

STUDY SUMMARY

Choosing a Chair Based on Fit, Comfort and Adjustable Features 2.1

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Summary

Research is beginning to prove what ergonomists have long suspected, that supporting workers in high performance chairs positively affects comfort and productivity. This outcome is achieved through a process of thoughtful product design, careful evaluation by clients and proper use by informed workers.

Maximizing comfort and support will be accomplished only when all stakeholders have been actively involved in providing, choosing and adjusting the right chair.

- Chair features must adjust to fit a high percentage of users and their personal preferences.
- Workers need to change postures throughout the day in order to remain comfortable.
- There is a basic set of adjustments that ensures a good fit and encourages posture changes necessary to reduce back and leg discomfort.
- A secondary set of features or adjustments improve the chair's ability to maintain comfort of the back, neck, shoulder, and upper arm.
- The ideal chair design should encourage and support the small, unconscious posture changes that reduce the onset of muscle fatigue and discomfort.

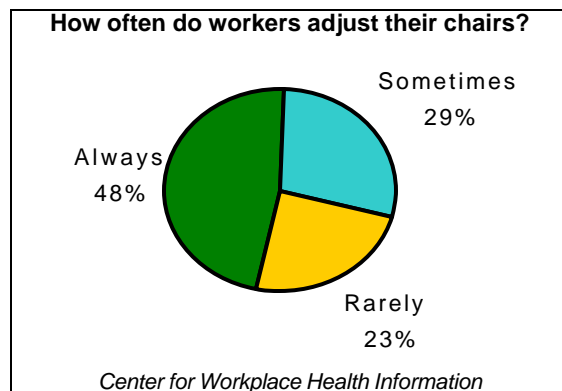
The Evolution of Adjustable Seating

During the last fifteen years, designers of seating have become more aware of the physical needs of the human body, user expectations and how office workers adjust their chairs. A recent study completed by Ben Amick, a researcher with the University of Texas Health Science Center at Houston, shows that computer worker productivity, as well as comfort, is increased when they are seated in high performance chairs and are taught proper ergonomic practices¹.

The sure path to sustained comfort and performance requires that workers adjust their chairs to fit individual physical needs, and re-adjust them to support changing tasks throughout the workday. Unfortunately, providing adjustable chair features that enable a good fit for each worker is wasted if workers don't take advantage of this flexibility. Making adjustments is essential because many workers share chairs, or they change tasks frequently, requiring an adjustment in seated posture. Additionally, demographic trends confirm the need to provide adjustable seating as the diversity of the workforce increases.

The results (see diagram) of the survey conducted by the Center for Workplace Health

Information show frequency of chair adjustments.



The principal reason people don't adjust their chairs is because they don't know how, or even why they should. But the proper fit between worker and chair can reduce the incidence of back pain and other musculoskeletal disorders, especially for workers involved in long-term, task-intensive work. The good news is that some chair manufacturers have answered client requests that adjustment controls become easier to find and use. Some have even developed chairs that automatically change for users based on individual needs or tasks. The design of chair controls can guide users to adjustable features and strengthen the behavior of using chair controls to obtain optimum support.

When to consider high performance seating

Workers who sit for four or more hours performing a single dedicated task need additional adjustments compared to workers who sit for only two or three hours a day in their workstation.

Alexander Magora², a researcher who examined the causes of back discomfort, looked at the correlation between back pain and the amount of time workers spend sitting or standing. He found that workers who could alternate between sitting and standing had the lowest incidence of back pain. Only 3.5% of people who held jobs with two to four hours of sitting per day reported back pain, compared to 42% of those who sat for more than four hours. Did sitting too long bring on discomfort? Or was it poor seating design, faulty chair fit, poor sitting habits, or a combination of these factors?

If workers can't (or won't) change their work processes to allow themselves to stand or move around more often, what can they do to prevent back pain and other related musculoskeletal distress? Research provides convincing evidence that workers who sit for hours on the job require not just comfort and support, but the ability to change position regularly.

Adjusting for comfort

In a study examining the relationship between comfort and back posture, Margarita Vergara found that low-back pain has a large impact on determining general comfort³. Avoiding back pain will help workers stay focused and more productive.

Designing comfortable office seating requires a basic understanding of how to support the user, coupled with knowledge of how the chair will be used. The trend continues that people are sitting for longer periods during the workday, and will need to make posture changes in order to maintain comfort. A number of studies support this.

- M. Graf found that 20 to 30 posture changes per hour are typical while seated. The study also demonstrated that people who changed posture most frequently had fewer complaints about discomfort⁴.

