Let's Get It Clear No. 69
First published in THIIS March 2025
By Dr Barend ter Haar

What makes a good trunk support?

5. Back support prescription

Within a seating system, the primary support surfaces are the seat cushion and back support. In this part we discuss the relevant measures of the occupant needed to prescribe the most appropriate back support.

Selecting the correct back support dimensions, and prescribing the correct placement of the back support, are critical to the wheelchair occupant's functionality. In Part 4 of this series, we addressed the core measures of a back support itself as they relate to the dimensions of the occupant: these go well beyond the normal back support sizing dimension used which relate to the size of the wheelchair. In this article we address the measures of the occupant which match up with the back support measures, but also reflect on the placement of the back support to give support to relevant parts of the upper body.

Back support height and length

As a starting point for managing the upper body, we need to make sure that the lower body is positioned correctly. Are the feet far enough back so that the upper part of the lower legs are not pulling on the hamstrings to pull the pelvis into posterior tilt? Are the thighs and pelvis stabilised and positioning aids such as a pre-ischial ridge in the cushion and correctly placed pelvic positioning belts in place? (For advice on these aspects see other articles in the THIIS Let's Get It Clear series.)

Part of our pelvic positioning aims is to manage the degree to which the pelvis can rotate in the backward/forward direction. Some degree of pelvic posterior tilt is desirable for comfort and relaxation, but the more the tilt the more likelihood there is of kyphotic compensation in the spine, and with time this amount of compensation can become fixed. To control the degree to which the pelvis can rotate backwards a 'block' behind the PSISs at the top of the pelvis is an ideal tool. This is where the bottom of the back support can come into play if positioned at the level of the PSISs.

From here, we have a starting point for calculating the required length (vertical dimension) of the back support, and to do this, we need to work out the required height. (As a reminder, the length is the distance from the top to bottom of the back support. It does not have a height until it is placed on the chair, when the distance from the top of the back support can be measured to a reference point – usually the top of the seat cushion.) Most back supports that are prescribed are longer than they should be for the purpose of supporting the spine posteriorly (Fig.1). Any of the back support that goes above the highest posterior curvature of the spine is not supporting the back, but just adding weight to the chair. Importantly, this extra length, and therefore height, can also impede the occupant's upper body movements.

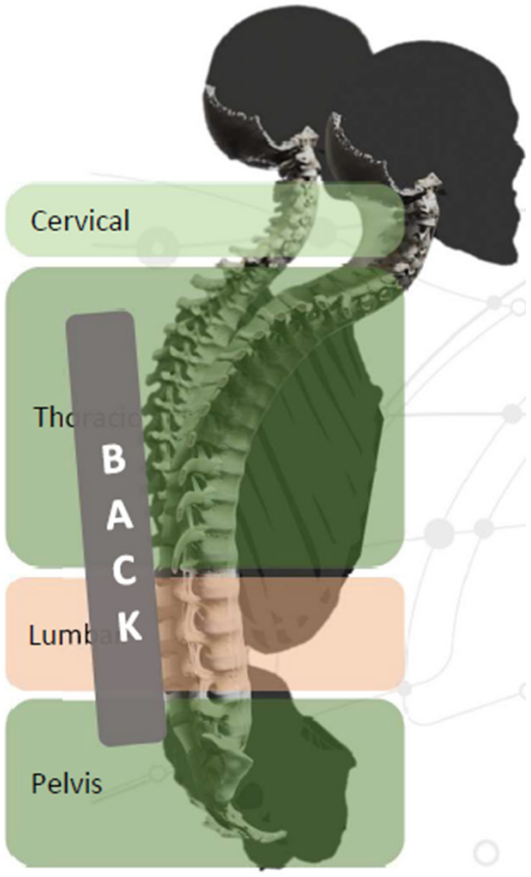


Figure 1. How much of the back support is supporting the back?[1]

We have twelve thoracic vertebrae numbered T1 to T12 from the top. Anything in the T3 to T8 zone will impede movement of the shoulder blades, the scapulae. For the average person the top of the back support probably does not need to go any higher than being level with T7: this then gives us a typical length needed for the back support to cover the distance from the PSISs to T7, of around 33 cm (Fig. 2).

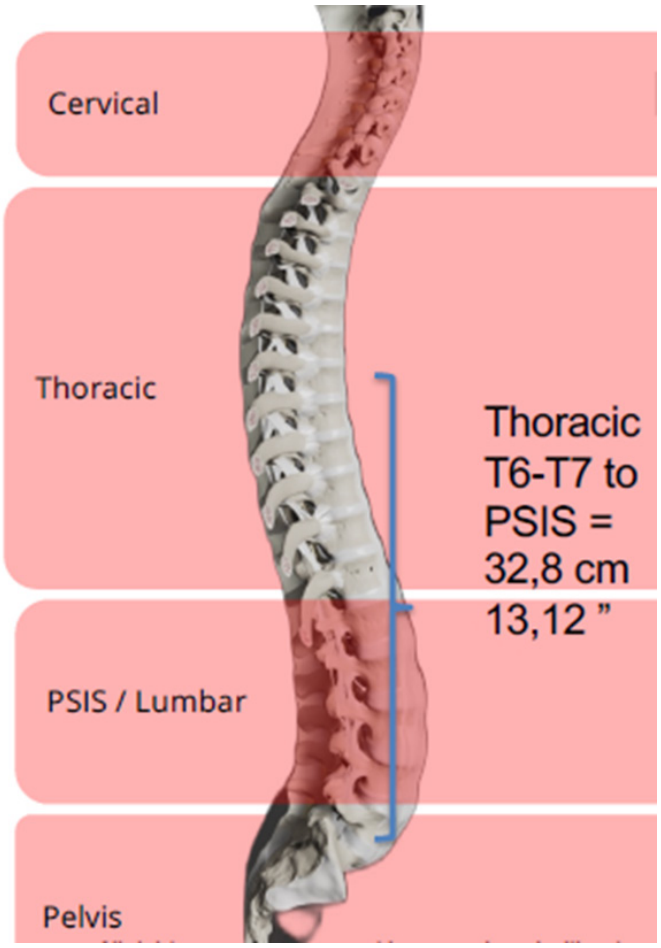


Figure 2. Distance from PSISs to apex of spinal thoracic curve[1]

Is there a need for this extra height?

