Anthropology:

Anthropology is the scientific study of humanity, concerned with the human behavior, human biology, cultures and societies in both the present and past, including past human species. Anthropology is a discipline that studies the human being within the framework of society and the environment to which it belongs. And it is based on an ethnographic methodology to collect the data set on a particular social group. Based on the participant observation (living with the group, observing what the group says and does, as well as their cultural actions) the anthropologists carry out several interviews to understand more deeply the meanings that individual people registered in collective give to the actions of their day to day, with a consequent interpretation of the collected data. Physical anthropology is the branch that concentrates on the biology and evolution of humanity. The branches that study the social and cultural constructions of human groups are variously recognized as belonging to cultural anthropology (or ethnology), social anthropology, linguistic anthropology, and psychological anthropology.

Human Factors Engineering: "Human factors engineering" is a term from the 1920s and 30s that has recently seen a resurgence, to describe efforts to improve relationships between humans and machines. The work of this profession, which is primarily comprised of engineers and social scientists of all sub-fields, is largely occupied with discovering the limitations and capabilities of people as they interact with technology, and to design for and with these characteristics. Designing with human factors in mind entails rigorous scientific testing as an alternative to relying on aesthetic and functional intuition to create technological solutions intended for human use. The ideal of this field is to conceive of the human as participating in a system within with she is but one agent. With careful scientific study, techno-mechanical systems can be designed in such a way as to prompt predictable responses in their users, or can be adjusted in response to routine user behavior. Green explains: "common examples include the design of medical devices, medical procedures, and medical information systems, aircraft cockpit, spacecraft living quarters, nuclear and chemical plan control rooms, web sites, factory work stations, and so forth."

One of the focal points of the HF engineer's effort is the machine display, the simplest means by which a machine indicates its condition to a user—these may take the form of audio or visual cues: warning signs, lights, or audible messages. To properly use the machine, HF engineers work to insure that the display is correctly interpretable by users, and prompts them to make efficient and correct decisions in response to their output. Here, psychology often intersects with HFE (the reason many engineers in this field have backgrounds in the subject). Understanding the nature of human decision-making allows engineers to, in essence, manipulate it—to predict what actions a user is likely to take and to design for it, or to design for an action they wish users to take.

Because the process of trial and error can slow down the production process, however, much technological development bypasses the research stage and engenders user-interface or other issues.

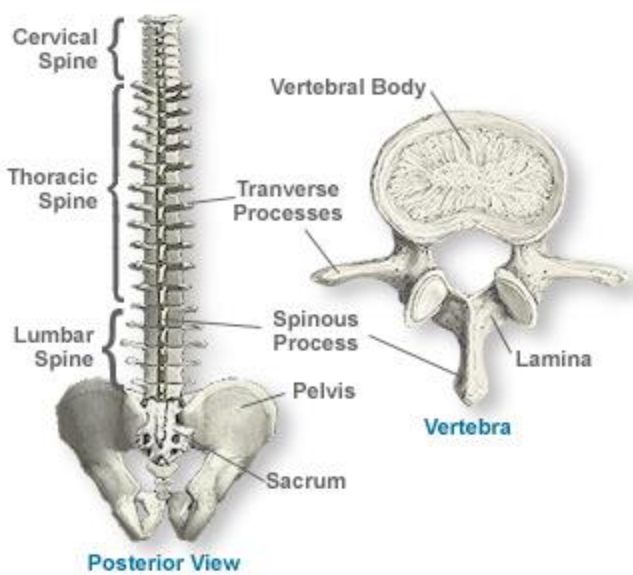
Anthropologists in the Fields: Anthropologist Amy Santee recently outlined her job functions in a post on Anthropology News as being twofold: "I plan, conduct, and manage research projects, and deliver results and recommendations to stakeholders.” In a practical sense, she explains that the results of her work tend to manifest in “minor changes in an interface that improve navigation and efficiency, or major enhancements to a service that facilitate trust and control.” And most significantly, she emphasizes that there is no single path to working in design and engineering research; the newness of the fields means that many who end up pursuing this path have finished their education before the development of programs, which are currently increasing in number, but not yet widespread.

