

Influence of two years study in Special Education of Security Sections on the body posture

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Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
- D Manuscript Preparation
- E Funds Collection

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Abstract

Background & Study Aim: The role of body posture is often underestimated in a sport performance. The sport training often focuses only on achieving the highest level of performance. On the other hand, this type of condition can be connected with serious health problems which can be one of the reasons of career-ending injury. One of them, which can often occur during the athletes training are low and upper back pain. Back pain syndromes are often completely preventable. The highest level of postural control and postural stability is required in sport when the athletes have to maintain the position in static or dynamic position during single-leg stance. The main aim of the study was the answer to question: whether is a significance difference between value of cervical lordosis and lumbar lordosis value during 2 years of study in *Special Education of Security Sections* (in pre-test and post-test)? The question is how the trainer can integrate the training with corrective exercises?

Material & Methods: Nineteen healthy students participated in this study (mean age = 20.2 ± 1.32 years; mean height = 1.80 ± 0.05 m; mean mass = 76.93 ± 7.90 kg). The participants practiced combat sports in average 5.8 ± 2.52 years. Before study, participants responded questions about personal information (age, sex, combat sport, length of sport practice and regeneration in their sport practise). DTP-3 diagnostic system was used for measuring body posture. The examination includes palpating and marking chosen points (the skin projection of the left and right lateral parts of the acromion, bilateral posterior superior iliac spine and 22 processus spinosi C3–L5. The chosen points were measured by touching the stylus of the sensor and then transmitted into the computer. The participant's free standing position was measured 3 times in pre-test and post-test.

Results: The results showed that field of study *Special Education of Security Sections* had positive impact of value cervical and lumbar lordosis in a group of students (cervical lordosis: pre-test 3.57 ± 0.99; post-test 2.84 ± 0.89 and lumbar lordosis: pre-test 4.82 ± 0.73; post-test 3.89 ± 0.89). The paired samples t-test was used for cervical lordosis value and lumbar lordosis value (p = 0.000001; p = 0.000065; the significance level 95%).

Conclusions: According to the results, the field of study *Special Education of Security Sections* at Faculty of Sports Study improved the value of cervical lordosis and lumbar lordosis and it was also observed a shift from asymmetry between shoulders position. The design of the field of study includes also corrective exercises and theoretical lectures about importance of body posture and postural stability.

Keywords: back pain · education · lordosis · postural · spine · stability

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DTP 3 diagnostic system - a somatographic method which enables a graphic and numeric analysis of selected points from body. This system allows assessing body posture.

Postural stability - is the ability to sustain the body in equilibrium. Postural stability depends on sensory detection of body movements and integration of sensorimotor information which are processed in the central nervous system.

Special Education for Security Sections – the field of study at Faculty of Sports Study (Masaryk University, Czech Republic), which focuses on preparing qualified, university educated specialists in security services.

INTRODUCTION

Special Education of Security Sections is a unique field of study offered by Masaryk University (Brno, Czech Republic). The study is covered by university programme Physical Education and Sport and it focuses on preparing qualified, university educated specialists in security services. Graduates can find employment as university educated specialists in the practical application through purpose-disciplinary regulations, especially in security and special armed forces. The labour market is also open to graduates in civil security services, correctional facilities, airport and railway protection, private martial arts and at position of self-defence teacher and at the Police of the Czech Republic. Masaryk University was awarded the ECTS Label by the European Commission as proof of the university’s high standards of excellence in 2010.

Learning outcomes are included in ECTS standards for every single course as well as for field of study *Special Education of Security Section*. They are defined in cognitive, affective, and psychomotor domains. Outcomes for psychomotor domain express the level of expected physical performance with definition below:

Student with individual’s sex and age is able to present practical skills in any kind of physical activity and repeat new sport skills only by visual ability.

Student can naturally apply all practical skills in self-defence model situations.

Among all basic theoretical subjects in the sport sciences, students are prepared also practically subjects (compulsory courses in 2nd, 3rd, 4th, and 5th term). Every term consists of thirteen weeks of teaching. It is expected that students practised for 442 hour in controlled lectures under supervision of teachers between two exam periods (Tables 1 and 2).

