

# THE RELATIONSHIP BETWEEN CHANGES IN THE BODY GROWTH AND STABILITY OF THE LUMBAR SPINE

*Rżany M.,<sup>1</sup> Brzęk A.,<sup>2,3</sup> Blicharska I.,<sup>1</sup> Famuła A.*

<sup>1</sup> Institute of Kinesiology, Chair of Physiotherapy, Medical University of Silesia, Poland

<sup>2</sup> The Student Scientific Set near the Kinesiology Institute, Chair of Physiotherapy, Silesian University of Medicine in Katowice

<sup>3</sup> Department of Medical Rehabilitation, Medical University of Silesia, Poland

## **Abstract**

**Introduction** There are many changes both on the cellular and structural level during the day. Hydration changes in the intervertebral discs which causes of the daily change of the body growth. Changes within bone structures relative to each other bring about changes within the muscle to stabilize the lumbar spine and pelvis.

**Aim** The aim of study was measurement the changes of the body height during the day and their influence on the stability of the lumbo-pelvic complex and possible compensation within this complex.

**Material and Methods** The study was conducted in 30 patients aged 19 to 24 years average

The study included two tests: growth measurement in standing position, and measurement of lumbo-pelvic complex in the front and the back lying position, twice a day: once in the morning twice to break 12 hours.

**Results** Statistical analysis showed that the level of the body during the day has decreased from 0.5 to 1, 5 cm ( $p < 0.00001$ ). 50% of lumbo-pelvic complex stabilization of the complex was the highest in the morning. There were no differences between the measurements in 33, 3% of respondents. In 56.6% of subjects experienced spine movement during the activation of the transversus abdominis muscle.

## **Conclusions:**

1. The stability of the spine is better in the morning than in the evening

2. Move of bending the spine during the activation of the transversus abdominis is the most frequent compensation.

**Keywords:** body height, the transverse abdominal muscle, the lumbo-pelvic complex

## **Introduction**

A multitude of biochemical reactions that affect functioning of the human body take place per day. The amount of water in the body varies both during the day and throughout life. The intervertebral disc is made of water in 70%. The most hydrated and vulnerable to dehydration and structure of the intervertebral disc is the nucleus pulposus. Biochemical changes in the disc begin at an early age thus the amount of in water in the intervertebral disc falls in and the amount of collagen increases while the amount of elastin decreases. The nucleus pulposus dries and loses coherence with age.<sup>5</sup>

Axial load which the body is subjected to during daily activities puts pressure on the intervertebral discs which loses water because of it. The loss of water results in the daily change of the intervertebral disc height of 1-2 mm which is about 10% of the entire album. Throughout the day the height of the body is changed approximately about 19 mm<sup>7</sup>. The fluid is replenished during the night due to the osmotic pressure of proteoglycans, which results in that the disc swells and is compressed during the day.

Both the lifestyle and way of spending free time has an impact on the size and speed of these changes. These changes occur relatively quick: 26% loss of height within eight hours of being in a standing position falls on the first hour; these changes occur in the opposite direction in an alike pace: the first hour accounts for 41% of the amount recovered within four hours of rest<sup>9</sup>. The reduction of the height of the disk during the day also changes the mobility and biomechanics of the spine. Range of motion of the spine is increased during the day<sup>10</sup>. The main changes concern flexion. Hard tissue elasticity increases as the amount of water in it decreases. Therefore, the maximum load the disc and posterior longitudinal ligament suffer falls on the morning hours.<sup>7</sup>

The multifidus muscle is responsible for the stabilization of the lumbar spine – the transverse abdominal muscle. These muscles are connected through thoracolumbar fascia resulting in lumbar creating a kind of corset which provides a rigid spine<sup>1</sup>. Multifidus muscle is characterized by segmental attachment system and is the most medially positioned lumbar muscle. The fibers connect the lumbar vertebrae and sacrum together.

The main function of the transversus abdominis muscle is the thoracolumbar fascia, lumbar tension during activation.

Changes in the amount of intervertebral discs entail changes in the distance between the circles, which causes minimal close-up of multifidus muscle attachments. The level of hydration of the intervertebral disc and the change in the distance of multifidus muscle attachments can affect the stability of the complex and the presence of Lumbo pelvic compensation within it.

The aim of this study was to evaluate the impact of changes in the body throughout the day to stabilize the lumbo pelvic complex. It was decided to examine: How does the height of the body during the day change and does the stability of the lumbar spine and pelvis changes throughout the day.

## **Materials and methods**

### **The study group**

The study involved a group of 30 adults of both sexes between the ages of 19 - 24 years ( $x = 20.1 \pm 1.12$ ). They were students of Physiotherapy, Medical University of Silesia in Katowice. Each subject was taught proper technique of transversus abdominis muscle tension, and took note of the research methodology. The study was conducted in the Department of Kinesiology Department of Physiotherapy of Silesia.