In sum, these fields are highly accessible to anthropologists. Anthropological training prepares us for skills similar to user research, studying the use of technology by individual users and making recommendations. We’re good at interviewing, practiced at designing questionnaires, and competent to synthesize observations into analysis. Making technological development and engineering work align more closely with the needs of users is interesting and rewarding work

Anatomy of spine and Pelvis related to posture:

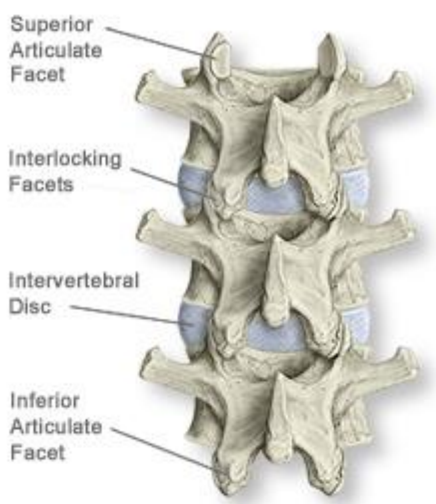
The normal anatomy of the spine is usually described by dividing up the spine into three major sections: the cervical, the thoracic, and the lumbar spine. (Below the lumbar spine is a bone called the sacrum, which is part of the pelvis). Each section is made up of individual bones, called vertebrae. There are 7 cervical vertebrae, 12 thoracic vertebrae, and 5 lumbar vertebrae.

An individual vertebra is made up of several parts. The body of the vertebra is the primary area of weight bearing and provides a resting place for the fibrous discs which separate each of the vertebrae. The lamina covers the spinal canal, which is the large hole in the center of the vertebra through which the spinal nerves pass. The spinous process is the bone you can feel when running your hands down your back. The paired transverse processes are oriented 90 degrees to the spinous process and provide attachment for back muscles.



A healthy spine has three natural curves that make an S-shape. These curves absorb shocks to your body and protect your spine from injury. Many different parts make up your spine:

- **Vertebrae:** The spine has 33 stacked vertebrae (small bones) that form the spinal canal. The spinal canal is a tunnel that houses the spinal cord and nerves, protecting them from injury. Most vertebrae move to allow for a range of motion. The lowest vertebrae (sacrum and coccyx) are fused together and don't move.
- **Facet joints:** These spinal joints have cartilage (a slippery connective tissue) that allows vertebrae to slide against each other. Facet joints let you twist and turn, and they provide flexibility and stability. These joints can develop arthritis and cause back pain or neck pain.
- **Intervertebral disks:** These flat, round cushions sit between the vertebrae and act as the spine's shock absorbers. Each disk has a soft, gel-like center (the nucleus pulposus) surrounded by a flexible outer ring (the annulus). Intervertebral disks are under constant pressure. A herniated disk can tear, allowing some of the nucleus' gel substance to leak out. Herniated disks (also called bulging, slipped or ruptured disks) can be painful.
- **Spinal cord and nerves:** The spinal cord is a column of nerves that travels through the spinal canal. The cord extends from the skull to the lower back. Thirty-one pairs of nerves branch out through vertebral openings (the neural foramen). These nerves carry messages between the brain and muscles.
- **Soft tissues:** Ligaments connect the vertebrae to hold the spine in position. Muscles support the back and help you move. Tendons connect muscles to bone and aid movement.



There are four facet joints associated with each vertebra.
A pair that face upward and another pair that face downward.
These interlock with the adjacent vertebrae and provide stability to the spine.
The vertebrae are separated by intervertebral discs, which act as cushions between the bones.
Each disc is made up of two parts. The hard, tough outer layer, called the annulus, surrounds a mushy, moist center, called the nucleus. When a disc herniates or ruptures, the soft nucleus spurts out through a

tear in the annulus and can compress a nerve root. The nucleus can squirt out on either side of the disc, or in some cases, both sides.

The amount of pain associated with a disc rupture often depends upon the amount of nucleus that breaks through the annulus and whether it compresses a nerve. To help alleviate the pain, a laminotomy/microdiscectomy may be performed.

The 33 vertebrae make up five distinct spine segments. Starting at the neck and going down toward your buttocks (rear end), these segments include:

- **Cervical (neck):** The top part of the spine has seven vertebrae (C1 to C7). These neck vertebrae allow you to turn, tilt and nod your head. The cervical spine makes an inward C-shape called a lordotic curve.
- **Thoracic (middle back):** The chest or thoracic part of the spine has 12 vertebrae (T1 to T12). Your ribs attach to the thoracic spine. This section of the spine bends out slightly to make a backward C-shape called the kyphotic curve.
- **Lumbar (lower back):** Five vertebrae (L1 to L5) make up the lower part of the spine. Your lumbar spine supports the upper parts of the spine. It connects to the pelvis and bears most of your body's weight, as well as the stress of lifting and carrying items. Many back problems occur in the lumbar spine. The lumbar spine bends inward to create a C-shaped lordotic curve.
- **Sacrum:** This triangle-shaped bone connects to the hips. The five sacral vertebrae (S1 to S5) fuse as a baby develops in the womb, which means they don't move. The sacrum and hip bones form a ring called the pelvic girdle.
- **Coccyx (tailbone):** Four fused vertebrae make up this small piece of bone found at the bottom of the spine. Pelvic floor muscles and ligaments attach to the coccyx.

