

What has the Diaphragm Ever Done for Us? (Well, Apart from...?)

In this essay, Lee Anthony Taylor consolidates a wealth of knowledge about this vital part of the body. Taken in large part from his Anatomy and Physiology Refresher Course, the following information will be invaluable for therapists, directing and guiding them in their assessments and case-taking.

Think of the process of breathing and you would have to include the diaphragm. This major muscle of breathing influences all other breathing muscles within the body. By altering the shape and size of the rib cage, it creates the difference in pressure that draws air into the body.

However, the influence of the diaphragm goes way beyond its role of pumping air in and out of the body. Understanding these influences gives us some of the answers as to why strengthening the performance of the diaphragm through reflex therapy work can help so many functional disorders and chronic diseases.

A Summary of Influences

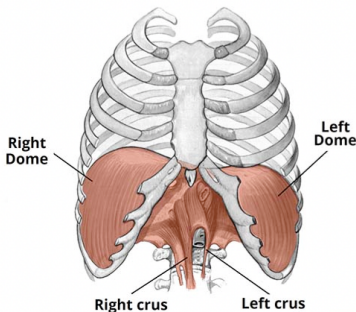
The diaphragm muscle is an important crossroads for information involving the entire body. It has an astonishing number of functions beyond breathing. For instance,

- it is important for **postural** control, maintaining core stability when the spine is loaded
- it also plays a vital role in the functioning of the **cardiovascular** and **lymphatic** systems
- it has heavy involvement in **digestive** functions such as vomiting and swallowing and forms a large part of the barrier against gastroesophageal reflux. It is worth considering the diaphragm when assessing abdominal pain and **irritable bowel syndrome**
- the movement of the diaphragm is tightly co-ordinated and **neurologically linked** with the movement of the **pelvic floor** and with the muscles of the **throat**, the **tongue** and the **buccal diaphragm**. Breathing has been shown to be the major influence on the circulation of **venous blood** and **cerebral spinal fluid** in the brain.
- breathing physically moves the **brain** and affects the **whole nervous system**. The vibrational rhythm created by breathing is echoed in the neural activity of the **limbic system** and other parts of the **central, peripheral** and **autonomic nervous system**. Deep diaphragmatic breathing can enhance the physiological effects on the brain and nervous system.
- in relation to the **urinary system**, the diaphragm has strong links to the autonomic nervous system and the pelvic floor, in particular, can help regulate **incontinence** and **bedwetting**.

Do any of these sound like symptoms you are working with?

Anatomy and Physiology

The thoracic diaphragm muscle extends from the trigeminal system to the pelvic floor, with links to the floor of the mouth. It is a thin, concave, dome-shaped structure which separates the chest from the abdomen. It is attached by costal, lumbar, and sternal ligaments.



Although the diaphragm separates the chest and the abdomen, it plays a vital role in regulating the physiology related to both cavities. This is due in part to the fact that the superior diaphragmatic surface merges into the pulmonary pleura, whereas the inferior surface merges into the peritoneum.

From a functional perspective, two areas can be recognized in the diaphragm, for example, the crural region and the costal region. The former is responsible for correct breathing, whereas the latter prevents gastroesophageal reflux. More details are given on my A&P Refresher Course.

What? There's More than One Diaphragm?!

There is a strong connection between the respiratory and pelvic diaphragms. During normal respiration, or in the event of coughing, a corresponding change in the pelvic floor occurs. For example, MRI studies have shown that during inspiration the thoracic diaphragm descends, with a corresponding lowering of the pelvic floor in order to regulate any change in intra-abdominal pressure. It also ensures the stability within the torso and the maintenance of urinary continence during respiration and coughing.

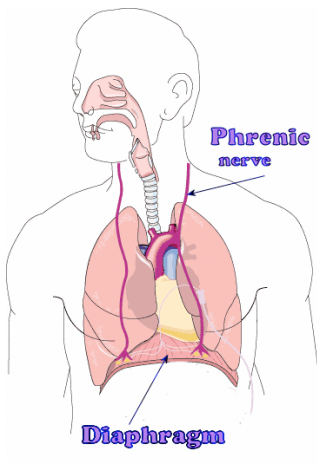
Studies have also established that, before inhalation, electrical activity can be observed in the muscles of the pelvic floor and the same electrical activity is traceable for the *transverse* and *obliquus internus abdominis* muscles. This can be explained in part by the fact that the *retroambiguus nucleus*, part of the medulla oblongata in the brain, controls the abdominal muscles as well as being part of the respiratory centre.

