

International Encyclopedia of Rehabilitation

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This publication of the Center for International Rehabilitation Research Information and Exchange is supported by funds received from the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education under grant number H133A050008. The opinions contained in this publication are those of the authors and do not necessarily reflect those of CIRRIE or the Department of Education.

Posture, the lumbar spine and back pain

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Introduction

The definition of posture can be rather vague. A classic ergonomic text book discusses aspects of posture at great length without actually defining it (Pheasant 1998). A more recent ergonomic textbook is slightly more explicit: 'posture is defined as the average orientation of the body parts over time.' (Bridger 2003). An undergraduate textbook on human movement also keeps it simple: 'posture means simply position or alignment of body parts' (Trew and Everett 2001). A dictionary defines it as 'the way one holds one's body while standing, sitting or walking', or 'a particular position or attitude of the body' (Chambers Concise Dictionary 2004).

Probably a more useful reflection of aspects of posture are the dimensions considered relevant in analysing static workloads (Corlett 2005):

- Angular relations between body parts
- Distribution of mass of body parts
- Forces exerted on environment during posture
- Length of time held in that posture
- Effects on individual who maintain that posture

Of these dimensions it is probably the last two that are of most interest, and will be the focus of this article. As we will see the length of time that a posture is held has a crucial connection with the effect of that posture, and makes the topic highly relevant to modern life as modern humans in the West spend long periods in relatively static postures.

All descriptions of posture imply that posture is an active process, rather than a static one. We may remain in relatively static postures for long periods during work, relaxation or sleep, but all of these activities are characterised by intermittent changes in posture. Periods of relatively static posture can be interrupted by periods of vigorous activity, for instance during running, working out at the gym, manual labour, or gardening. 'Posture cannot be separated from movement, but should be regarded as temporarily arrested movement as it is in a constant state of change, as anyone trying to stay still for any length of time will know' (Trew and Everett 2001).

Static postures tend to grow more fixed as we age, and our active postures decline. For instance, between childhood and 60s there is nearly a halving of sagittal and frontal plane movements of the lumbar spine (Twomey and Taylor 1994), and there is an age-related decline in participation in exercise, especially amongst women (O'Brien Cousins 1998). Aging can be associated with more fixed postures, such as

loss of lumbar extension and exaggerated cervico-thoracic kyphosis because of spondylotic changes or osteoporosis. Inflammatory joint pathologies, such as ankylosing spondylitis and rheumatoid arthritis, can produce dramatically reduced movement (Bland 1994).

Posture is thus a constant; something we are never free from; but also by its nature something that we rarely give conscious thought to. The exception to this is when different postures cause a change in a healthcare problem. It is known also that different postures affect physiological functions, and that postural possibilities may be affected by pathology. This article will focus on posture and lumbar spine pain; and specifically address these areas:

- Analysing posture
- Affect of posture of anatomy and physiology
- Normal posture
- 'Ideal postures'
- Affect of sustained postures
- Is there an optimal posture for sitting?
- Is sitting a risk factor for low back pain?
- Are certain sitting postures a risk factor for back pain?
- Do certain postures aggravate back pain when it is present?
- Are there postural variations in those with symptoms?

Analysing posture

There are numerous ways of analysing posture that are explored in detail in ergonomic text books (Pheasant 1998, Bridger 2003, Corlett 2005). These include direct observation, measurement with goniometers, video-computer analysis, subjective measures, such as onset and levels of discomfort from sustained postures and different types of electromyography (Corlett 2005). Obviously the different methods of observation capture different dimensions of the components of posture; some focusing on the angular relations between body parts, some on muscle work, and others on the effect of posture in terms of discomfort.

Affect of posture of anatomy and physiology

Different postures affect the spine in different ways. Bending and sitting is associated with flexion of the lumbar, thoracic and lower cervical spine, unless a very upright sitting posture is maintained, whereas walking and standing is associated with extension or lordosis of the lumbar spine (McKenzie and May 2003). Flexion of the hip and knee causes posterior tilting of the pelvis, which in turn produces a flattening of the lumbar lordosis (Bridger 2003). Thus crossing the legs flattens the lumbar spine. Forces on the spine result from the posture of the spine, muscle activity, and passive support, as from a chair (Adams et al. 2006). The angle of the sitting surface will have implications for the posture of the spine: a downward sloping surface encourages a lordotic posture; a flat seat encourages a flattening of the lordosis, and a very low seat, in which the knees are higher than the hips, encourages flexion of the lumbar spine (Bridger 2003).