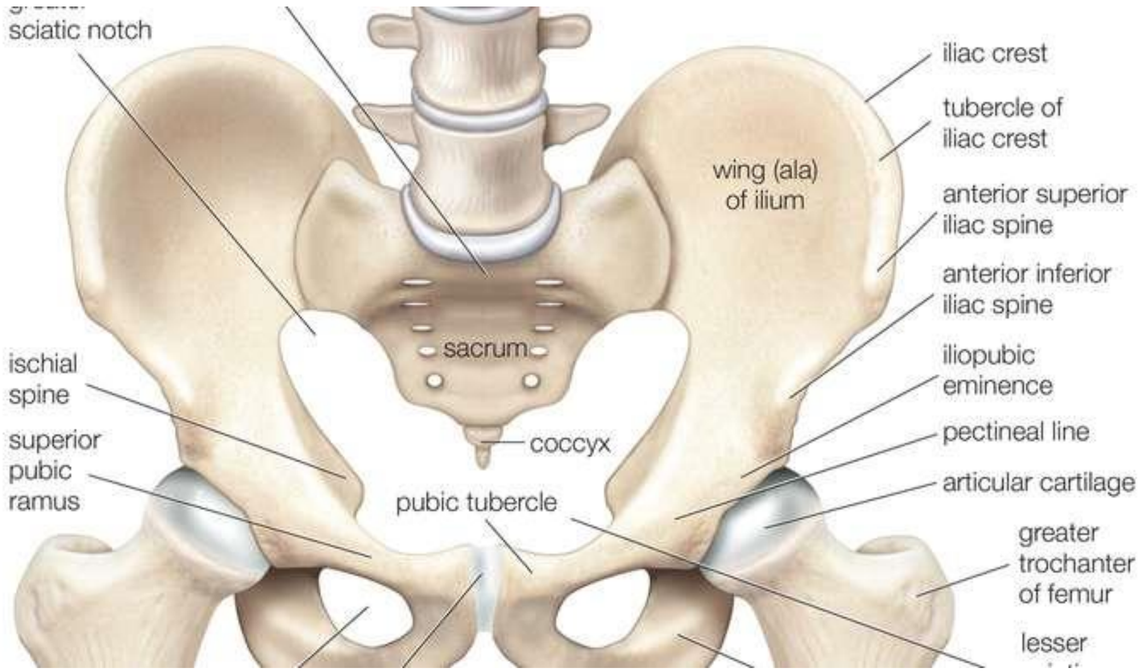
Refer this video link for the overview of spine and pelvis related problem and their anatomy:

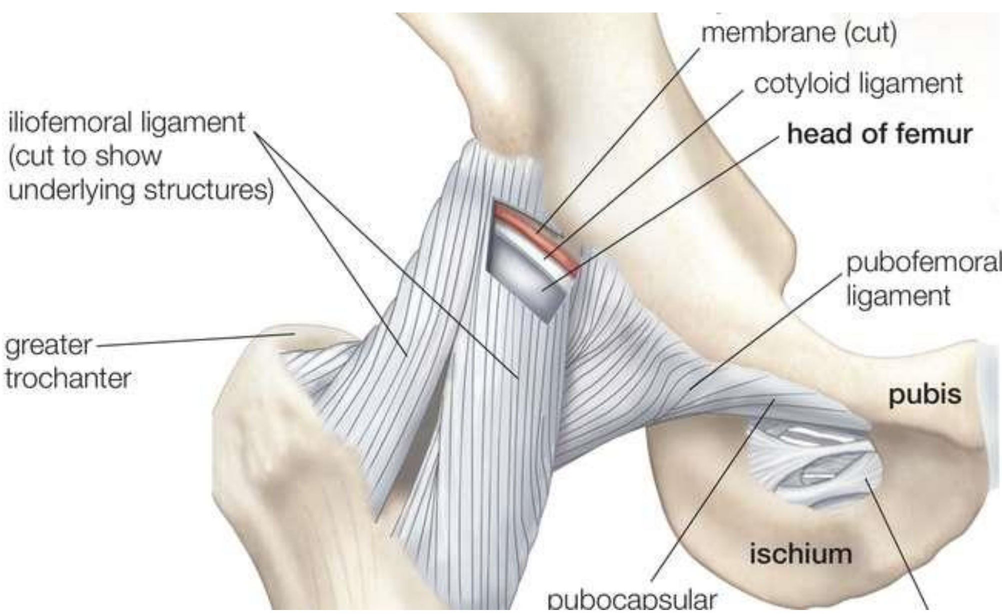
https://www.spine-health.com/video/spine-anatomy-overview-video