Students attend practically compulsory sport courses like swimming, gymnastics, track and fields, fitness, and bouldering. *Special education of security sections* disposes also by two groups of special combative courses. One group consisted of four combat sports: boxing, wrestling, judo, karate and aikido. Second group of special course focused on personal self-defence, self-defence for specific groups and preparatory exercises for self-defence (Table 2).

Table 1. List of compulsory sports at the field of study (2nd and 3rd term)

Course	Lectures per week	Lectures in total	Course	Lectures per week	Lectures in total
2nd term	9	117	3rd term	11	143
swimming	1	13	gymnastics	1	13
boxing	2	26	karate	3	39
wrestling	3	39	judo	3	39
bouldering	2	26	boxing	2	26
track and fields	1	13	wrestling	2	26

Table 2. List of compulsory sports at the field of study (4th and 5th term)

Course	Lectures per week	Lectures in total	Course	Lectures per week	Lectures in total
4th term	10	130	5th term	4	52
gymnastics	1	13	self-defence	3	39
preparatory exercises in self-defence	1	13	self-defence for specific groups	1	13
aikido	3	39			
judo	2	26			
karate	2	26			
fitness exercises	1	13			

In the colloquial meaning *aikido* is mentioned as martial arts and even combat sport. Kalina and Barczyński [1] in broad analysis of the milestones of martial arts, combat sports, arts of self-defence, in promoting neo-gladiator games qualify *aikido* to the arts of self-defence. The authors of this analysis underline that turn of 20th and 21st c. also revived interests on the border of arts of self-defence and dance: Indian *kalaripayattu*, Brazilian *capoeira*, and also establishment of the arts of self-defence in 20th c. which are not rooted in the traditional military training: *aikido* based on gentle and relatively gentle counteractive measures; *bapkido*, a combination of gentle, relative gentle and heavy counteractive measures; *krav-maga*, a combination of aggressive defence with offensive techniques. Part of methods and combat assets characteristic for of the ones arts of self-defence are filling the contents of self-defence programs for students of the *Security Sections*.

It is known, that martial arts can have positive influence on many aspects as functional movements in *MMA neo-gladiators* [2], or posture stability in karate practitioners [3-4].

The authors, as signatories of the *Czestochowa Declarations 2015: HMA against MMA* do not identify with MMA as a sport [5]. However, it is an objective fact that still the main candidates for the *neo-gladiators* are recruiting among combat sports and martial arts athletes.

Especially, internal martial arts are aimed to gain better postural control [6]. There is no evidence that sports activities mentioned above can have positive impact on posture of students. It is expected that controlled lectures under supervision of highly qualified teachers can improve posture of students and prevent painful disorders of locomotors apparatus. Students of *Special Education of Security Section* are taught to compensate postural overloading caused by repetitive sports tasks and they are also educated to use their body language properly. It is very important to hold upright posture to show straight mind and self-confidence martial arts and even more in self-defence [7]. It follows that human posture reflects not only the state of musculoskeletal system but also internal – psychological well-being of each individual.

The majority of pathologies of posture are connected with painful disorders of locomotors apparatus which can lead to involuntary termination sporting, working career. The most common painful disorders are neck pain and low back pain. The neck has a complicated

structure, containing several joints with capsules, discs, ligaments, fasciae and muscles, which all of them may become hypersensitive to loading in conditions of pain. Pain may arise directly from painful muscle during contraction, or forceful muscle contraction may provoke pain from deep joint structures due to increased mechanical stress [8]. Chiu, Ku and Lee [9] explain a principle of this pathology together with an increased cervical lordosis. In this condition the pressure is concentrated on the posterior part of the vertebral bodies and intervertebral discs of the vertebral joints. In addition, there is evidence that overloaded both right and left trapezius and levator scapulae on the side of dominant arm together with spine extensors can cause painful disorders in a region of neck and shoulder [10].

In the lumbosacral region of the spine, the relations between the angle of declivity of the sacrum and radius and inclination of curvature of the lower spine show correlation with the painful disorder and pathology [11].

The main aim of the study was the answer to question: whether is a significance difference between value of cervical lordosis and lumbar lordosis value during 2 years of study in *Special Education of Security Sections* (pre-test and post-test)?

