

ADJUSTABLE TABLES AND CHAIRS CORRECT POSTURE AND LOWER MUSCLE TENSION AND PAIN IN HIGH SCHOOL STUDENTS

Osmo Hänninen and Reijo Koskelo

Department of Physiology, University of Kuopio, P.O.Box 1627, 70211 Kuopio Finland

e-mails: osmo.hanninen@uku.fi and reijo.koskelo@uku.fi

ABSTRACT

The aim of this study was to compare the effects of the traditional non-adjustable and new adjustable school tables and chairs on the sitting and standing postures, muscle tension and pain levels as well as the learning success during the three high school years when the growth of the students reaches the adult measures. In one school the students received tables and chairs which were adjustable and were personally adjusted for the students (8 girls, 7 boys) whereas in the control school the students (8 girls, 7 boys) continued to use non-adjustable tables and chairs.

When the students started to use their adjustable tables and chairs the muscle tension levels fell significantly in lumbar and trapezius muscles. In the students of the control school an increase was found during the follow-up. The headache and low back pain correlated with the neck-shoulder pain as well as trapezius muscle tension. The intervention corrected the posture much as expected, when the students were sitting in their new units. The standing stature was also corrected (kyphosis, scoliosis and lordosis). Positive responses were observed even when the growth had stopped. The intervention students reported that they experienced benefits from the adjustable tables and chairs. They got significantly better grades at the end of high school than the controls. The results support the necessity of ergonomic approach in furniture planning of school classes and individual adjustment possibility of tables and chairs.

INTRODUCTION

The neck, shoulder and back pain problems are common already among school children (e.g. Salminen 1984, Taimela et al. 1997). The recent interviews have documented an increase of health problems (Vikat et al. 2000). Students experience that problems are due to school tables and chairs (Mandal 1985, 1991, Troussier et al. 1999). School furniture forces the students to poor sitting postures (Mandal 1985, Koskelo 2003). Unfortunately very few studies have so far been carried out to clarify the effects of poor postures and even less experimental studies have been made on the irreversibility by furniture.

The commonly used chairs require about 90 degree angle between the trunk and thighs. The hip joint does not permit this, as the flexion limit is about 60 degrees. Bendix and Biering-Sorensen (1983) have shown that the additional 30 degrees are made possible by the modification of the lumbar spine posture. It has been shown that the electric activity of the back muscles is lowest, when the back rest has an inclination of 110 – 130 degrees. Then the intradiscal pressures are also then lowest. (Harrison et al. 1999)

The aim of the present study was to compare the effects of the traditional nonadjustable and new adjustable school tables and chairs on the sitting and standing postures, muscle tension and pain levels as well as the students' learning success during the three high school years, when the growth of the students reaches the adult measures.

MATERIALS AND METHODS

The students of two high schools in the eastern Finland participated in the study with the consent of their parents and teachers. In the intervention school the students received tables (prototypes manufactured by Martela Oyj, Helsinki, Finland) and chairs (Salli Saddle Chairs, Easydoing Ltd, Rautalampi, Finland), which were adjustable and also individually adjusted to the measures of the students. In the intervention group the sitting trunk – thigh angle was adjusted to about 135 degrees. The chairs had wheels so that the students could move which makes the sitting more dynamic compared to the traditional sitting when any motion is cumbersome (Fig 1). Students (8 girls, 7 boys) in the control school continued to use their non-adjustable tables and chairs.

The height, weight, physical fitness (bicycle ergometer test) and trunk muscle strength were measured in the beginning and at the end of each semester. There was no difference between the anthropometric measures or fitness of the boys in the intervention and control groups. The girls of the two groups were similar except that the sitting length of the controls was slightly but significantly shorter than of the intervention girls.

The students were photographed with a digital camera when sitting in their units during classes and also when standing in standardized way before the intervention and during the study. The sitting postures and the different angles were analysed by using computer programs (Adobe Photoshop 5.0) (Fig 1). The curvatures of the spine were recorded by placing Cirtometer device (Plasti db, Milano, Italy) on the spinous processes from C7 to L5. Cirtometer was transferred on paper and the curvatures were manually depicted and photographed with digital camera to store the data for later computer analysis of the angles (see also Mattox et al. 2000).

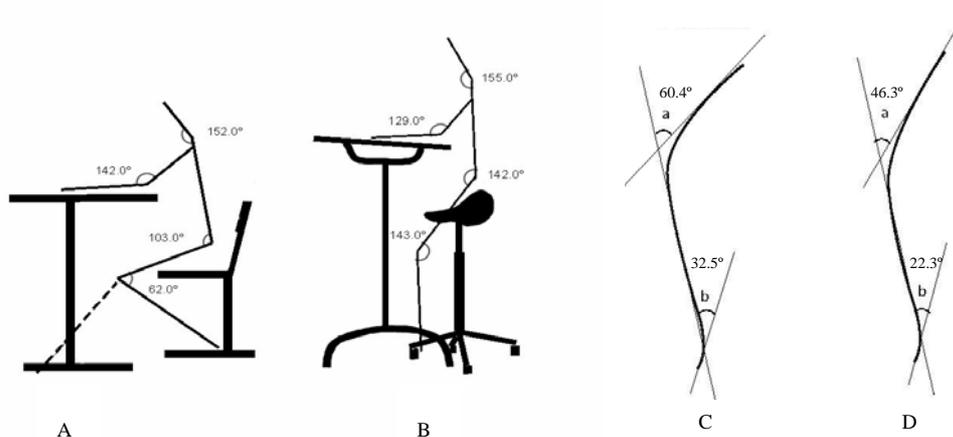


Figure 1. Evaluation of sitting postures from the stick models drawn from digital photographs. In **A** one student is using on a traditional non-adjustable chair and table. In **B** he is using adjustable table and chair. **C** and **D** depict the Cirtometer graphs of spine profile of another standing student before and after 12 months intervention.

