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Original article

Active self-correction of back posture in children instructed with 'straighten your back' command

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ABSTRACT

The ability to adopt the properly corrected body posture is one of the factors determining the effectiveness of therapeutic programmes. This study determined the active self-correction expressed by the change of sagittal spinal curvatures (in standing and sitting positions) in 249 children (136 females, 113 males, aged 10–14 years) instructed with 'straighten your back' command (SYB). Spinal curvatures (sacral slope-SS, lumbar lordosis-LL, global, lower and upper thoracic kyphosis-TK, LK, UK, respectively) were assessed using Saunders inclinometer. The assessment was done in spontaneous standing and sitting positions and in the positions adopted after the SYB.

In a standing position SYB led to the significant ($P < 0.001$) increase in SS, and the significant ($P < 0.01$) decrease in LL, TK, LK, UK. In a sitting position SYB led to significant changes ($P < 0.001$) from kyphotic to lordotic position of SS and LL and to the significant ($P < 0.001$) reduction of TK (36.5° ± 10.8 vs. 23.5° ± 11) and the flattening of LK (15.2° ± 8.7 vs. 1.0° ± 8.4). There were gender-based discrepancy regarding active self-correction only for LL in a standing and UK in a sitting position. Females demonstrated a significant decrease in LL ($P < 0.001$). UK significantly increased only in males ($P < 0.001$).

The 'straighten your back' command leads to moving the spine away from mid-range towards end range of motion. Therefore, the command should not be used to elicit the most optimal back posture. Further studies are needed to determine if the active self-correction is different in females and males.

1. Introduction

'Good' posture is the complex interplay between biomechanical and neuromuscular functions which safely loads spinal segments and conserves energy (Claus et al., 2009a). Although it is widely accepted that a 'good' posture is vital for proper functioning of the body, it proves to be difficult to define by means of quantitative factors (Claus et al., 2009a).

One of the basic features determining the quality of body posture is spinal curvatures in sagittal plane (Kendall et al., 2005). It is suggested that a correct standing position should involve slight lumbar lordosis and slight thoracic kyphosis (Kendall et al., 2005). Kyphotic shape of lower thoracic kyphosis is of importance as well since it serves an important role in maintaining rotational stabilisation of the spine (Kotwicki, 2002). However, it seems to be more difficult to define the optimal sitting position. Some authors claim that spinal curves in sitting should be similar to "ideal" standing position (Lee, 2003; O`Sullivan, 2004; Claus et al., 2009a).

Currently, a number of children and youth are being diagnosed with postural faults as well as back and neck pain (Jones and Macfarlane, 2005; Kendall et al., 2005; Geldhof et al., 2007). One reason, among other factors, may be prolonged poor sitting (Murphy et al., 2004; Geldhof et al., 2007). Prolonged sitting has also been reported to be a common aggravating factor for subjects with low back pain (LBP) (Williams et al., 1991). Commonly adopted relaxed postures (sway standing, slump sitting) has been also reported to frequently exacerbate LBP (O`Sullivan, 2000; O`Sullivan et al., 2002). Therefore, youths can be referred to various therapeutic programmes aimed at improving the quality of body posture along with fostering the awareness of the importance of correct posture when sitting and standing (Geldhof et al., 2007). Teaching the appropriate active self-correction might be one of the elements of such programmes (Weiss et al., 2006; Romano et al., 2008). According to Weiss et al. (2006) the ability to adopt and maintain the properly corrected body posture whilst completing activities of daily living is one of the factors determining the effectiveness of corrective programmes concerning the improvement of body

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posture. Active self-correction is also an essential part of the programme of conservative treatment for idiopathic scoliosis (Romano et al., 2008; Zaina et al., 2009) which may prove that the quality of performing active self-correction is important.

Giving different commands such as 'straighten your back' might be one of the ways of improving one's body posture. The command is used during therapeutic sessions as well as included in guidance provided by a physiotherapist (Bulińska, 2005). Our experience and observations show that it is also commonly given by parents and teachers. However, it has not been yet determined whether subjects following the aforementioned command adopt an optimal position of the spine and hence whether the instructions prove useful in improving the quality of body posture in youths.

The aim of this study was to determine the active self-correction expressed by the change in the magnitude of spinal curvatures in the sagittal plane both in standing and sitting positions in children aged between 10 and 14 years instructed with 'straighten your back' command. As yet there have been no studies examining whether females and males perform active self-correction differently, we have additionally conducted the assessment of changes in sagittal curvatures of the spine in individuals instructed with 'straighten your back' command for females and males separately.

