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# Increased spinal height using propped slouched sitting postures: Innovative ways to rehydrate intervertebral discs

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ABSTRACT

*Background:* Upright and slouched sitting are frequently adopted postures associated with increased intradiscal pressure, spinal height loss and intervertebral disc pathology.
*Objectives:* To examine the effects of two sustained propped slouched sitting (PSS) postures on spinal height after a period of trunk loading.
*Methods:* Thirty-four participants without a history of low back pain (LBP) were recruited (age 24.4 ± 1.6 years). Subjects sat in (1) PSS without lumbar support and (2) PSS with lumbar support for 10 min, after a period of trunk loading. Spinal height was measured using a stadiometer.
*Results:* Mean spinal height increase during PSS without lumbar support was 2.94 ± 3.63 mm and with lumbar support 4.74 ± 3.07 mm.
*Conclusions:* Both PSS with and without lumbar support significantly increased spinal height after a period of trunk loading ($p < 0.001$). Such PSS postures can provide a valuable alternative to upright sitting and may be recommended for recovering spinal height in the working environment following periods of loading.



## 1. Introduction

Sitting is the most common posture in the workplace (Endo et al., 2012; Li and Haslegrave, 1999; Pynt et al., 2008) and has been identified as a risk factor for lumbar IVD pathology (Kelsey and White, 1980; Videman et al., 1990). Increased trunk loading results in reduced spinal and intervertebral disc (IVD) height (Adams et al., 1996; Zhao et al., 2005). Sustained compressive loading has been used to generate IVD degenerative changes (Guehring et al., 2006; Kroeber et al., 2002). Both IVD height loss (Hancock et al., 2015) and degeneration (Luoma et al., 2000) are associated with LBP, a major cause of morbidity (Hoy et al., 2010), high cost and disability (Manachikanti and Hirsch, 2015). Prevention of these problems would be central in the future management of LBP (Reuler, 1985). To date research has mainly focused on symptomatic episode treatments and little is known about preventive strategies (Eklund et al., 2014).

Many physiotherapy groups advocate upright sitting postures in a degree of lumbar extension (Mckenzie and May 2003; Winkel, 1996), despite a lack of evidence supporting the superiority of these postures over other sitting postures (O'Sullivan et al., 2012). Intradiscal pressure (IDP) in sitting increases with forward bending and actively straightening and extending the back (Nachemson, 1966; Sato et al., 1999; Wilke et al., 1999). Stadiometry has been shown to be an accurate and reliable measure of spinal height changes (Althoff et al., 1992; Healey et al., 2005; Kourtis et al., 2004). Correlation with magnetic resonance imaging has shown stadiometry to be a valid measure for changes in lumbar IVD height (Fryer et al., 2010; Kourtis et al., 2004; Lewis and Fowler, 2009). Eklund and Corlett (1984) demonstrated that increased load increased the spinal shrinkage rate. This has been associated with the increased IDP demonstrated in the studies of Nachemson (1966). It has been suggested that various lying postures could be utilized during breaks at the workplace or at home to recover spinal

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**Abbreviations**

| | |
|---|---|
| IVD | Intervertebral Disc |
| PSS | Propped Slouched Sitting |
| ANOVA | Analysis of Variance |
| LBP | Low Back Pain |
| IDP | Intradiscal pressure |
| BMI | Body Mass Index |
| SD | Standard Deviation |
| DSI | Dorsal sacral inclination |
| IDD | Internal Disc Disruption |

height (Gerke et al., 2011). Presumably this strategy could be utilized to recover from spinal height lost during upright sitting. Unfortunately, many workers are unable to take breaks or adopt non-seated postures during their working day (Straker et al., 2013; Trinkoff et al., 2006). However, IDP is reduced in selected seated postures ie. Propped slouched sitting (PSS) in lumbar flexion using a backrest but without lumbar support (0.27 MPa), compared to upright sitting (0.45–0.50 MPa) (Wilke et al., 1999). Consequently there was a need to investigate if selected seated postures would produce similar recovery in spinal height, following a period of loading.