- Margarita Vergara found that when seated individuals rest against on their backrest they tend to make small movements of the pelvis and lumbar portion of the spine³.
- Steve Reinecke and Roland Hazard demonstrated the positive effect of small pelvic movements around a posture to reduce muscular strain and increase low-back range of motion⁵.

Thoughtful chair design permits, and even encourages, frequent changes in posture. The shape and flexibility of the seat and backrest, along with mechanisms that control reclining, should not restrict movement. The feeling of comfort should not only be immediate, but persist over the workday⁶. Designing chairs that provide maximum short-term comfort may actually penalize long-term comfort. For example, the deep upholstery and restrictive arm placement of a typical easy chair may feel comfortable at first, but the feeling soon disappears as the user becomes more and more confined.

Research has established that people frequently modify postures in an effort to shift muscle loading and prevent the onset of fatigue and discomfort⁷. Vergara determined that small posture modifications are especially beneficial in the back³. Many of these small spine movements occur without the sitter realizing he or she made a change. Vergara also noted that unchanging back postures with a forward leaning pelvis are the principle cause of increased lumbar discomfort. In a long-term study, Ben Amick found that computer workers who used highly adjustable chairs with flexible low back support, who also received ergonomics training, experienced a reduction in back pain as well as reduced neck and shoulder pain¹.

Seating Standards

Chairs are typically designed to meet a wide range of users, usually the 5th percentile female to the 95th percentile male. Dimensions relevant to office chairs can be found in two guidelines, the BSR/HFES 100 (Draft Standard) Human Factors Engineering of Computer Workstations, and the BIFMA G1-2002 Ergonomic Guidelines for VDT Furniture Used in Office Work Spaces.

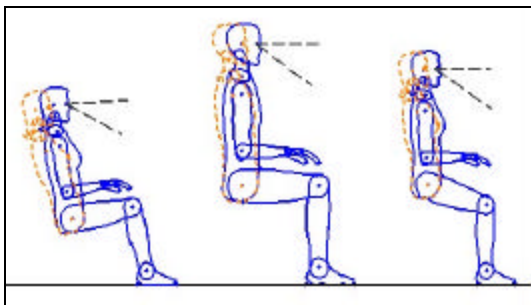
There are two important lessons here for people who select and use workplace seating. Chairs should have obvious adjustments that users can easily understand and control. This encourages workers to set chair adjustments correctly and change posture when early feelings of discomfort arise. The ideal chair design should encourage and support the small, unconscious posture changes known to reduce the onset of muscle fatigue and discomfort.

How we sit

Different tasks require different postures. For example, computer work is usually done while seated. Filing and photocopying are standing jobs. Historically, core tasks were split between sitting and standing, allowing workers to change postures⁸. This work style is recommended to help prevent back discomfort, but in today's computer-based work setting, there are fewer and fewer tasks that require standing, and more time is spent sitting.

There are four recommended postures that computer workers adopt. Three are seated, and the fourth is standing. Today's highly adjustable chairs can be configured to support all three seated positions (see diagram):

1. Reclined, knees level with or slightly higher than hips.
2. Sitting upright, knees level with hips.
3. Sitting upright, knees lower than hips.



In all three seated positions, people prefer backrest support⁹, yet it's common to see people leaning forward, away from the backrest and into their work, which is not recommended. Unsupported upright or forward leaning postures flatten the lumbar curve¹⁰, increase pressure within the spinal discs, and greatly increase muscle activity in the lower back¹¹. These unsupported postures also correlate with a high incidence of neck and upper back discomfort in computer users¹². Vergara

suggests that the use of a backrest prevents an increase in lumbar pain³.

Basic support and comfort

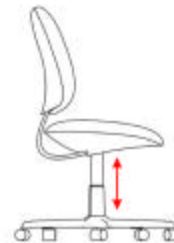
When selecting or comparing chairs, remember that of all the different styles, features, and adjustments available, three things are central for users to achieve proper support:

- Adjusted chair height must allow the user to keep both feet flat on the floor or on a footrest.
- The user should be able to sit in contact with the backrest at all times.
- The backrest must support the chosen posture with even pressure on the lower and upper back.

In addition, chair controls that are operable while seated should provide immediate feedback to help the user adjust the chair quickly and correctly. Adjustment controls that require the user to get out of the chair make it difficult to fine-tune any adjustment and reduce the likelihood that the user will engage the control frequently.

There are three fundamental features to look for in desk seating – seat height, seat depth, and tilt tension.