The pelvic diaphragm not only has a significant role in supporting the pelvic organs and in resisting increasing pressure, but also affects respiratory function. This significance indicates that respiration needs to be supported by the pelvic floor, in order to control the pressure of intra-abdominal fluid properly. It is believed that these same areas, which are connected to the motor neurons of the floor of the mouth, send impulses to the pelvic zone.

In the mouth, there is a close relationship between the diaphragm, the buccal diaphragm, and the brain-covering *dura mater*. The connection between the diaphragm and the floor of the mouth is easily recognised with poor swallowing or sleep apnea, or some form of diaphragmatic dysfunction.

The Role of the Phrenic Nerve

This nerve innervates the diaphragm and runs from the roots of C3 to C5. The phrenic motor units not only control breathing but also vocalization and the expulsion of waste-containing substances for the expectoration of the airways.



If there is a problem in the diaphragm or phrenic nerve, the whole system that controls the crural region is negatively affected, causing **oesophageal reflux** and/or **swallowing problems**.

It is important to emphasize that when an organ such as the **liver** or the **gall bladder** does not function properly, the phrenic nerve will be affected. This is because the peritoneal surface related to the gall bladder and the hepatic (liver) attachment to the diaphragm are innervated by the phrenic nerve.

Connection to the Cardio-Vascular System

Diaphragmatic breathing (with long and slow exhalation) is the key to stimulating the **vagus nerve** and slowing the **heart rate** and **lowering blood pressure**. Respiration is a constant regulator of cardiovascular functioning and control and, by means of a muscular contraction of the limbs, the venous drainage is enhanced. This is because, during inhalation, the inferior vena cava diameter decreases. Therefore, if there are symptoms of poor blood circulation, work on the diaphragm is recommended to help the blood flow reach the peripheral areas.

Involvement with the Lymphatic System

There is a large amount of lymphatic drainage within the abdominal region, especially in the peritoneal cavity. In particular, the **cisterna chyli**, which is located under the diaphragmatic crural region, is the main destination point for the lymph. Added to this, lymph flowing from the diaphragm enters the thoracic duct, and finally enters the venous system. Lymphatic absorption depends on the contraction of the diaphragm, then on intraperitoneal pressure and the *posture* of the individual. This highlights how poor functioning of the diaphragm, for any reason, can negatively affect the lymphatic system.

Links to the Fascia

Finally, it is important to consider the fascial and connective links between the diaphragm and the pelvic floor, and the rest of the body. First, the abdominal muscles are related to the costal, lumbar, and pubic iliac regions of the body, for example, *rectus abdominis*, the *internal* and *external oblique* muscles, *pyramidalis*, *cremaster*, *transversus abdominis*, *great psoas*, *quadratus lumborum*, *sacrospinalis*, and *transversus spinalis*.

The fascia involving the diaphragm posteriorly, in other words, at the retroperitoneal level, is separated into four distinct parts. It joins the *aortic system*, *inferior vena cava*, *liver*, *psaos* muscles, *quadratus lumborum*, *cardiac* area, *oesophageal* ligaments and, finally, the *kidneys*.

In addition, the *transversus abdominis* muscle, along with the respiratory diaphragm and the pelvic floor, plays a significant role in the stability of the *sacroiliac joint*.

As if that wasn't enough, another important fascial system is the thoracolumbar fascia, which develops posteriorly from the cervical region through the thoracic region, and finally to the sacral region. It involves muscles such as *latissimus dorsi*, *trapezius*, *gluteus maximus*, and the *external oblique*, as well as the ligaments that connect the *ileum* to the *sacrum*. Indeed, the sacral bone belongs to the system of the pelvic floor). The *gluteus maximus* muscle runs in part anterior to the pelvic floor.

Phew, all this from involvement of the diaphragm system!

Conclusion

To sum up, the diaphragm muscle not only plays a role in respiration but also has many roles affecting the health of the whole body. It should not be seen as a distinct unit but rather as an interlocutor between all parts, keeping them all in touch and allowing them to communicate effectively. (This concept and others are explained in detail on my A&P Refresher Course). Everything is touched by the presence and the activity of the diaphragm and, it can be argued, that the key to overall better health is to master the art of deep diaphragmatic breathing. Maybe this is something we should be teaching to our children in our schools? Imagine the benefits they would inherit!

Bibliography/Sources

Keywords to look out for and type in:

- The role of the diaphragm
- The diaphragm and fascia links
- The Deep Front Line
- Read more in the Anatomic connections of the diaphragm: influence of respiration on the body system (Bordoni and Zanier, The Journal of Multidisciplinary Healthcare 2013)