Should spinal height increase with PSS without lumbar support, it would represent a posture that would allow recovery following postures that tend to shrink the spine. Since Adams and Hutton (1983) hypothesized that fluid outflow from the IVD was increased in postures involving flexion, extension exercises in sitting appear to increase spinal height (Magnusson and Pope, 1996) and the reduced IDP in PSS without lumbar support has been attributed to load transferred through the backrest (Wilke et al., 1999), it was hypothesized that lumbar spine extension combined with PSS ie. PSS with a lumbar support, may also increase spinal height. No investigations to date have examined the effects of PSS postures on spinal height.

### 1.1. Aims & hypotheses

The specific aims of this study were to investigate (1) the effects of two different types of PSS postures on spinal height after a period of trunk loading; (2) if PSS with a lumbar support resulted in greater changes in spinal height as compared to PSS without a lumbar support; and (3) if the degree of lumbar spinal flexion and dorsal sacral inclination (DSI) recorded in both PSS postures correlated with spinal height change. We hypothesized that, after a period of trunk loading: (1) spinal height would increase following PSS with and without lumbar support; (2) there would be a greater spinal height increase in PSS with lumbar support as compared to without lumbar support; and (3) as Adams and Hutton (1983) demonstrated reduced outflow from the IVD in extension, there would be a negative correlation between spinal height changes and the measured degree of lumbar flexion.

## 2. Materials and methods

### 2.1. Subjects

The local University Institutional Review Board granted approval to this research project. A total of 40 subjects were recruited from a convenience sample of a healthy population without LBP. Subjects aged 18–35 years and without current neck or LBP were included. Subjects with un-correctable spine pathology; history of spinal surgery; back pain necessitating visit to a healthcare provider within the last year; pregnancy; current diagnosed neurological disorder; un-correctable visual impairments; and difficulty with sitting in upright, flexed or extended postures for 10 min were excluded.

### 2.2. Power analysis

For an alpha level of 0.05, power of 80%, assumed spinal height increase of 1.7 mm (Magnusson et al., 1994) and estimated standard deviation (SD) of 3.0 mm from pilot testing, it was calculated that 27 subjects would be required for detecting a significant difference in spinal height following the sustained PSS with or without lumbar support.

### 2.3. Apparatus

A commercially available digital stadiometer (QuickMedical® Model 235D Heightronic Stadiometer) mounted on a custom wooden frame measured spinal height (Gerke et al., 2011; Owens et al., 2009). An adjustable footrest (Workrite Ergonomics Footrester #215) allowed replication of lower limb position during measurements.

To ensure clinical relevance, a commercially obtainable 125 mm diameter heavy density lumbar roll (The original McKenzie® heavy density roll) that is frequently used in the treatment of LBP (Mckenzie and May, 2003) and a simple armless upright type chair widely available were utilized for the experimental postures. The fixed backrest was high enough to allow mid-to-upper thoracic support in the PSS test positions. The seat was covered with a non-slip surface (Dycem®) and Velcro (VELCRO® Brand Sticky Back™) fastening for the lumbar roll (Fig. 1). A duplicate second chair with holes cut in the seat pan and backrest allowed spinal position. A commercially available Dual Inclinometer (ACUMAR Dual

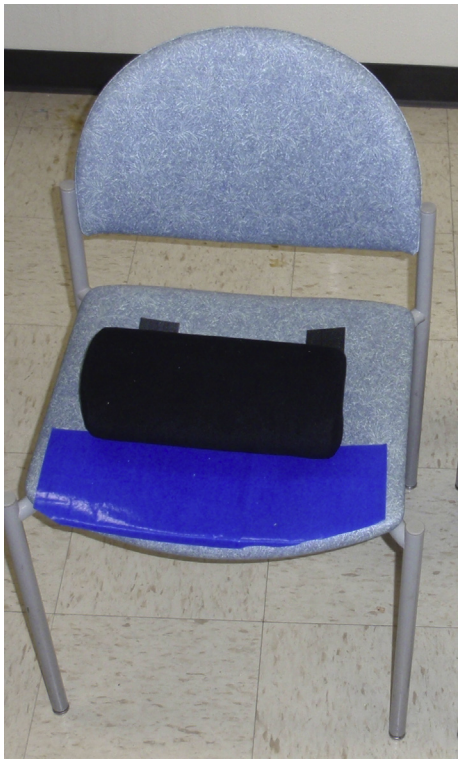

**Fig. 1.** Chair with lumbar support with velcro and dycem in situ.