2. Material and methods

2.1. Subjects

The recruitment of the subjects to the study took place during the presentations for parents and their children. The presentations were given in 5 randomly selected primary schools. The information about the study was placed on notice boards and school websites with the school master's consent. 450 parents and their children participated in the meetings. Finally, the study included 249 children (136 females and 113 males) aged 10–14 years (11.8 ± 0.8), who met the following criteria: written informed consent of parents who allowed their children to participate in the study, no participation in corrective gymnastics classes, no previous guidance on how to acquire the correct posture, no neurological disorders, injuries or musculoskeletal pain in the preceding 12 months. The basic demographics of the study group are given in Table 1.

2.2. Measurement protocol

2.2.1. Evaluation of sagittal curvatures of the spine

All of the children underwent the evaluation of spinal curvatures in sagittal plane. The assessment was carried out with Saunders inclinometer (Baseline Digital Inclinometer, The Saunders Group Inc, Chaska, MN, USA). The measurements were conducted according to the producer's instructions following the American Medical Association guidelines (Saunders, 1998; Andersson and Cocchiarella, 2004). Prior to measurements, a non-toxic skin marker was used to mark the following measurement points found by palpation (Muscolino, 2008; O`Sullivan et al., 2010): lumbosacral junction – L5/S1 (LS point), thoracolumbar junction – T12/L5 (TL point), cervicothoracic junction – C7/T1 (CT point) and T6/T7 junction (T6 point) (Fig. 1). In order to assess the angle of sacral slope, the inclinometer was reset in the horizontal position and placed on the LS point. The angle of lumbar lordosis was determined after the inclinometer was reset at the LS point and the reading was taken at the TL point. The measurement of global thoracic kyphosis angle started with resetting the inclinometer at the TL point and then it was applied to CT point. Additionally, the magnitude of lower (T6/T7–T12/L1) and upper thoracic kyphosis (C7/T1–T6/T7) was determined. The inclinometer was placed on the TL point, after which it was reset and applied to T6 point to determine the magnitude of lower thoracic kyphosis. In order to assess the upper kyphosis, the inclinometer was reset at the T6 point and placed at the CT point. Each measurement was carried out three times. The average values of the three measurements were used for the analysis (Saunders, 1998; Andersson and Cocchiarella, 2004).

The assessment of sagittal curvatures of the spine was carried out with subjects in spontaneous standing and sitting positions and the position adopted after the 'straighten your back' command. The first measurement was carried out in a standing position. The subjects were neither provided with any guidance nor received any feedback on their posture. Kyphotic curves were represented as positive angles, whereas lordotic curves were recorded as negative (Claus et al., 2009a).

All the measurements were performed by one investigator.

2.2.2. Measurement of sagittal curvatures of the spine in a standing position

The assessment was conducted with subjects in a spontaneous standing position, shoeless (O`Sullivan et al., 2002). Their lower limbs were extended at the knee joint, with feet hip-width apart. The upper limbs were relaxed at the side of the body. Subjects were requested to view a designated point ahead at eye level.

First, the magnitude of sagittal curvatures of the spine was measured with subjects standing in a habitual, spontaneous position, in line with the above mentioned methodology. Immediately afterwards, every subject was given the 'straighten your back' command and after 5 s the measurement was taken (Fig. 2).

2.2.3. Measurement of sagittal curvatures of the spine in a sitting position

The examination was conducted on a therapeutic table with a subject in a sitting position, with no back support. The height of the table was adjusted to every subject individually to achieve the most natural and comfortable position. The height of the seat was adjusted to the posterior knee crease level to achieve the flexion of hip and knee joints at 90° (Claus et al., 2009a). The positions of hip and knee joints were verified with a goniometer. The subject's hands rested on laps and their feet rested on 20-cm high box.

Every subject was requested to adopt a relaxed, spontaneous position after being instructed with 'sit as you usually do' command (O`Sullivan et al., 2010). Subjects were also requested to view a designated point ahead at eye level (Caneiro et al., 2010; O`Sullivan et al., 2010). After 5 s, spinal curvatures were measured following the aforementioned measurement guidelines. Afterwards, the subjects were instructed with 'straighten your back' command and, after 5 s, the measurement was repeated (Fig. 3).

2.2.4. Active self-correction evaluation

In order to determine the effect of active self-correction, the angular values of each spinal curvature were compared in different positions: spontaneous standing and sitting positions as well as positions adopted after 'straighten your back' command. The results obtained during the examinations were compared for the whole group as well as for females and males separately.

The local Ethical Commission granted permission for this research (permission number: 2/2012).

Table 1
Demographics of the study group ($n = 249$).

	Mean	Minimum	Maximum	SD
Age (years)	11.8	10.0	14.0	0.8
Height (m)	1.51	1.3	1.74	0.1
Weight (kg)	44.4	21.0	72.0	10.2
BMI (kg m^{-2})	19.2	11.0	35.1	4.0

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