The muscle tension was recorded by using a portable EMG device (ME3000p, Mega Electronics Ltd, Kuopio, Finland). The skin electrodes were placed on the paraspinal muscles at L1-2 level, and on the

descending part of trapezius muscle in the middle of the muscle mass and. The recordings were made during the normal class sessions into the memory of the device, and the data were transferred to a personal computer. The root mean square (rms) activity during the lessons was calculated.

The students evaluated their subjective health and school success by using questionnaires. The learning success was evaluated by the teachers at the time of national exams.

SPSS 8 Windows program was used in the statistical analysis of data obtained, and students' t and Wilcoxon tests were used. If the difference reached the level $p=0.05$, it was considered significant.

RESULTS AND DISCUSSION

The traditional tables and chairs forced the students to sit in cumbersome positions (Fig.1). The taller the students were the more problems they faced, because the tables and chairs were all alike. When the students started to use the adjustable tables and chairs, their postures became much better(Fig 1). The standing posture of the intervention students was also corrected (Fig. 1). The lumbar lordosis ameliorated significantly both in boys and also in girls (Fig.2). Kyphosis and scoliosis were significantly lessened. They occurred even when the growth had stopped. (Not illustrated) To our knowledge such results have not been published earlier.

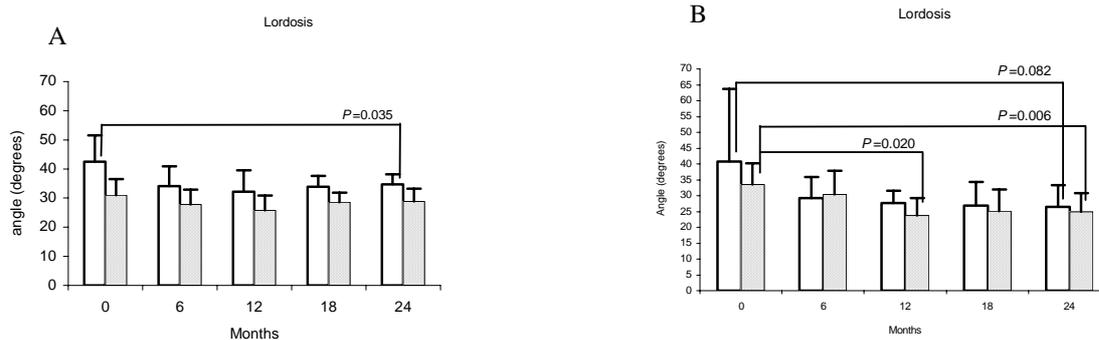


Figure 2. Lumbar lordosis of **A control high school** and **B intervention high school** girls (clear columns) and boys (shaded columns) measured when standing (in both groups n=8, n=7).

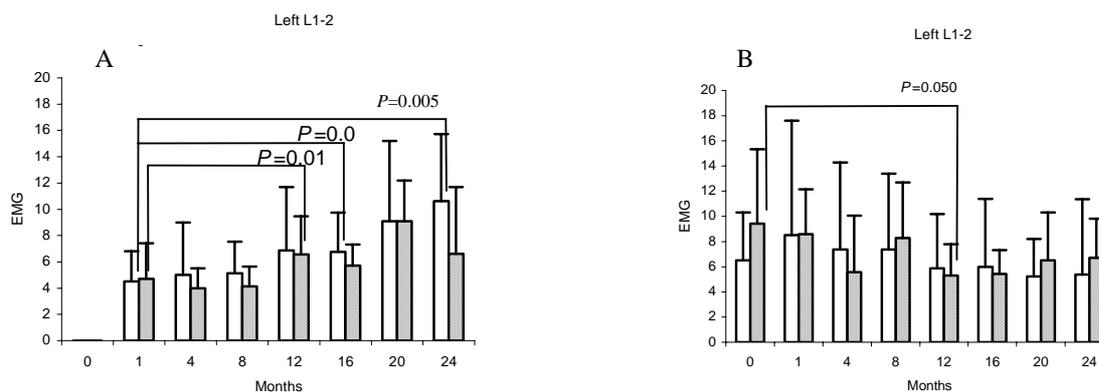


Figure 3. The tension (rms EMG) of left trunk extensor muscle (level L1-2) **A: control** and **B: intervention high school** girls (clear columns) and boys (shaded columns).(n=8, n=7 in both groups)

The tension in the lumbar and trapezius (not illustrated) muscles of the intervention students lowered significantly (Figure 3) whereas it increased in the controls. Such results have not been reported earlier to our knowledge.

The headache and low back pain correlated with the neck-shoulder pain as well as trapezius muscle tension. The intervention students got better marks at the end of their high school. It appears that ergonomic adjustments may pay off even at the level of effectiveness.

In conclusion, the postures of the high school students require attention. The use of adjustable tables and chairs should be propagated, because their use had significant positive effects on the muscle tension with the better sitting postures. Sitting posture apparently affects also the standing posture. It was encouraging that the positive findings were observed also in students whose growth had ended before this study. The students experienced adjustable furniture better than the non-adjustable ones.

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