MATERIAL AND METHODS

Participants

Nineteen healthy students (only men) participated in this study (mean age = 20.2 ± 1.32 years; mean height = 1.80 ± 0.05 m; mean mass = 76.93 ± 7.90 kg) (Table 3). The athletes practiced combat sports in average 5.8 ± 2.52 years. Before study, participants responded questions focused on personal information (age, sex, combat sport, length of sport practice and regeneration in their sport practise). All participants signed the informed term of consent. The study was approved by the local Ethical Committee.

Table 3. The mean age, height and weight of students (n = 19)

Age (years)		Height (m)		Weight (kg)	
Mean	SD	Mean	SD	Mean	SD
20.2	1.32	1.8	0.05	76.93	7.9

Methods

The body posture was measured with using DTP-3 diagnostic system. It was not allowed to speak during the measuring of body posture and there were only

experimenter and the participant in the room in order to ensuring a calm environment as much as possible. The temperature was set up for 24° Celsius in the room during the testing. The examination includes palpating and marking chosen points (the skin projection of the left and right lateral parts of the acromion, bilateral posterior superior iliac spine and 22 processus spinosi C3–L5. The chosen points were measured by touching the stylus of the sensor and then transmitted into the computer. The participant’s free standing position was measured 3 times in pre-test and post-test. The results are listed as a mean value of these measurements.

Statistical analyses

Analyses were conducted using programme Statistica 12.0. Paired t-test for dependent samples was used to analyse the data. The significance level was set at $p < 0.05$ and results are given as the mean \pm SD.

RESULTS

A mean value of cervical lordosis and lumbar lordosis in group decreased during 2 years of studying at the Faculty of Sports Studies (cervical lordosis: pre-test 3.57 ± 0.99 ; post-test 2.84 ± 0.89 and lumbar lordosis: pre-test 4.82 ± 0.73 ; post-test 3.89 ± 0.89) (Tables 4 and 5).

Table 4. The mean value of cervical lordosis (expressed in centimetres) of students (n = 19)

Cervical lordosis value (pre-test)		Cervical lordosis value (post-test)	
Mean	SD	Mean	SD
3.57	0.99	2.84	0.89

Table 5. The mean value of lumbar lordosis (expressed in centimetres) of students (n = 19)

Lumbar lordosis value (pre-test)		Lumbar lordosis value (post-test)	
Mean	SD	Mean	SD
4.82	0.73	3.89	0.89

It was supposed any changes between the value of cervical and lumbar lordosis. The alternative hypothesis was contrary to the null hypothesis. The paired t-test for dependent samples was used for cervical lordosis value and lumbar lordosis value ($p = 0.000001$; $p = 0.000065$; the significance level 95%). We accepted the alternative hypothesis (there is a significance level between the values of cervical and lumbar lordosis).

We calculated effect size by Cohen’s d in view of finding the magnitude of differences (cervical lordosis: $d = 0.775$; lumbar lordosis $d = 1.142$ which indicates a large effect).

Secondly, it was reported a shift from asymmetry between shoulder position and (pre-test 7.8 mm; post-test 2.05 mm) (Table 6). Likewise, the paired t-test for dependent samples was used for calculating the statistical significance. According to the result, a significant difference was found ($p = 0.00043$; the significance level 95%).

Table 6. Mean values of acromial angle (expressed in degrees) of students (n = 19)

Acromial angle: pre-test		Acromial angle: post-test	
Mean	SD	Mean	SD
1.56	0.54	0.41	0.25

1 degree means 5 mm difference between the symmetry of shoulders

The significant difference were found between the mean value of posterior superior spine angle in pre-test and post-test ($p = 0.000001$; the significance level 95%). It was observed shift from asymmetry between sides (pre-test 3.48 mm; post-test 0.78 mm) (Table 7).

Table 7. Mean values of posterior superior spine angle (expressed in degrees) of students (n = 19)

Posterior superior spine angle (pre-test)		Posterior superior spine angle (post-test)	
Mean	SD	Mean	SD
1.16	0.31	0.26	0.18

1 degree means 3 mm difference in the pelvic area

We calculated effect size by Cohen’s d in view of finding the magnitude of differences (acromial angle: $d = 2.733$ posterior superior spine angle $d = 3.550$ which indicates a large effect).

