Kałużny Krystian, Kochański Bartosz, Szadkowska Renata, Kałużn Annaa, Cichosz Michał, Zukow Walery, Hagner Wojciech, Hagner-Derengowska Magdalena. The assessment of the relation between the transverse abdominal muscle (TRA) and the occurrence of injuries and contusions at university students. Pedagogy and Psychology of Sport. 2020;6(3):33-43. elSSN 2450-6605. DOI http://dx.doi.org/10.12775/PPS.2020.06.03.003
https://apcz.umk.pl/czasopisma/index.php/PPS/article/view/PPS.2020.06.03.003
https://zenodo.org/record/4039544

The journal has had 5 points in Ministry of Science and Higher Education parametric evaluation. § 8. 2) and § 12. 1. 2) 22.02.2019.

The authors declare that there is no conflict of interests regarding the publication of this paper.

Received: 01.09.2020. Revised: 07.09.2020. Accepted: 20.09.2020.

The assessment of the relation between the transverse abdominal muscle (TRA) and the occurrence of injuries and contusions at university students

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ABSTRACT

PURPOSE: The aim of this study is the assessment of the relation between the transverse abdominal muscle (TRA) activity and the risk of occurrence of injuries and contusions as well as the number of injuries in a six-month observation.

MATERIALS AND METHODS: The research was conducted in a group of 50 people, 29 men and 21 women. The assessment of the TRA activity was conducted with the use of Pressure Biofeedback Stabilizer (PBU) and the FMS test. The examined were divided into two groups. First comprises people with the proper transverse abdominal muscle activity, second consists of people with improper results.

RESULTS: People with the proper transverse abdominal muscle activity gained higher average result (20,04 vs 18,11) and median value (20,00 vs 18,00) than people with the improper TRA activity according to the FMS test. The statistical analysis revealed that people with the improper TRA activity had statistically significant higher results in the FMS test than people with the improper TRA activity. The average number of injuries and contusions among people with the proper TRA activity equaled 0,70 (median 0,00), whereas, among people with the improper TRA activity equaled 1,92 (median 2,00).
The statistical analysis revealed that people with the improper TRA activity had a statistically significant higher number of injuries and contusions during previous 6 months than people with the proper TRA activity.

CONCLUSIONS: 1. The TRA activity has statistically significant effect on the risk of injuries and contusions occurrence, which according to the FMS test is higher among people with the improper TRA activity. 2. People with the improper TRA activity had remarkably higher number of injuries and contusions during previous 6 months than people with the proper TRA activity. 3. Statistically significant relation between the TRA activity and the number of injuries and contusions was demonstrated.

KEY WORDS: transverse abdominal muscle, FMS, injuries and contusions, TRA

INTRODUCTION

The modern functional model divides lumbar spine muscles into local stabilizers, mono articular global stabilizers and multi articular global stabilizers [1,2,3]. The main role of local muscles group is to provide the spine stability by feedforward. This group comprises the diaphragm, the transverse abdominal muscle (TRA), the fibers deep multifidus muscle, the fiber back of the lumbar muscle and the pelvic floor muscles [4,5,6]. The transverse abdominal muscle plays an important role the spine stabilization. Many scientific reports show the relation between the

incorrect motoric control as well as risk of injury and the TRA activity [7,8,9].

PURPOSE

The aim of the research is the assessment of the relation between the transverse abdominal muscle (TRA) activity and the risk of occurrence of injuries and contusions as well as the number of injuries in a six-month observation.

MATERIALS AND METHODS

The research was conducted with the approval of the Bioethics Committee of University of Bydgoszcz. The research participants were recruited on the basis of advertisements put on the Internet. The research was conducted in a group of 50 people, 29 men and 21 women.

The criteria for inclusion: participants age bracket 18-35

The citeria fo exlusion: age < 18 and > 36 , pregnancy, cancer diseases, operative interventions carried out on the spine, traffic accidents or injuries, the absence of informed consent to participate in the research and diagnosed respiratory diseases, which could affect the TRA activity measurement with the use of Pressure Biofeedback Stabilizer (PBU).