### **Research Tools**

The study used:

1. The survey created by the author consisting of 11 questions. The questions included in the survey pertained to the ways spending time during the day, physical activity, pain in the spine and ways to deal with them, and the situation that increases the pain. The questions were supplemented by visual analogue scale VAS.
2. A height measuring device mounted to the wall with which a height was measured in a standing position. Each person was examined without shoes in an upright standing position. The measurements were taken twice: in the morning from 8:00 - 9:00, and after 10 hours from the first measurement to assess changes in body length per day.

3. A pressure Biofeedback Unit device by Chattanooga company, which was used to evaluate the Pelvic lumbar stability of the complex twice – in the morning and in the evening by diversifying the deep muscle tension superficial muscle (Richardson et al 2004). Every time the study was performed thrice to avoid the possibility of improper performance of a motor task. The study was conducted while lying on the stomach and lying on the back. In the first position a transversus abdominis muscle force and power that occur during the compensation of the muscle was assessed.

In the back position movements of the spine / pelvis during conscious transversus abdominis muscle tension were evaluated.

The results were analyzed according to the guidelines (C. Richardson, W. Houdges, Hades J) shown in the table below:

**Tabl. 1** Standards of Stabilizator Pressure Bio-Feedback’s examination.

<b>STANDARDS</b>	<b>LYING FACE 70 MMHG</b>	<b>LYING BACK 40 MMHG</b>
<b>Proper connection in a reduction</b>	Pressure drop 4-10 mmHg	No change in pressure
<b>Asymmetric voltage</b>	Pressure drop 0- 4 mmHg	No change in pressure
<b>Global muscle tension</b>	The increase in pressure	The increase or decrease in pressure
<b>Movement of the spine or pelvis</b>	The pressure drop over – 10mmHg	The increase or decrease in pressure

### **Statistical Tools**

The data obtained were placed in a single database and developed through programs belonging to the Exel MS Office 2007 and Statistica v. 10

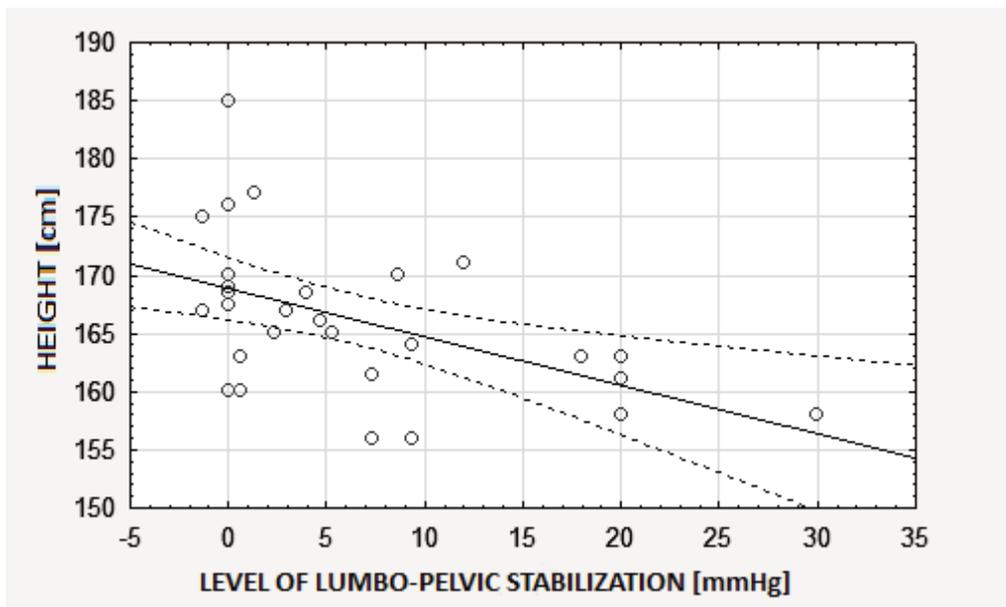
Statistical analysis was performed for muscle quality of pelvic lumbar complex. The assessment of measurable parameters was performed using Pearson's R-factor, and to assess the comparative

performance measurements taken in the morning against the readings taken in the evening a Test "t" was used for dependent and independent samples. Statistically significant values gives were in proximity of  $p < 0.05$ .

## Results

The individual analysis of the measured body height shows that in the group of patients whose height was measured in the morning was in ranging from 158 cm to 185 cm ( $x = 166.33 \pm 6.5$ ) changing daily by an average of 0.57 cm at 66 , 67% of cases. In 33.3% of cases there was no diurnal variations in height. These differences were statistically significant ( $t = 6.38$   $p < 0.000001$ ), which confirms the theoretical assumptions of the study. The analysis of the results of the examination in the morning showed that the activation of the deep stabilizing muscles lumbar spine muscles movements comes to global, and often a move is initiated by the bending of the spine (35.8%). In a study at a back-lying position in 30% of cases muscle tension were flawless during the test within normal standards. In 70% of cases, however, the transversus abdominis muscle tension was without sufficient reduction to allow the corresponding reduction in the pressure or test subject asymmetrically strained muscle. The measurement of stability taken after 10 hours showed that during the lying on the back position a proper muscle tension was finished by only 13.33% of respondents. The difference between the measurements is not statistically significant ( $t = 1.28$ ,  $p > 0.2$ ). There was no correlation between the difference in the length of the body and the values obtained in the study of complex stabilization of the lumbar-pelvic-go basic group ( $R = 0.14$ ,  $p > 0.46$ ). However, there was, a relation between the level of the complex stability test-lumbar pelvic taken during the morning back lying position test and the length of the body in the first measurement ( $R = 0.5$  gives  $p < 0.003$ ). The resulting correlation indicates a better level of muscles stabilization in the morning in cases of shorter respondents (Fig. 1).

