

Ergonomic Car Seating Principles and Evaluation

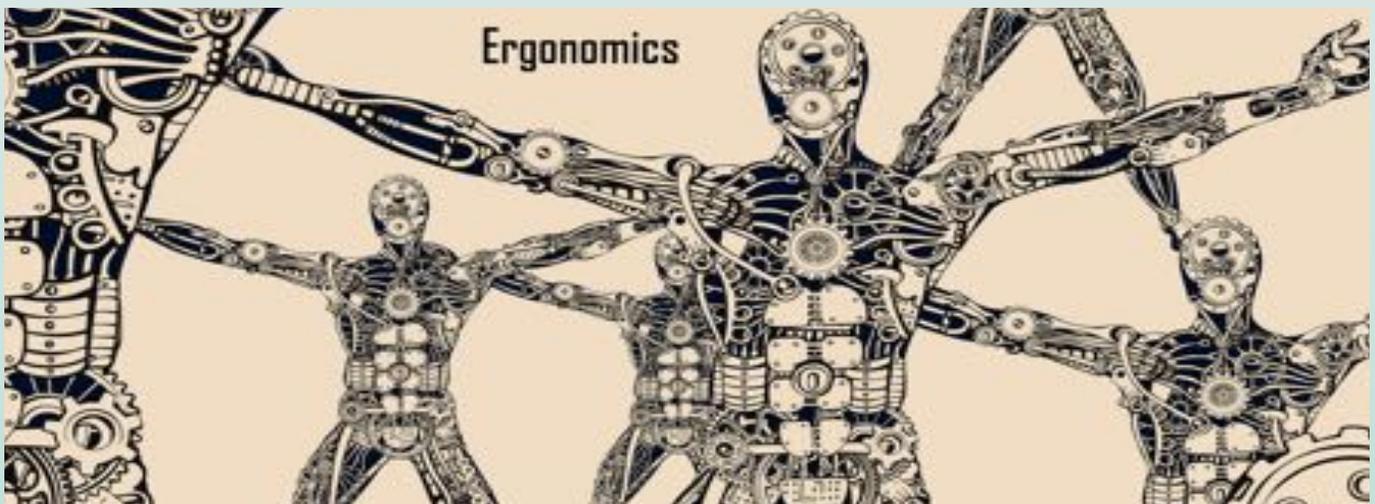
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Introduction to Ergonomics

The word ergonomics comes from two Greek words. Ergo meaning work and nomos meaning laws.¹ Ergonomics is a science which aims to improve safety and comfort for people as they use products.¹ Ergonomic design aims to make products which fit people and allow them to be more productive with whatever they are doing.¹ This science of ergonomics has been around for a long time and originated around about the time of World War I when people who operated machines were experiencing growing mental and physical demands.² Ergonomics may also be called human factors.²



Behind The Wheel



<http://topnews.in/usa/files/Vibrating-steering-wheel.jpg>

American drivers spend an average of more than 293 hours behind the wheel each year.³ That is equal to seven 40-hour weeks at the office.³ It is estimated that 50% of drivers have low back pain.⁴ Research shows that longer hours behind the wheel to can lead to a greater risk of back pain and other issues involving the joints, ligaments, muscles, nerves, and tendons.⁵ For example, many drivers report pain in the neck and shoulder.⁵ This is even more of a problem for people who work out of their vehicle or drive for a living.⁵⁵

The Impact of Sitting



Sitting in a moving car places different stress on the body than sitting in a non-moving seat, like at a work desk. When a person sits in a non moving chair, they can be supported by both feet flat on floor with their arms resting by their sides or on armrests. Driving requires people to move their arms and feet to operate the vehicle.