Different postures alter muscle activity; during standing back muscles show slight, intermittent or no activity, with activity influenced by the position of the spine in

reference to the line of gravity (Bogduk 1997). The more off the centre of gravity the more contra-lateral muscle groups will need to work to maintain control. During sitting muscle activity is minimal so loads tend to be transferred to local soft tissues (McKenzie and May 2003).

Postures affect anatomy and physiology. With flexion of the lumbar spine the intervertebral disc is compressed anteriorly, which causes a posterior displacement of the nucleus pulposus, an increase in intra-discal pressure, there is even distribution of stress within the disc, and increased supply of metabolites to the disc. The spinal and vertebral canals are widened, the spinal cord is tensioned, and the load on the zygapophyseal joints is reduced with flexion. Opposite effects occur with extension, as well as reduced pressure on the nucleus pulposus (Adams et al. 2006). These are all normal anatomical changes to these different postures. Prolonged standing causes peripheral pooling of the blood, changes to heart rate and blood pressure, and cessation of the venous muscle pump, which returns blood to the heart (Bridger 2003).

Normal posture

There have been attempts to define types of body posture, but these are generally not useful as individuals have unique anthropometric and physiological profiles (Trew and Everett 2001). Individual variability during the day and inter-individual variability about what is considered 'normal' makes this impossible to define. For instance, sitting can range from upright sitting with lumbar support maintaining almost end-range lumbar extension to relaxed slump sitting on the sofa, which might be near end-range lumbar flexion.

'Ideal postures'

Ideal postures have been defined, mostly related to symmetry of body parts and equilibrium or balance between right and left and posterior and anterior (Trew and Everett 2001). However it is unclear if there are ideal body postures. Asymptomatic asymmetry is not unusual and if not dramatic is not linked to pain or functional limitations. Given the multiple effects of different postures on numerous structures, and the theoretical basis for determining what the 'ideal posture' is, not surprisingly there have been conflicting interpretations about this. Some authorities suggest that the lumbar spine should be slightly flexed when sitting (Adams et al. 2002); whereas others suggest that a more lordotic posture is best (Harrison et al. 1999; Pynt et al. 2001; 2008).

Affect of sustained postures

When soft tissues are exposed to sustained loading in a single direction without interruption further movement occurs. This slight movement, known as creep, results from rearrangement of collagen fibres and water being squeezed from the soft tissue. If the sustained loading is not excessive the soft tissues recover reasonably quickly. However excessive loading, with limited interruption and frequent repetition, despite the fact that these are normal loads can alter the mechanical properties of the soft tissues. Thus these tissues may become susceptible to fatigue failure, and the insidious development of musculoskeletal symptoms despite no obvious trauma (McKenzie and May 2003). Once static postures have induced discomfort the further growth of discomfort increases linearly with time held, and recovery can be slow (Corlett 2005).

It has been estimated that in Western countries 75% of work is now performed sitting (Pynt et al. 2008). Numerous contemporary office jobs require long hours of sustained sitting, which is a position of flexion. Numerous office workers and students sit on the way to and from work, spend most of their working day sitting, and then relax in the evening slumped on the sofa. For instance about 87% of Australians over 15 watch an average of more than 3 hours of television each day (Pynt et al. 2008). Thus activities of sustained flexion dominate many peoples' every-day lives.

Is there an optimal posture for sitting?

There is some debate about the optimal sitting posture. Some experts suggest that sitting in moderate flexed postures is preferable, whereas during walking a slight lordosis has certain advantages (Adams et al. 2006). However too much flexion is worse than a little; and prolonged flexion may compromise the ability of the muscles to protect the lumbar spine. Others have suggested that there are several disadvantages to sitting in flexion and that maintenance of lordosis is best when sitting (Harrison et al. 1999; Pynt et al. 2001; 2008).

A lot of this debate is based on the anatomical and physiological effects of different postures that are outlined above. Several studies suggest that sitting in more flexed postures for sustained periods is more likely to generate discomfort than extended postures (Knutsson et al. 1966; Mandal 1984; Harms-Ringdahl 1986; Eklund and Corlett 1987; Harms 1990; Wormersley and May 2006; Bakker et al. 2007; McGill and Fenwick 2009), though some of the earlier studies have weak study designs. Furthermore those who develop postural back ache sit in more flexion and for longer periods without interruption than those who do not develop this discomfort (Wormersley and May 2006). Ultimately it should be recognised that there may be no single ideal sitting or standing posture. It is clear that any posture maintained for any length of time without interruption will become uncomfortable and even painful. Despite disagreement about what is the optimal sitting position, several reviewers were clear and consistent about the recommendation for regular interruption from any sustained position, and the importance of intermittent postural adjustments (Pynt et al. 2001; Adams et al. 2006).