https://www.spine-health.com/conditions/spine-anatomy/videos

Spinal anatomy is a remarkable combination of strong bones, flexible ligaments and tendons, large muscles and highly sensitive nerves. It is designed to be incredibly strong, protecting the highly sensitive nerve roots, yet highly flexible, providing for mobility on many different planes. Most of us take this juxtaposition of strength, structure and flexibility for granted in our everyday lives—until something goes wrong. Once we have back pain, we're driven to know what's wrong and what it will take to relieve the pain and prevent a recurrence.

Pelvis, also called bony pelvis or pelvic girdle, in human anatomy, basin-shaped complex of bones that connects the trunk and the legs, supports and balances the trunk, and contains and supports the intestines, the urinary bladder, and the internal sex organs. The pelvis consists of paired hipbones, connected in front at the pubic symphysis and behind by the sacrum; each is made up of three bones—the bladeshaped ilium, above and to either side, which accounts for the width of the hips; the ischium, behind and below, on which the weight falls in sitting; and the pubis, in front. All three unite in early adulthood at a triangular suture in the acetabulum, the cup-shaped socket that forms the hip joint with the head of the femur (thighbone). The ring made by the pelvis functions as the birth canal in females. The pelvis provides attachment for muscles that balance and support the trunk and move the legs, the hips, and the trunk. In the human infant the pelvis is narrow and nonsupportive. As the child begins walking, the pelvis broadens and tilts, the sacrum descends deeper into its articulation with the ilia, and the lumbar curve of the lower back develops.





Biomechanics:

Biomechanics is the science of movement of a living body, including how muscles, bones, tendons, and ligaments work together to produce movement. Biomechanics is part of the larger field of kinesiology, specifically focusing on the mechanics of the movement. Biomechanics includes not only the structure of bones and muscles and the movement they can produce, but also the mechanics of blood circulation, renal function, and other body functions.

Elements of Biomechanics

These are the key areas that biomechanics focuses on:

- **Dynamics**: Studying systems that are in motion with acceleration and deceleration.
- **Kinematics**: Describing the effect of forces on a system, motion patterns including linear and angular changes in velocity over time as well as position, displacement, velocity, and acceleration are studied.
- **Kinetics**: Studying what causes motion, the forces, and moments at work
- **Statics**: Studying systems that are in equilibrium, either at rest or moving at a constant velocity

Biomechanics is interesting because many people marvel at the ability and beauty in animal movement. Some scholars have purely theoretical or academic interests in discovering the laws and principles that govern animal movement. Within kinesiology, many biomechanists have been interested in the application of biomechanics to sport and exercise. The applications of biomechanics to human movement can be classified into two main areas: the improvement of performance and the reduction or treatment of injury Human movement performance can be enhanced many ways. Effective movement involves anatomical factors, neuromuscular skills, physiological capacities, and psychological/cognitive abilities. Most kinesiology professionals prescribe technique changes and give instructions that allow a person to improve performance. Biomechanics is most useful in improving performance in sports or activities where technique is the dominant factor rather than physical structure or physiological capacity

Biomechanics provides information for a variety of kinesiology professions to analyze human movement to improve effectiveness or decrease the risk of injury. How the movement is analyzed falls on a continuum between a qualitative analysis and a quantitative analysis. Quantitative analysis involves the measurement of biomechanical variables and usually requires a computer to do the voluminous numerical calculations performed. Even short movements will have thousands of samples of data to be collected, scaled, and numerically processed. In contrast, qualitative analysis has been defined as the "systematic observation and introspective judgment of the quality of human movement for the purpose of providing the most appropriate intervention to improve performance" Analysis in both quantitative and qualitative contexts means identification of the factors that affect human movement performance, which is then interpreted using other higher levels of thinking (synthesis, evaluation) in applying the information to the movement of interest. The advantages of numerical measurements of quantitative over those of qualitative analysis are greater accuracy, consistency, and precision. Most quantitative biomechanical analysis is performed in research settings; however, more and more devices are commercially available that inexpensively measure some biomechanical variables. Even with very fast modern computers, quantitative biomechanics is a labor-intensive task requiring considerable graduate training and experience. For these reasons and others, qualitative analysis of human movement remains the main approach kinesiology professionals use in solving most human movement problems.