The assessment of the TRA activity was conducted among all participants with the use of the Pressure Biofeedback Stabilizer (PBU) and the FMS test.

1. The assessment of the TRA activity with the use of the Pressure Biofeedback Stabilizer (PBU).

The analysis of the assessment of the TRA activity is based on evaluation of ability to perform a proper muscle contraction, which is assessed with the use of the Pressure Biofeedback Stabilizer (PBU). PBU is simple in its design device, which enables to assess and register pressure changes while performing movements in a lumbar-pelvic area. It allows objective monitoring and current correction of the lumbar-pelvic structure positioning while conducting tests and movement exercises. PBU has one compartment of 16,7 x 24,0, divided into three parts and it measures pressure ranging from 0 to 200 mmHg. The air is injected by an air pomp and a pressure gauge, which enables a readout of measurement results. While testing each patient, the compartment is placed between a particular body part and the surface. The mechanism of PBU action is simple and based on the pressure differences analysis of the compartment filled with air while performing body pressure changes. Putting pressure on the device results in the increase of pressure in its

compartments, releasing pressure on the device results in the decrease of pressure in its compartments [10].

1. The functional assessment with the use of the Functional Movement Screen test.

The research was conducted according to the FMS test protocol and with the use of the FMS set (a base, a pole, two bars and a gum) The test comprises seven trials assessing muscle flexibility, joints mobility, stabilization, balance and coordination, which are as follows: 1. a deep squart, 2. a hurdle step, 3. an in-line lunge, 4. a shoulder mobility, 5. an active straight leg raise, 6. a trunk stability push-up, 7. a rotational stability.

Each participant performed each test three times and the best result was assessed .The observation was made during performing a movement in a frontal and a sagittal plane. Each of the mentioned above parts of the test was assessed with the scale ranging from 0 to 3 points: 3 points- the test run properly, absence of compensation patterns; 2 points: the test run properly, compensation patterns present; 1 point: lack of possibility to run the test; 0 points: the pain occurred while running the test [11,12].

The reading of the test was made by a professional physiotherapist properly trained in the scope of using the Pressure Biofeedback Stabilizer (PBU) and holding the FMS International Certificate. The participants were divided into two groups. First comprises people with the proper TRA activity measured with the use of PBU <-4 TO -10 mmHg>. Second consist of people with the result ranging from <+10 to -3>. The statistic analysis was made in Statistica 12.5. Statistical significance was taken as **p<0,05**.

RESULTS

In the achieved FMS test results (Tab. I) the difference in the average value and median value is in favor of participants with the proper TRA activity. Their average score (20,04 vs 18,11) and median (20,00 vs 18,00) were higher. The lowest result in the group with the proper TRA is 18, while the lowest in the second was 15. The highest achieved result in both groups was 21. The statistic analysis (Tab. II and Fig. 1) showed that people with the proper TRA activity have statistically significant , (**p<0,05**) higher results in the FMS test, than people with the improper TRA activity.

Tab. I. The descriptive statistics for the FMS test results with reference to the transverse abdominal muscle activity.

variable	The aggregated results The descriptive statistics							
	TRA activity	M	Me	Min	Max	Lower quartile	Upper quartile	SD
FMS final result	Proper	20,04	20,00	18,00	21,00	20,00	21,00	0,90
FMS final result	Improper	18,11	18,00	15,00	21,00	17,00	19,00	1,53

Tab. II. The comparison of the FMS test final result between the groups.