1. Seat height



The proper seat height allows the user to place both feet squarely on the floor or a footrest. When the seat is too high, the user tends to lean forward and forgo back support in order to get the feet on the floor. When the seat is too low, weight is shifted to the buttocks, ultimately resulting in sore sitting bones¹³. Chairs with a larger seat height adjustment range allow a greater number of people to sit comfortably.

The seat pan should not compress the leg behind the knees while the user leans back. If the front edge of the seat pan moves significantly upward while reclining, pressure is uncomfortably

increased behind the knees. It's essentially the same as having the seat height set too high.

2. Seat pan depth



To get the full benefit from the lumbar support, the user must be able to contact the backrest without feeling pressure behind the knees. That means the seat pan must be short enough to allow full contact with the backrest. Conversely, if the seat pan is too short the legs overhang the front edge causing pressure in the mid-thigh area.

3. Tilt tension

Tilt tension is probably the most beneficial, yet under-utilized posture enhancing adjustment. In some cases, people will not use the chair's backrest at all because they never increase the tilt tension enough to support them in any position, even fully upright. In order to support user preference, the tilt tension control should be easily accessible and require a minimal number of turns to adjust from high backrest force to low force.

The correct tilt tension varies from person to person depending on height, weight, and preferred support¹⁴. When properly adjusted, the backrest force should be just high enough that the user can easily rock into any reclined angle and balance there. If the chair does not allow the user to relax while reclined, the small posture changes that slow the onset of fatigue will not occur

Because the tilt tension adjustment has historically been hard to find, activate, and set properly, some manufacturers have designed mechanisms that adjust automatically for the user. Designing a self-adjusting tilt tension mechanism that performs well for all sizes of people is complicated. When assessing the comfort and functionality of a chair with self-adjusting tilt tension, make sure to have a wide variety of users test the chair, especially short and slender, and tall and broad shouldered users.

Advanced features

For long-term, task intensive use, advanced features enhance the ability to custom-fit the chair to each user's physical requirements and personal preferences. Advanced adjustments and features distinguish high performance chairs from general office seating.

There are five additional features to consider for users who sit for long periods each day – lumbar support, adjustable armrests, seat pan angle, backrest height and angle, and a headrest. Providing these adjustments will reduce back and shoulder pain and help workers stay focused on their job.

1. Lumbar support

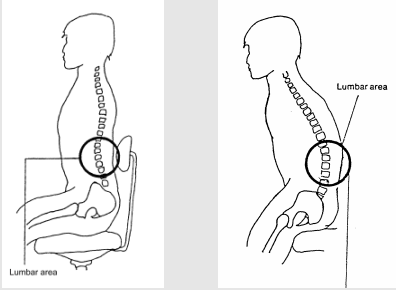


Good lumbar support can be the single most important element in defining chair comfort³. According to research by Gunnar Andersson, the lumbar support should fall somewhere between 6 and 10" from the seat pan¹⁵. Different people prefer different locations for lumbar support. When able to adjust the lumbar support, some prefer their support high, and others like it low. Additionally, Wachslar and Learner report that seat comfort ratings are heavily influenced by back and buttock support¹⁶.

Field research conducted in 1999 assessed a flexible lower backrest designed to conform to the shape of the users back. Results imply that, depending on design, a backrest can be supportive and comfortable without a user adjustable lumbar pad¹⁷.

Some backrests tend to pull the lumbar support up or away from the person when reclining, so proper support is not maintained. Look for a chair design that holds the lumbar support in the same relative position when fully reclined and upright.

Lordosis vs. kyphosis



Lordotic curve

Kyphotic curve

When standing, the lumbar section of the spine naturally curves inward. This is referred to as lumbar lordosis. When this natural curve is flattened or bent outward it is referred to as kyphosis.¹⁰

- A lordotic curve distributes pressure evenly on the discs.
- A kyphotic curve distributes pressure unevenly on the discs¹⁸.

Some researchers believe sitting with the spine in chronic kyphosis weakens the ligaments and muscles that hold the spine erect¹⁹. Unsupported sitting reduces lordosis and increases pressure within discs and also increases back muscle activity. A well-designed lumbar support can help restore lordosis¹⁶. Reclining on such a backrest will actually reduce disc pressure as well as lower back muscle activity.

Another way to encourage lordosis involves providing support in the sacral (tailbone) region of the back. Placing the lumbar pad about 6" off the seat pan stops the pelvis from rotating completely backwards during sitting. Blocking the pelvis in this manner naturally keeps the spine in lordosis²⁰.

triggered by lack of support for the arms while keyboarding and using the mouse.