Muscular System:

The muscular system is composed of specialized cells called muscle fibers. Their predominant function is contractibility. Muscles, attached to bones or internal organs and blood vessels, are responsible for movement. Nearly all movement in the body is the result of muscle contraction. In addition to movement, muscle contraction also fulfills some other important functions in the body, such as posture, joint stability, and heat production. Posture, such as sitting and standing, is maintained as a result of muscle contraction. The skeletal muscles are continually making fine adjustments that hold the body in stationary positions. The tendons of many muscles extend over joints and in this way contribute to joint stability.

Muscle Types

In the body, there are three types of muscle: skeletal (striated), smooth, and cardiac.

Skeletal Muscle

Skeletal muscle, attached to bones, is responsible for skeletal movements. The basic unit is the muscle fiber with many nuclei. These muscle fibers are striated (having transverse streaks) and each acts independently of neighboring muscle fibers.

Smooth Muscle

Smooth muscle, found in the walls of the hollow internal organs such as blood vessels, the gastrointestinal tract, bladder, and uterus, is under control of the autonomic nervous system. Smooth muscle cannot be controlled consciously and thus acts involuntarily.

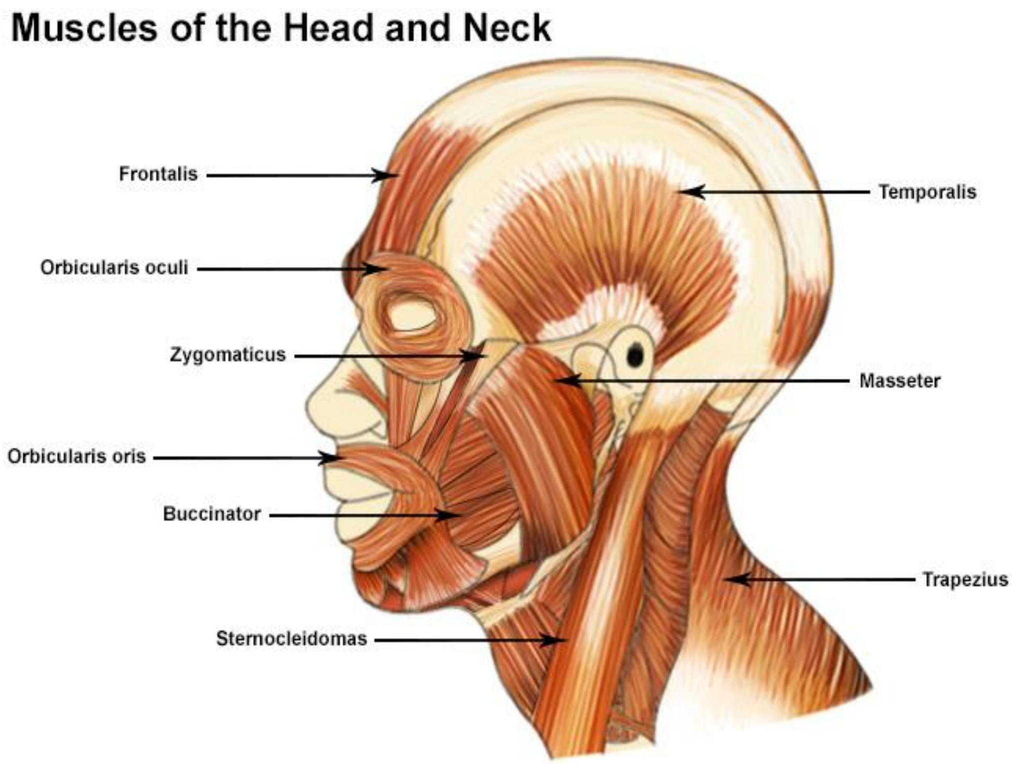
Cardiac Muscle

Cardiac muscle, found in the walls of the heart, is also under control of the autonomic nervous system. The contraction of cardiac muscle is involuntary, strong, and rhythmical.