The Impact of Sitting

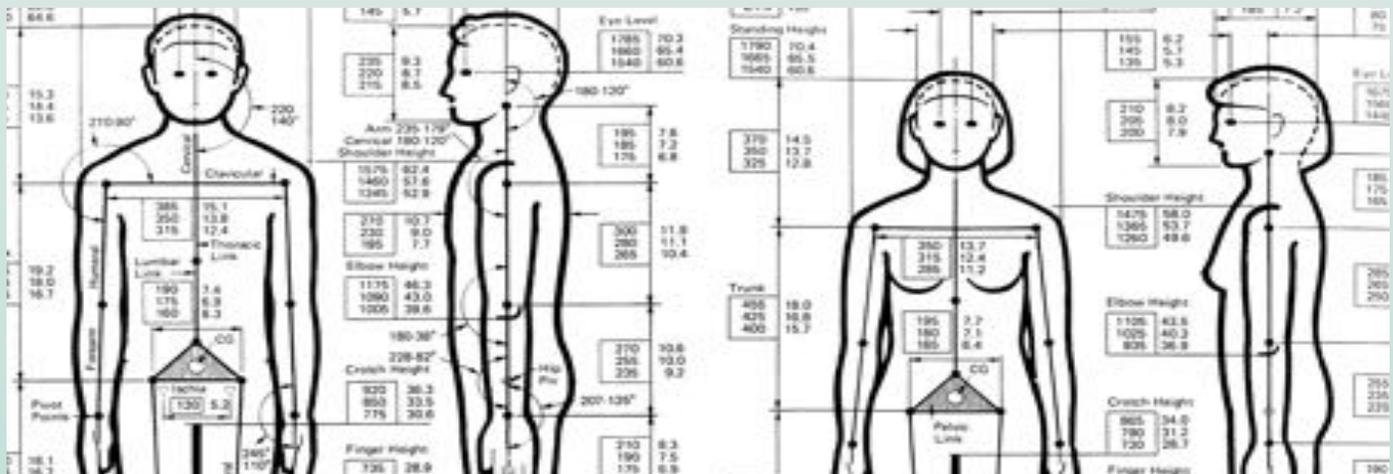
Drivers are usually unable to move around or change their posture as much as people sitting at a non moving work area. When sitting in a car, drivers experience the car speed up, slow down, and go around curves or turns.

Vibrations from the road and car travel into the body of the driver potentially causing back pain, muscle weakness and other negative symptoms over time.^{6,7} Longer time behind the wheel can lead to a greater risk for low back trouble than sitting and standing jobs or activities.⁸



Ergonomic Principles

Anthropometry is the science that seeks to measure the range of body sizes in a population.¹ The idea that the seat should fit the sitter is the main concept in seating ergonomics.⁹ Ergonomic design tries to create seats that fit the 5th percentile (small) female to the 95th percentile (large) male.^{1,9} Car seat manufacturers use this information to cater to the masses in a “one size fits all” approach. As Americans continue to get larger, ergonomic design struggles to keep pace.



https://brownstudio12.files.wordpress.com/2012/03/human_standard_1.jpg

Common Seating Position Issues

Joe Cool¹⁰

How to spot: Seat inclined, arm on window ledge/outside window, one hand on wheel.

Most common symptoms: arm and shoulder ache from resting on the window ledge.

Solutions: Sit more upright, with knees lower than hips. Make sure you can reach the accelerator and brake without stretching your legs. Keep both arms on the steering wheel.



Common Seating Positions

Rollercoaster Rider¹⁰

How to spot: Driver is leaned forward and sitting upright, seat forward, bent legs, bent arms.

Most common symptoms: Shoulder pain, neck strain, leg cramp and side ache.

Solutions: Try to relax if you are tense or nervous. Try to avoid stressful driving situations when possible. Try to sit back more into the seat to get better back support. Take breaks to get out of the car to stretch your legs.



Common Seating Positions

Street Racer ¹⁰

How to spot: Straight arms, seat reclined, straight legs, low driving position.

Most common symptoms: Side aches and back pain.

Solutions: Remember that low seat positions provide limited support to the lower back and sides. Sit in a more upright position. Knees should not be higher than your hips.



Correct Sitting Posture

“Correct” sitting posture while driving is still debated amongst ergonomic researchers and professionals. The comfort of a seat is hard to measure scientifically and differs from person to person. Because of this, it is important to find a seat that works for you and your body. The following step by step guide is a great place to start when trying to improve the ergonomics and comfort of your car seat. Before following these steps, it may be helpful to read the *vehicle manual* and understand all the adjustments that you can do.



Step-by-Step Seat Adjustments^{10,11}

Before you begin, remove items from your pockets (e.g., wallet or keys) and position items that you may need during your drive (e.g. sunglasses, water bottle).

Put the seat into the following initial setup position, where adjustable:

- Steering wheel fully up and fully forward.
- Seat height at its lowest.
- Cushion tilted so that front edge is in lowest position.
- Back rest approximately 30 degrees reclined from vertical.
- Lumbar adjustment backed off.
- Seat fully rearwards.



Step-by-Step Seat Adjustments^{10,11}

Seat height

Raise your seat as high as you can but still be comfortable so that you can see the road well. You should be able to see at least 3 inches over the top of the steering wheel.



Step-by-Step Seat Adjustments^{10,11}

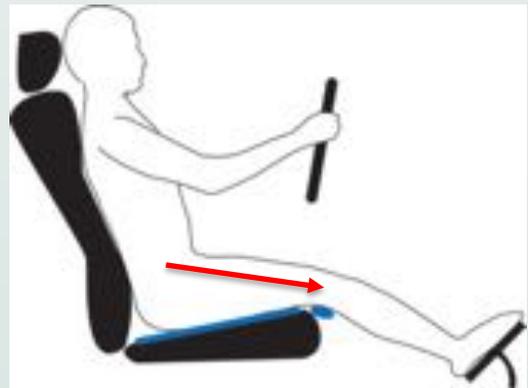
Seat forward/backwards position

Move the seat forwards until you can easily fully push down on the accelerator, brake and clutch pedals (if you have one).