Height, width and pivot adjustments improve the ability to properly adjust the arm cap so that computer users can work with their arms close to their torso and get support for the elbows and forearms. These adjustments also ensure that a computer user can support his or her arm even if they have to reach for the mouse.

Benefits of Adjustable Armrests

Armrests relieve loads on the neck, shoulders and arms .

- When the forearms of computer operators are supported, there is a lower incidence of neck and shoulder discomfort, A. Aaras²³
- Supporting the arms while keyboarding significantly reduces muscle activity in the upper back, Y. Feng²⁴
- Positioning armrests under the forearms enhances keying posture and allows free movement of the hands and wrists, S. Horie²⁵
- Armrests may help computer users type more lightly, M. Rose²⁶
- Seated posture improves when large forearm/wrist supports are used by computer operators, M. Nakaseko²⁷

If nonadjustable armrests are provided, make sure that users can get close enough to the worksurface to perform their tasks. Consider discontinuing armrest use if:

- The user's arms are put into an awkward position
- Shoulders are noticeably hunched
- User leans heavily to one side

2. Adjustable armrests

A recent study by Fred Gerr and colleagues found that 58% of computer workers reported neck and shoulder symptoms during a one-year period²¹. In a related study, Michelle Marcus and colleagues found that computer workers who used chairs equipped with armrests reported significantly less neck and shoulder pain and disorders²². One probable cause of shoulder pain is muscle fatigue

3. Seat pan angle



Adjusting the seat pan angle is another way for task intensive computer workers to change posture. Research shows that the best weight distribution occurs on a rearward sloping seat²⁸. Angling the seat pan forward and getting the hips higher than the knees is also beneficial because it opens the trunk angle. Seats that automatically change angle as the user moves promote posture change even further.

Extensive user observation has shown that computer workers often do not angle their seat forward, mainly because in many chairs the user slides forward on the seat. Seat pan shape or seat angle adjustment can be designed to allow the knees to drop lower than the hips without the user sliding forward. When selecting a chair, consider looking for this more advanced design, which allows a beneficial posture change and mitigates the usual increase in low back and hip muscle activity in this position.

4. Backrest height and angle



People who prefer to lean back in their chair while working should have a backrest that reaches the shoulder blades (at least 20" high). High backrests provide upper back support and also help stabilize the neck and head in the fully reclined position. High backrests have been found to relieve static muscle loads on the abdomen and back during prolonged office work¹³.

Maintaining a slightly reclined position helps keep the lower back in a recommended posture. Also the backrest will carry more upper body

weight, helping to reduce muscle load and intradisc pressure¹⁹. Leaning back in the chair is an excellent way for users to rest back muscles while working.

Good chair designs limit the amount of head and hand travel as the user reclines, maintaining proper distance from the computer display and keyboard. This allows workers to recline and continue working without having to readjust their work tools. When evaluating a chair, check that the user's head and hands do not move too far away from the screen and keyboard in the reclined position.

5. Headrest

This feature is often offered as an option on high performance seating. A well-designed headrest provides additional support for the upper body while in an upright or reclined posture. It can also help position the head while viewing the computer display. Look for a padded headrest adjustable for both height and depth that supports the neck or base of the head.

Making the grade

The best way to assess a chair is to have a wide range of people use it during a typical workday. Initial comfort is nice but it's more important to determine how long workers remain comfortable while using a chair. Pay particular attention to how the assess sors feel at the end of the work day. Was everyone able to fit the chair to his or her personal needs and set of tasks? And finally, make an objective evaluation of the adjustments and features available on the chair. Were they able to keep workers comfortable and productive all day?

As you evaluate office solutions, remember that a supportive and adjustable chair is one key factor in determining worker effectiveness. Although a high performance chair can be considered the foundation of worker comfort and productivity, it is important to keep in mind that the chair is one element of a larger work setting. While evaluating the performance of seating, also take time to evaluate how well the remainder of the work environment supports computer workers.

What to avoid

- Sitting all day.
- Sitting without changing posture.
- Leaning forward away from the backrest for more than a few minutes.
- Sustained tipping the head back without support.

What to encourage

- Stand up periodically. Better yet, stand up and perform a task other than computer work at least once an hour.
- Make sure workers know how and why to adjust their seating. Most user guides are removed by installation crews and cleaning personnel before the user has a chance to read them. Keep extra copies on hand. If instructional videos are available from the office furniture dealer or manufacturer, let employees know how they can view the videos.
- Consider high performance seating for conference rooms where meetings are likely to last over two hours.
- For some people standing is difficult. Provide seating in areas where people need to wait for more than 5 minutes.

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