that length. When a muscle fibre is stretched to the point of minimal overlap of contractile protein myofilaments actin and myosin, the contraction force will be minimal. Similarly, when a muscle is shortened, contractile force will be weakened. Therefore, muscles can become weak because they are stretched or when they are too tight. When these muscles are tight, there is a reduction in blood flow, making it difficult for them to accomplish their basic physiological functions, which include removal of waste products that would naturally be carried away in the blood circulation. In addition to this, oxygen is essential for tissues to remain healthy; thus, a lack of oxygenated blood being delivered to the muscles will have a compounding effect to its dysfunction.

Commonly observed postures in people who adopt long term seated positions
As well as other health problems associated with prolonged sitting (obesity, type 2 diabetes, some types of cancer and premature death) it can also cause muscular imbalance:

- Thoracic hyperkyphosis (flexed thoracic spine) with lengthened middle trapezius and rhomboids (muscles of the back).
- Protracted shoulders and shortened pectorals.
- Extended cervical spine and shortened upper trapezius.

The concept of reciprocal inhibition
Just imagine when you contract your bicep brachii muscles (the agonist, prime mover) of your upper arm, the antagonist muscles, triceps brachii, on the back of your arm will relax to allow this to happen.

If you sit down all day (hip flexion), your hip flexor muscles (rectus femoris, psoas major and iliacus) will be in a constantly contracted state, whilst the gluteus maximus (antagonist) will be constantly relaxed or inactivated.
due to reciprocal inhibition. They are therefore not able to contribute to hip extension as well as hip and back stabilisation as they usually do. Without the help of the gluteal muscles, the erector spinae group of muscles and hamstring group have to take over the role of the glutes and these muscles can easily become overloaded and develop trigger points. A trigger point is a tight area within muscle tissue that causes pain in other parts of the body. A trigger point in the back, for example, may produce referral pain in the neck. The neck, now acting as a satellite trigger point, may then cause pain in the head. The pain may be sharp and intense or a dull ache.

With the knees in a flexed position whilst sitting down, the hamstrings become tight and because of reciprocal inhibition, the antagonist muscle group – the quadriceps will be weakened. Tight hamstrings are associated with back pain as they stop the hips from flexing during forward bending, forcing the lower back to bend to beyond its strong middle range. To summarise, muscle over activity commonly comes about to compensate for other weak muscles. When one muscle group is weak and underactive, the other tends to pick up the slack and become overactive. The resulting imbalance often leads to pain and even injury.

Two other major muscles that are related to lower back pain
1) Piriformis
This muscle is important for stabilisation of the pelvis during standing. It is one of the abductor muscles (other abductors are tensor fasciae latae and the iliotibial tract, sartorius, gluteus medius and gluteus minimus) that control rapid hip lateral rotation during walking.

This flat muscle originates from the anterior aspect of the sacrum and connects to the greater trochanter of the femur. It lies superficial to the sciatic nerve and deep to the gluteus maximus. If the piriformis muscle becomes tight or goes into spasm (Piriformis Syndrome) it can compress the sciatic nerve and cause pain which can radiate down the leg, commonly known as sciatic pain.

A common cause of piriformis syndrome is a tight adductor group of muscles (adductor brevis, adductor longus, adductor magnus, gracilis and pectineus) on the medial aspect of the thigh. This means the abductors on the
lateral aspect of the thigh cannot work properly thus putting more strain on the piriformis which may cause it to go into spasm.

Stretching the piriformis is almost always necessary to relieve the pain along the sciatic nerve and can be done in several different positions. A number of stretching exercises for the piriformis muscle and hamstrings may be used to help decrease the painful symptoms along the sciatic nerve and improve flexibility.

![Piriformis Syndrome](image1)

2) Quadratus lumborum (QL) muscle
The Quadratus lumborum is an important muscle of the core – it is often considered to be an abdominal muscle located on the posterior aspect of the thorax. Its medial portion is deep to the erector spinae, but its lateral border is palpable from the side of the torso. It originates from the posterior iliac crest and inserts to the 12th ribs and transverse processes of L1-L4. It is a postural muscle responsible for lateral flexion or lifting one side of the pelvis up (when it contracts unilaterally) and extension of the lumbar spine (when it contracts bilaterally). It is also used in respiration and helps to stabilise the lumbar spine along with the transversus abdominis (they share the thoracolumbar fascia) and function with other ‘core’ musculatures.

The QL is commonly involved in but often overlooked as the source of lower back pain. If the gluteal muscles are weakened, the QL will be excessively recruited in order to stabilise the pelvis. The result is often low back pain with a notable side bend (hip hike) to the same side of the noted pain. The glutes and the QL generally work together during walking, running, single leg or heavy bilateral strength exercises and change of direction sports.

![Left & Right Quadratus Lumborum](image2)

If you have any questions, please do not hesitate to get in touch
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