Step-by-Step Seat Adjustments^{10,11}

Adjust cushion tilt angle so that your thighs are supported along the length of the cushion and there is no pressure behind your knees. The seat of your car should allow for your knees to be slightly lower than your hips.



http://www.posturemedic.com/images/seat_filt.jpg

Step-by-Step Seat Adjustments^{10,11}

Adjust the backrest so it provides continuous support along your entire back and is in contact up to shoulder height. If you are leaning too far back, you may end up bending your head and neck forward, which may cause muscle fatigue, neck or shoulder pain, etc.



Step-by-Step Seat Adjustments^{10,11}

Adjust the lumbar support to give even pressure along the length of the backrest from your hips to shoulder height. The lower part of your back should feel supported with no gaps or pressure points in the back support area.



Step-by-Step Seat Adjustments^{10,11}

Adjust the steering wheel rearwards and downwards for easy reach. Make sure there is enough room between the wheel and legs when using pedals. Change your hand postures on the wheel frequently to improve circulation and reduce fatigue.



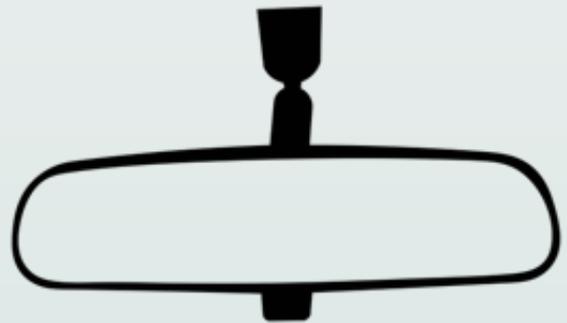
Step-by-Step Seat Adjustments^{10,11}

Adjust the head restraint (rest) to ensure the risk of injury is reduced in the event of a car accident. Raise the head rest until the top of it is level with top of your head. Adjust the angle of the head rest until it is almost touching the back of your head.



Step-by-Step Seat Adjustments^{10,11}

Adjust the rearview and side mirrors ensuring that they can be used without craning your neck to see.



Step-by-Step Seat Adjustments^{10,11}

Many vehicles will not allow you as much flexibility of driving posture as you would like. Some vehicles may cause you to adopt coping postures. For example, limited headroom (smaller car or taller people) forces a reclined posture, making it difficult to reach the steering wheel. This can cause drivers to bend their head and neck forward into a slouched posture.



<http://www.simplebackpain.com/images/3-driving-postures.jpg>

Replacement Car Seat Options

Often times, the original seat that comes in a new or used car may not be an ideal match for the driver. In this case, consumers may seek out more comfortable alternatives. Companies, such as JC Whitney, offer car seats (aftermarket and replacement) and car seat components so that consumers can modify and customize their seats for ideal comfort. Sparco, Recaro, Corbeau, and Greiner are independent manufacturers of car seats which claim to incorporate ergonomic design and promote spinal alignment.¹²⁻¹⁵ Visit the websites below to explore these options:

- **JC Whitney:** www.jcwhitney.com
- **Sparco:** www.sparcousa.com
- **Recaro:** www.recaro-automotive.com/us/home.html
- **Corbeau:** www.corbeau.com
- **Greiner:** <http://www.greiner-gmbh.de/en/home.html>

Replacement Car Seat Options

Companies such as Ride-Away and The Mobility Resource offer products like swivel seats, lift-up seats, and extended and lowered mobility seats which allow drivers with mobility limitations to get into and out of the car with little to no assistance.^{16,17} These options can be useful for individuals who have had surgeries such as joint replacements which can make it difficult to enter and exit their vehicles. Visit the following websites to learn more about these options:

- **Ride Away:** www.ride-away.com
- **The Mobility Resource, Adaptive Driving Marketplace:**
www.themobilityresource.com

Car Seat Modifications/ Accessories

Companies such as Back Designs Inc, and Relax the Back offer car seat supports (such as seat cushions and neck supports) which are designed to fit a wide range of anatomies and car seat types.^{18,19}

- Back Designs Inc.: www.backdesigns.com/
- Relax the Back: www.relaxtheback.com



ObusForme LB Low Back
Support, from Back
Designs Inc.