DISCUSSION

The study sought to identify if the *Special Education of Security Sections* (the field of study offered by Masaryk University) would result changes in body postures. The data gathered in the study suggest that design of *Special Education of Security Sections* can have a positive effect on body posture and preventing painful disorders. We are convinced that this fact is connected

with design of the field of study (every lesson is under the supervision of highly qualified teachers who present the importance of including compensatory exercises as an important part of sport participation).

Nowadays, the measurement of values of cervical and lumbar lordosis is considered to be the key component of assessing postural pathologies. Based on research, several factors affect mean values of these components such as age, gender or sport. There is overwhelming evidence corroborating these opinions that mean value and angle of lumbar lordosis significantly correlate with spondylolysis [12]. Then, measurement of lordosis values is key component for prevention in population. According to the results (expressed in centimetres), it was found difference between pre-test and post-test in mean values of cervical and lumbar lordosis (cervical lordosis: pre-test 3.57 ± 0.99 , post-test 2.84 ± 0.89 ; lumbar lordosis pre-test 4.82 ± 0.73 , post-test 3.89 ± 0.89).

Subsequently, asymmetry between shoulder positions was evaluated. This imbalance is often responsible for neck or back pain. Shoulders asymmetry is often observed in group of people who suffered from scoliosis. On the other hand, it has been already proved that not only scoliosis is key factor. Furthermore, we can find others factors which positively correlate with shoulders asymmetry with no evidence based of scoliosis [13]. One of them is lateral dominance which is responsible for using only one side of the body. The final result of using regular, repeated motions can be factor of overloading of shoulder internal rotator muscles. Therefore, a mean values of acromial and posterior superior spine angle (expressed in degrees) were assessed (acromion angle: pre-test 1.56 ± 0.54 ; post-test 0.41 ± 0.25 and posterior superior spine angle: pre-test 0.99 ± 0.66 ; post-test 0.26 ± 0.18). We calculated effect size by Cohen's d in view of finding the magnitude of differences (acromial angle: $d = 2.733$; posterior superior spine angle: $d = 3.550$; both indicate a large effect size).

The results show improving body posture from the view of anatomy. The current discussion is about how upright body posture can have impact on self-confidence which is essential in security forces. Keeping the body in an upright position (posture) affects not only what others think about the person, but also it can reveal a person's current state of mind. Then, the relationship between body and mind is reciprocal [14]. The positive effects of therapeutic and rehabilitative aikido exercises confirmed among other the studies made by Mroczkowski and Jaskólski [15, 16].

Crime is the result of a dynamic set of visible and progressively aggressive interactions between offender and person who is targeted by offender [17]. This process also includes recognition of movement kinematics of possible victim. We are convinced that body posture, type of walking, coordination and self-confidence are factors which influence decision-making process of offender in terms of victim selection. Some studies have already proved this assumption of possible victim selection [18-20]. Self-defence exercises, combat sports and martial arts are elementary subjects in education of contemporary body guards and detectives (in schools and courses) in many countries [21-24].

This information is now adopted into the self-defence classes or courses which are highly popular in society with aim of prevention of crime. Self-defence programmes include learning different physical techniques of martial arts but also some parts of programme are focused on using body language as a tool of prevention or how to enhance self-confidence. It was confirmed that even short self-defence course has positive influence in reducing vulnerability to physical attack [25]. Findings from the study are not caused only by attained practically compulsory sport courses. Theoretical subjects also provide the necessary insight into anatomy, health physical education, corrective exercises, sport psychology or biomechanics. Subsequently, students are able to apply their knowledge within their own experience.

CONCLUSIONS

According to the findings, the field of study *Special Education of Security Sections* provided observed change in values of lordosis which lead to better upright posture and it was observed a shift from asymmetry between shoulders position. Dozens of sports and recreational activities are using nonverbal communications without knowing their participants of doing it. A closer look at nonverbal communications is often underestimated, but athletes often refers that they are able to predict next movements of their opponents. A very similar principle of communication with using body language can be found in relation to improving posture. Next studies should include the assessment of self-confidence with aim of define the role of psychological well-being on postural assessment.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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