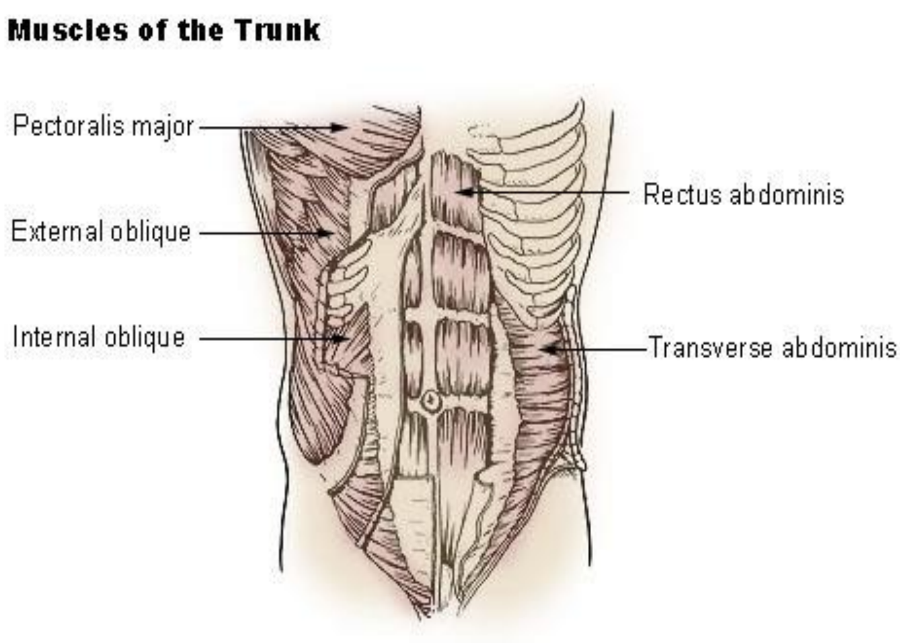
Muscle Groups

Four major muscle groups of the body include:

- Muscles of the head and neck



- Muscles of the trunk



- Muscles of the upper extremity

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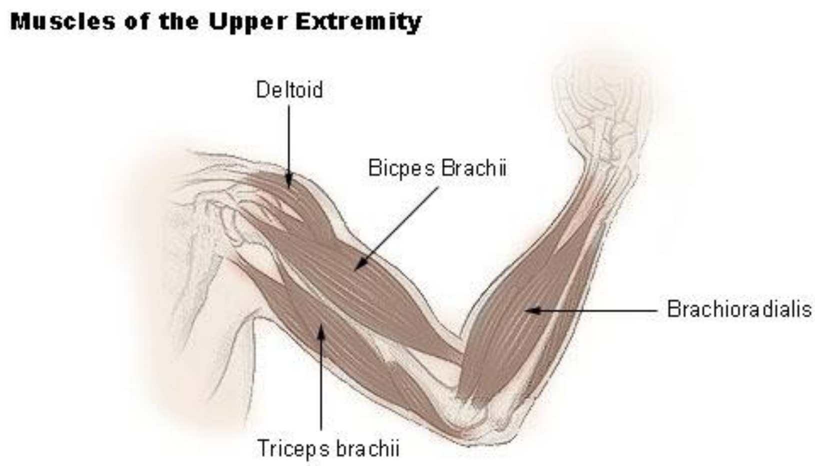
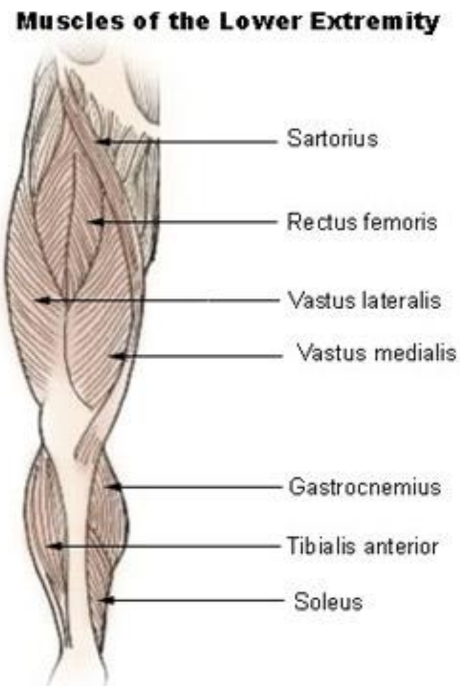


- Muscles of the lower extremity



There are more than 600 muscles in the body, which together account for about 40 percent of a person's weight. The following are some terms relating to muscle features that are used in naming muscles.

- Size
- Shape
- Direction of fibers

- Location
- Number of origins
- Origin and insertion
- Action

Ergonomics and the Musculoskeletal System:

Musculoskeletal disorders (MSD) are injuries or disorders of the muscles, nerves, tendons, joints, cartilage, and spinal discs. Work-related musculoskeletal disorders (WMSD) are conditions in which:

1. The work environment and performance of work contribute significantly to the condition; and/or
2. The condition is made worse or persists longer due to work conditions

Musculoskeletal disorders (MSDs) affect the muscles, nerves, blood vessels, ligaments and tendons. Workers in many different industries and occupations can be exposed to risk factors at work, such as lifting heavy items, bending, reaching overhead, pushing and pulling heavy loads, working in awkward body postures and performing the same or similar tasks repetitively. Exposure to these known risk factors for MSDs increases a worker's risk of injury.