Highback Backrest
Support,
from Relax the Back

Car Seat Modifications/ Accessories

Ergonomic accessories such as the McKenzie® Lumbar Roll™ have been developed for use in any seat that does not provide adequate lumbar support.²⁰

Research shows that lumbar rolls can improve comfort in individuals with low back pain.²¹

Wedge seat cushions can help people maintain natural low back curvature when sitting.²²



McKenzie® Lumbar
Roll™



Wedge Seat Cushion

Car Seat Modifications/ Accessories

The United States Department of Agriculture Animal and Plant Health Inspection Service has an ergonomics program which recommends the following products:¹⁰

- McCarty's Sacro-Ease:
<http://www.mccartys.com>
- ObusForme Back Rest Supports:
http://www.obusforme.ca/obus_forme/sit/back-supports.html



Sacro-Ease

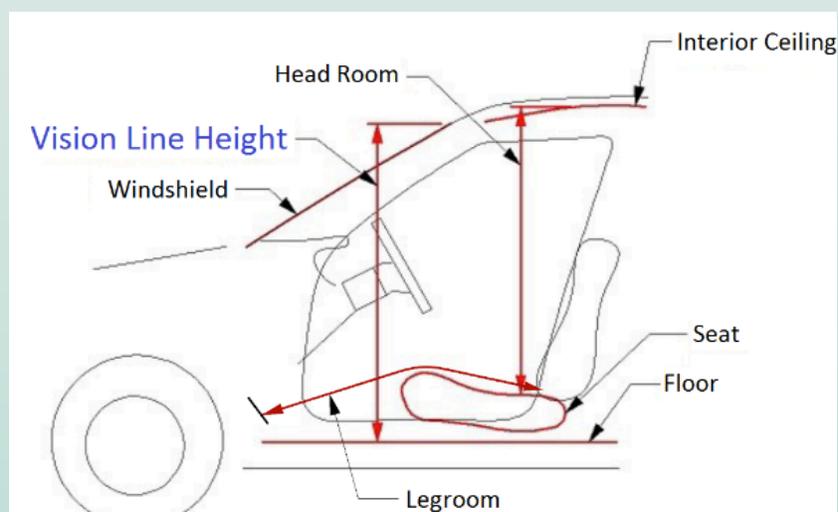


ObusForme

Car Seat Modifications/ Accessories

As the car itself can be hard to change, taller individuals can seek out resources such as Tall Life, which is a website that provides consumer reviewed information on how individuals can adapt their ergonomics to better suit their stature.²³ Detailed descriptions are provided for raised rear-view mirrors, extra tall car seats, car seat rail extensions, Fresnel lenses to assist in seeing traffic lights, cars with the most legroom, and seat modifications to get more headroom.

- **Tall Life:** <https://tall.life/cat/ergonomics/cars/>



Recommendations

Since every driver has unique dimensions, comfort preferences, and seating needs, blanket recommendations cannot be made for drivers in search of improving their driving comfort and ergonomics. However, recommendations can be made about how to find options that work best for individuals. The Kelley Blue Book website provides expert reviews on a variety of car related subjects, including seating comfort.²⁴ For example, in May of 2016 Kelley Blue Book published an article outlining what it found to be the 10 most comfortable cars under \$30,000.²⁵

- Kelley Blue Book: www.kbb.com

Recommendations

Consumer Reports is an independent, non profit organization which claims to provide “evidence-based product testing and ratings, rigorous research, hard-hitting investigative journalism, public education, and steadfast policy action on behalf of consumers’ interests”.²⁶ This organization publishes information related to vehicle comfort, amongst other topics.²⁶

- Consumer Reports:
www.consumerreports.org/cro/index.htm

Recommendations

Car manufacturers provide car model brochures which include information such as seat dimension specifications and seat adjustability options. These brochures are typically available on car company websites. The next 2 pages contain a checklist which was adapted from Loughborough University's Driving Ergonomics page.²⁷ Individuals can use the checklist to evaluate car seat adjustment components for new, used, aftermarket, or replacement car seats.

Recommendations²⁷

The seat

- Does the driver's seat have independent tilt adjustment?
- Does the driver's seat have independent height adjustment?
- Are the seat adjustment controls easy to use? When you have adjusted your seat are you able to reach the pedals without stretching?
- Does the back rest reach your shoulders? Does the back rest provide support along the length of your back?
- Is your lumbar curve supported without any points of pressure or gaps?
- Do you have enough leg and head room? Does the seat length put pressure on the back of your knees or calves?

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Recommendations²⁷

- Is the head restraint positioned close to your head?
- Is the head restraint height near the top of your head?
- Are you able to get in and out of the car easily?

The steering wheel

- Is the steering wheel centrally located?
- Does the steering wheel have the following adjustment features:
 - In/out?
 - Up/down?
 - Tilt ?
- Do you have full view of the display panel?

The pedals

- Are the pedals centrally positioned?
- Is there a left foot rest?
- Is there plenty of room for you to rest your left foot?

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