**Fig 1.** Correlation between level of stabilization and length of the body.



Age had no effect on the resulting differences in body length ( $R = 0.15$ ,  $p > 0.43$ ), and differences in the study of the complex stabilization pelvic-lumbar ( $R = -0.09$ ,  $p > 0.6$ )

The analysis of the survey questions revealed that 76.7% of respondents complained of pain in the spine area. Pain ranged from 2 to 6 points according to VAS scale ( $x = 4.05 \pm 1.1$ ). The symptoms were pointed out by students who spend an average of eight hours a day in a sitting position, and the pain was getting more intense as they day progressed in 75% of cases. The most common location was the lumbar spine - in 63.3% of patients. It is worrying that the students of physiotherapy did not ease the pain in prevention, and physical measures were applied by nearly 3.3% of respondents. The vast majority of them alleviated the pain with pain relievers. The total number of points in the VAS scale did not depend on the difference in body length between the two examinations ( $R = 0.008$ ,  $p > 0.9$ ), or on the difference in the study Stabilizer ( $R = 0.16$   $p > 0.5$ ). In an attempt to split up the group for active people (7 people) and inactive people (23 people) it turned out that the presence of numerous compensatory during stabilizer examination occurred in both groups. There was a limiting relation between the number of hours spent in an upright position during the day and the stabilization examination in the morning ( $R = -0.37$ ,  $p < 0.05$ ), indicating a lower level of it among people staying in the standing position for a long time.

## Discussion

The reduction in body length during the day due to changes within the intervertebral disc has a direct effect on the biomechanics of the spine. Range of mobility increase during the day<sup>7</sup>. The

biggest changes concern the range of flexion and less extension<sup>2</sup>. This is due to the plastic deformation influenced by the axial load acting in the day. This load reduces the height of the disc, an increased tendency for the formation of the protuberance and greater flexibility during bending<sup>2</sup>.

This study confirmed that daily changes in body height take place. However, not in all cases the differences were significant, this may provide a tonic postural muscle activity, which may vary depending on gender, age and body capacity. Postural muscle fatigue may increase the physiological curvature of the spine which in turn can cause a change in height. Changing the height of the body can not only be related to the hydration of the intervertebral discs but also muscle fatigability which is dependent on many factors. The study showed that prolonged standing affect the level of stability, which may be related to the load of the spine and postural muscle weakness. However, it was not tested whether the subjects ergonomic principles while standing.

Most of physiotherapy students did not show the correct tension of transversus abdominis muscle, and also did not declared active spending of free time. Most part of the day was spent in a sitting position. In other study conducted on school children and adolescents diagnosed with scoliosis it was also found that a many of them had a low lumbar stabilization of the lumbo- pelvic complex. However, regular physical activity influences a higher level of deep muscle tension. It can be concluded that in the future many people will feel pain in the spine. The authors deal with the issue of the impact of stabilization i.a Hodges, Richardson, Hides, McGill agree to the fact that insufficiency of deep stabilizer muscle, contributes to the development of low back pain. They even suggest exercises oriented on transversus abdominis muscle's activity, such as Pilates, as a form of therapy or prevention. Very disturbing is the fact that the group of young people – physiotherapy students, who should spread principles of ergonomics, physical activity and help in the elimination of the causes and release pain symptoms, complain of pain in a young age and do not encourage prevention and recommendations of how to avoid pain.

Examination by Stabilizer Pressure Bio- Feedback seems to be not fully objective. The ability of transversus abdominis muscle's tension without activating oblique abdominal muscle during the test is questionable. This issue could be solved ultrasound examination which was an opportunity to assess which muscles are used in this process. Significant is the fact that an ultrasound examination is performed by physician and the Stabilizer is a good tool in the hands of the therapist, particularly helpful in the early phases of therapy with patients, using biofeedback (co. pressure biofeedback).

With age, decreases the daily hydration of the intervertebral which may attribute to the hypermobility in the joints of the spine and increase physiological curves.

## Conclusions

- a. Stabilization of lumbar spine is changing daily. Deep muscles fulfill their function better in the morning than after a day.
- b. Compensation during examination may indicate poor motor control of the body's deep muscles.
- c. Physiotherapy students show low level of physical activity. It can be concluded that they do not respect principles of ergonomics, which may be the cause of back pain at such a young age.
- d. Staying in a standing position for a long time during the day can lead to destabilization of the lumbo-pelvic complex.

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