When a worker is exposed to MSD risk factors, they begin to fatigue. When fatigue outruns their body's recovery system, they develop a musculoskeletal imbalance. Over time, as fatigue continues to outrun recovery and the musculoskeletal imbalance persists, a musculoskeletal disorder develops.

These risk factors can be broken up into two categories: work-related (ergonomic) risk factors and individual-related risk factors.

Ergonomic Risk Factor: When a worker is asked to do work that is outside his body's capabilities and limitations, he is being asked to put his musculoskeletal system at risk. In these situations, an objective evaluation of the workstation design tells us the worker's recovery system will not be able to keep up with the fatigue that will be caused by performing the job. The evaluation will tell us that ergonomic risk factors are present, the worker is at risk of developing a musculoskeletal imbalance and a musculoskeletal disorder is an imminent reality.

There are three primary ergonomic risk factors.

- **High task repetition.** Many work tasks and cycles are repetitive in nature, and are frequently controlled by hourly or daily production targets and work processes. High task repetition, when combined with other risks factors such high force and/or awkward postures, can contribute to the formation of MSD. A job is considered highly repetitive if the cycle time is 30 seconds or less.

- **Forceful exertions.** Many work tasks require high force loads on the human body. Muscle effort increases in response to high force requirements, increasing associated fatigue which can lead to MSD.

- **Repetitive or sustained awkward postures.** Awkward postures place excessive force on joints and overload the muscles and tendons around the effected joint. Joints of the body are most efficient when they operate closest to the mid-range motion of the joint. Risk of MSD is increased when joints are worked outside of this mid-range repetitively or for sustained periods of time without adequate recovery time.

Exposure to these workplace risk factors puts workers at a higher level of MSD risk. It's common sense: high task repetition, forceful exertions and repetitive/sustained awkward postures fatigue the worker's body beyond their ability to recover, leading to a musculoskeletal imbalance and eventually an MSD.

Individual - related Risk Factors

Human beings are multi-dimensional. Limiting ourselves to a singular cause of MSDs will limit our ability to create a prevention strategy that addresses the multi-dimensional worker.

Individual risk factors include:

- **Poor work practices.** Workers who use poor work practices, body mechanics and lifting techniques are introducing unnecessary risk factors that can contribute to MSDs. These poor practices create unnecessary stress on their bodies that increases fatigue and decreases their body's ability to properly recover.

- **Poor overall health habits.** Workers who smoke, drink excessively, are obese, or exhibit numerous other poor health habits are putting themselves at risk for not only musculoskeletal disorders, but also for other chronic diseases that will shorten their life and health span.

- **Poor rest and recovery.** MSDs develop when fatigue outruns the workers recovery system, causing a musculoskeletal imbalance. Workers who do not get adequate rest and recovery put themselves at higher risk.

- **Poor nutrition, fitness and hydration.** For a country as developed as the United States, an alarming number of people are malnourished, dehydrated and at such a poor level of physical fitness that climbing one flight of stairs puts many people out of breath. Workers who do not take care of their bodies are putting themselves at a higher risk of developing musculoskeletal and chronic health problems.

Exposure to these individual risk factors puts workers at a higher level of MSD risk. Just like workplace risk factors, individual risk factors are common sense: when a worker uses poor work practice, has bad health habits, doesn't get adequate rest and recovery and doesn't take care of their bodies with a good nutrition and fitness regimen, they are at greater risk for fatigue to outrun their recovery system. Having a poor overall health profile puts them at greater risk of developing a musculoskeletal imbalance and eventually an MSD.

Work-related MSDs can be prevented. Ergonomics --- fitting a job to a person --- helps lessen muscle fatigue, increases productivity and reduces the number and severity of work-related MSDs.

Ergonomics is the science of fitting workplace conditions and job demands to the capability of the working population. The goal of ergonomics is to reduce stress and eliminate injuries and disorders associated with the overuse of muscles, bad posture, and repeated tasks. A workplace ergonomics program can aim to prevent or control injuries and illnesses by eliminating or reducing worker exposure to WMSD risk factors using engineering and administrative controls. PPE is also used in some instances but it is the least effective workplace control to address ergonomic hazards. Risk factors include awkward postures, repetition, material handling, force, mechanical compression, vibration, temperature extremes, glare, inadequate lighting, and duration of exposure. For example, employees who spend many hours at a workstation may develop ergonomic-related problems resulting in musculoskeletal disorders (MSDs).