So why do we prescribe these longer back supports? The first reason might be the advice that any anterior supports need to be attached horizontally across the top of the shoulders. This can, however, be achieved with a lower height back support by means of items such as Bodypoint's Strap Guides (Fig. 3), or Symmetric Designs' Strapparatus (Fig. 4).

A second reason might be the need for a head support, since this is usually attached via a mount on the back support. By choosing one of the modular mounting systems available on the market from the likes of Symmetric Designs (Fig. 4) or Stealth Products (Fig. 5), it should be possible to mount the head support on a shorter back support.

Figure 3. Bodypoint's Strap Guides for mounting anterior supports

Figure 4. Symmetric Designs' Strapparatus for anterior support mounting and extended height head support mounting

Figure 5. Stealth Products Unilink mounting system

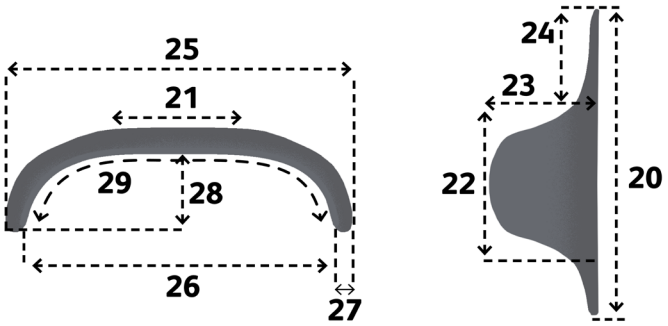
A third reason is that the wheelchair is going to be used in a motor vehicle with the occupant in the chair. In this case the chair needs to be crashworthy, as well as its seating system. The current crash tests in ISO 7176-19[2] for wheelchairs and ISO 16840-4[3] for seating systems originated from a philosophy that concentrated more on protecting other occupants in the vehicle and less on the

wheelchair occupant's needs. They were also developed in the days before the current ranges of after-market 'accessories' from independent manufacturers were available. The result is that the current test set-ups tend to give a crashworthy certificate to a basic chair without accessories in place, unless they are built into the chair in the first place. They do not cover for an after-market head support on a short back support as being a viable means to control upper body "excursions" during the test procedure, for example.

The ISO standards working groups have now started to address this, but currently there are no prescribed crash tests for back supports, head supports, etc on their own. The end result is that the prescriber needs to carry out an individual risk assessment for each client's situation and needs, and cannot fall back on a there being a crashworthiness certificate.

Back support width

Figure 6 presents various relevant measures of the back support cushion for an individual. For pure posterior back support, dimension 21 (planar width) covers the width needed for a planar posterior support on its own, and would cover the width of contact of the back with a flat board.



20 BSC length
21 BSC posterior planar width
22 BSC integrated lateral support length
23 BSC integrated lateral support depth
24 BSC integrated lateral support height
25 BSC maximum posterior width
26 BSC internal width
27 BSC thickness
28 BSC depth
29 BSC internal semi-circumferential width

Figure 6. Back Support Cushion (BSC) measures

However, most people prefer a degree of lateral support as well. The internal width (dimension 26) provides the maximum width of the torso with the lateral elements included, usually measured around the T11/T12 area of the trunk. Depth (dimension 28) gives a measure to which the lateral support wraps around the trunk: the greater the depth, the more support but the less degree of freedom. Further lateral support can be provided by integrated lateral supports (dimensions 22-24) or by externally mounted lateral supports on one or both sides.

These back support cushion measures will then relate back to the back support support structure (BSSS) as summarised in Part 4 of this series. The BSSS measures will usually be less than the cushion measures to allow some overlap of the cushion padding to stop the support edges harming the occupant.

The major implication from the width measures will be on how far back the back support can be mounted before it has interference from the back canes on the wheelchair itself. Some chairs and some back supports offer central mounting options, and then the limit comes from how far back these mounts will allow the back support to be mounted. For a manually propelled chair, the further back the back support is mounted, the more access there will be to the wheel rims. However, this is countered by the risks of moving the centre of gravity of the system too far back for safety.

Back support angle

There is much debate currently about the benefits versus the challenges of tilt and recline in seating systems. This is addressed in more detail in Part 6 in this series. In brief, if the bottom of the back support is placed at the PSISs, it will need to be reclined from the vertical to accommodate the kyphotic curvature around the thoracic vertebrae and possibly the scapulae – otherwise the occupant's upper body will be pushed too far forward, and they will need to accommodate this position with cervical extension at the neck to be able to see what they are doing. For those with greater degrees of kyphosis, simply by setting up the back support with an increased angle of recline can reduce the amount of hyperextension required at the neck.

1. *Figures 1 and 2 courtesy of Bart Van der Heyden, PT / SuperSeating*
2. *ISO 7176-19:2022 Wheelchairs — Part 19: Wheelchairs for use as seats in motor vehicles*
3. *ISO 16840-4:2009 Wheelchair seating — Part 4: Seating systems for use in motor vehicles*