Is sustained or repeated posture related to musculoskeletal symptoms?

The NIOSH review (1997) concluded that there was strong evidence of posture as a risk factor for the development of musculoskeletal disorders in general and convincing evidence that repetition and force were risk factors. However a common problem encountered by the authors of systematic reviews was the lack of a clear link between mechanical exposure and causality (Winkel & Westgaard 2002, NIOSH 1997). The NIOSH review concluded that there was limited quantitative data about exposure-disorder relationships. The NIOSH (1997) definition of strong evidence was that a causal relationship was *likely*; in other words, there is only a probable, not a proven link. Furthermore this type of evidence was only found in studies involving intense prolonged daily exposure to that risk factor.

Is sitting a risk factor for low back pain?

The link between sustained sitting postures and back pain is uncertain. NIOSH (1997) reviewed the relationship between back pain and 5 physical workplace factors; they found evidence that awkward posture were associated with back pain, but insufficient evidence that there was any relationship between static work postures and back pain. Two subsequent reviews failed to find a link in the studies that they reviewed between sitting-while-at-work and posture in general and the presence of back pain (Hartvigsen et al. 2000; Lis et al. 2007). However, given the insidious rather than the traumatic nature of the majority of back pain, the amount of time many people spend sitting, and the problems of assessing risk factors for back pain it might be premature to accept these conclusions. There was an increased risk of back pain if sustained sitting was combined with whole body vibration (as when driving a tractor) and/or awkward working postures (Lis et al. 2007), and a single study found a link between sitting at work most of the day and back pain (Hoogendorn et al. 2000).

Are certain sitting postures a risk factor for back pain?

Two recent systematic reviews set out to explore if there was any relationship between spinal postures and health outcomes, including low back pain (Nachemson and Vingard 2000; Christensen and Hartvigsen 2008). They concluded that there was no strong evidence for any association between any particular spinal posture and spine pain. However the authors identify the weakness of that evidence. Furthermore it could be suggested that attempts to link certain postures with a history of spinal pain is a generalised rather than a specific way to address this question, as posture and pain are not being directly studied at the same time.

Do certain postures aggravate back pain when it is present?

There has not been a systematic review that has sought to identify the postures that people who have low back pain find aggravates or relieves their symptoms most commonly. Unsurprisingly, the evidence we do have indicates that there are individual and variable response to the same postures. In other words, a sustained posture, such as sitting, might make one person with back pain worse, but another one better. This can provide useful information about which sustained loading strategies are provocative or easing for an individual's back pain.

We reviewed 5 studies that had reported on aggravating and relieving factors in about 1,000 patients with back pain (McKenzie and May 2003). The most consistent findings were that positions of flexion (sitting, bending and driving) or sedentary activities, which probably implies flexion, were most commonly identified as aggravating factors; whilst postures of extension (walking and standing) were less commonly identified. Equally positions of flexion, such as sitting or bending were extremely rarely reported to relieve symptoms, whereas positions of extension or lying down commonly were.

Subsequent work has further implicated flexion activities as a problem to people with low back pain, and implicated flexion activities as more likely to be associated with back pain than extension activities (van Deursen et al. 1999; 2002; Pengel et al. 2004; Bakker et al. 2007).

Are there postural variations in those with symptoms?

The data reviewed above would suggest that a firm conclusion about the link between posture and back pain is unclear. A more subtle and relevant question is whether specific patients need specific posture for the improvement of their symptoms. There is evidence that certain postures are associated with direction specific exercises. Thus people with back pain who sit in more flexion make their back better with extension exercises; whereas those who sit with more lordosis respond to flexion exercises, and that their postures are different from asymptomatic controls (Dankaerts et al. 2006, 2009). There is growing evidence that the back pain population is not a homogeneous group, and postural variability, regarding aggravating and relieving postures may be a helpful way to explain some different subgroups.

Conclusions

Posture is a complex issue, the definition frequently vague, and multiple variables are relevant when considering the issue. Posture is with us all the time and is generally ignored, but we know it affects anatomy and physiology. The most important variables are probably related to sustained postures and the effect these might have on an individual. The evidence about its role in provoking musculoskeletal symptoms and as a risk factor for back pain is weak. However it is clear that specific postures, most commonly ones of flexion, commonly aggravate back pain when present. The inconclusiveness of previous research about the relevance of posture and back pain may relate to the heterogeneous back pain population. Aggravating postures may be particular to certain sub-groups of the low back pain population.

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