Implementing an ergonomic process is effective in reducing the risk of developing MSDs in high-risk industries as diverse as construction, food processing, firefighting, office jobs, healthcare, transportation and warehousing. The following are important elements of an ergonomic process:

- **Provide Management Support** - A strong commitment by management is critical to the overall success of an ergonomic process. Management should define clear goals and objectives for the ergonomic process, discuss them with their workers, assign responsibilities to designated staff members, and communicate clearly with the workforce.

- **Involve Workers** - A participatory ergonomic approach, where workers are directly involved in worksite assessments, solution development and implementation is the essence of a successful ergonomic process. Workers can:
  - Identify and provide important information about hazards in their workplaces.
  - Assist in the ergonomic process by voicing their concerns and suggestions for reducing exposure to risk factors and by evaluating the changes made as a result of an ergonomic assessment.
- **Provide Training** - Training is an important element in the ergonomic process. It ensures that workers are aware of ergonomics and its benefits, become informed about ergonomics related concerns in the workplace, and understand the importance of reporting early symptoms of MSDs.

- **Identify Problems** - An important step in the ergonomic process is to identify and assess ergonomic problems in the workplace before they result in MSDs.
- **Encourage Early Reporting of MSD Symptoms** - Early reporting can accelerate the job assessment and improvement process, helping to prevent or reduce the progression of symptoms, the development of serious injuries, and subsequent lost-time claims.
- **Implement Solutions to Control Hazards** - There are many possible solutions that can be implemented to reduce, control or eliminate workplace MSDs.
- **Evaluate Progress** - Established evaluation and corrective action procedures are required to periodically assess the effectiveness of the ergonomic process and to ensure its continuous improvement and long-term success. As an ergonomic process is first developing, assessments should include determining whether goals set for the ergonomic process have been met and determining the success of the implemented ergonomic solutions.

Costs of Back Injuries

Injuries to the back are one of the most prevalent and costly work-related musculoskeletal disorders in workplaces worldwide. Lower back pain has a significant effect on productivity and healthcare costs in the workplace. This includes both direct medical and disability claims, as well as indirect effects on the overall productivity of the organization. The direct costs of back pain include workers compensation claims made by employers and the amount of money spent on healthcare to heal the lower back pain to the extent that it can be healed. Back pain is a significant contributor to the rising costs of healthcare. And because lower back pain often exists with other symptoms, such as depression and chronic fatigue it means back pain sufferers are among the most expensive patients. Healthcare costs for people with back pain are on average 60 percent higher than for those without back pain

The productivity costs of back pain

Although the medical costs of back pain are significant, costs to lost productivity are even greater. Indirect costs are in terms of:

- **Absenteeism** - When employees do not attend work because of illness, there can be significant costs in lost wages and lost productivity. Workers with back pain are absent an average of 4 days more each year than those without back pain. This amounts to a total cost in lost productivity of $13,100 per 100 workers annually.1
- **Presenteeism** - Negative effects on productivity are not just limited to employees being absent from work. Presenteeism, or the act of attending work while sick, can be nearly as costly to business as absenteeism. When employees are distracted by discomfort, they are much less likely to be focused on the work at hand.

- **Secondary costs of poor health -** Poor health, whether caused by back pain or other illness, can have a range of other negative effects. It could lead to reduced satisfaction with the employer, increasing turnover rate, reducing creativity and new ideas in the workplace, and reducing the effectiveness of customer service. There is a statistically significant correlation between health and job satisfaction.
- Lost Productivity
- **More jobs to fill:** New employs need to be recruited for the smooth work of the organization replacing the injured employess of employees with muscoskeletal disorders. For employers, the costs of injuries to staff include not only additional salary expenses for replacement staff but also other costs including:
  - Providing induction training for new staff (and temporary replacement staff)
  - Paying overtime to other staff to cover for injured staff
  - Costs related to increased staff turnover
  - Cost of injury investigation, recording details of the injury and notifying ACC, absenteeism and sick leave days (which are not covered by ACC)
  - Difficulties for employees returning to work following injuries.
  - Replacement costs may include the costs of:
    - Advertising and recruitment
    - Loss of profits as key business tasks may be interrupted by staff shortages
    - Hiring (e.g. paperwork, background checks and moving and travel expenses)
    - Orientation and training for new staff
    - Termination for long-term staff who leave
    - Loss of organizational knowledge

By investing in well-designed bin lifting equipment, ergonomically designed man-machine systems employers can significantly reduce the risk of injury to their staff and can potentially save not only themselves, but the country many times the value of the initial machinery investment.