Variable	U Manna-Whitney test with the respect to the variable: the TRA activity; statistically significant results with p <,05000				
	The sum o rank: Correct	The sum of rank Incorrect	U	Z	p
FMS final result	838,5000	436,5000	85,50000	4,388556	0,000011

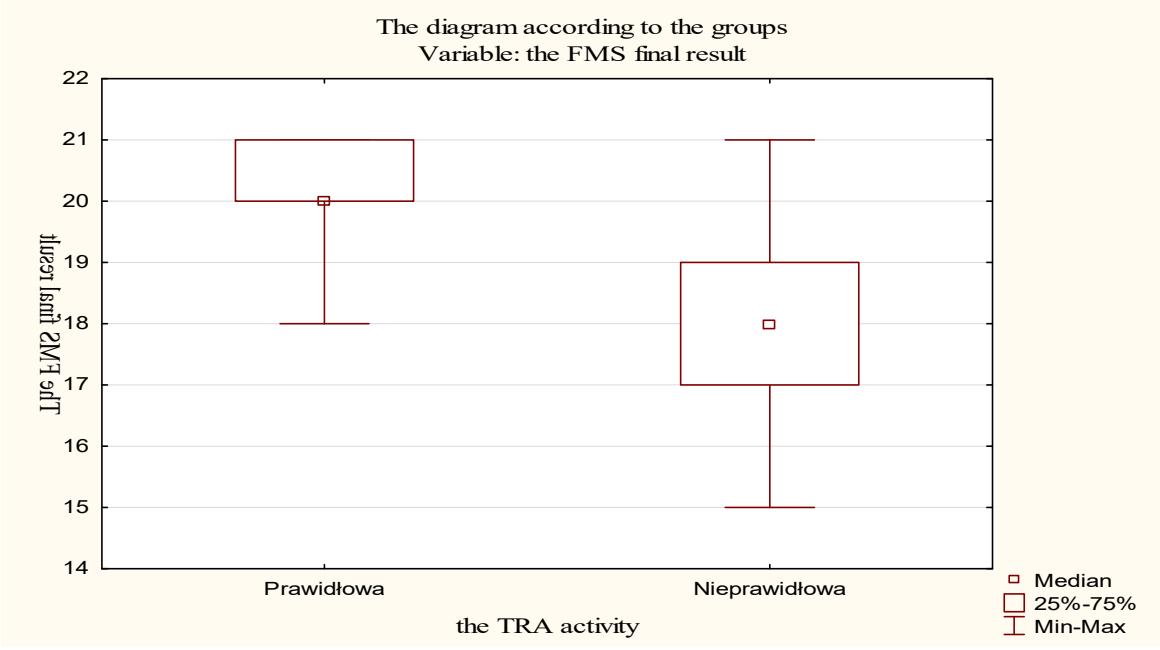

Fig. 1. The comparison of the FMS final result between the groups.

Number of injuries and contusions in the past 6 months was also assessed. (Tab III i Tab. IV) People with the proper TRA activity had average number of injuries and contusions in the past 6 months reaching 0,70 (median 0,00), whereas among people with the improper TRA activity the average result was 1,92 (median 2,00). The statistic analysis (Tab. IV) revealed that people with the improper TRA activity had statistically significant (**p<0,05**) higher number of injuries and contusions in the past six months than people with the proper TRA.

Tab. III. The descriptive statistics – the number of injuries and contusions in the past 6 months.

Variable	The aggregated results The descriptive statistics							
	the TR activity	M	Me	Min	Max	Lower quartile	Upper quartile	SD
The number of injuries an contusions in the past months.	Proper	0,70	0,00	0,00	3,00	0,00	1,00	0,99
The number of injuries and contusions in the past 6 months.	Improper	1,92	2,00	0,00	3,00	2,00	2,00	0,89

Tab. IV. The comparison of the number of injuries and contusions in the past 6 months between the groups.

Variable	U Manna-Whitney test with the respect to the variable: the TRA activity; statistically significant results with p <,05000				
	The sum of rank: Correct	The sum of rank: Incorrect	U	Z	p
The number of injuries an contusions in the past si months	424,5000	850,5000	124,5000	-3,63124	**0,000282**

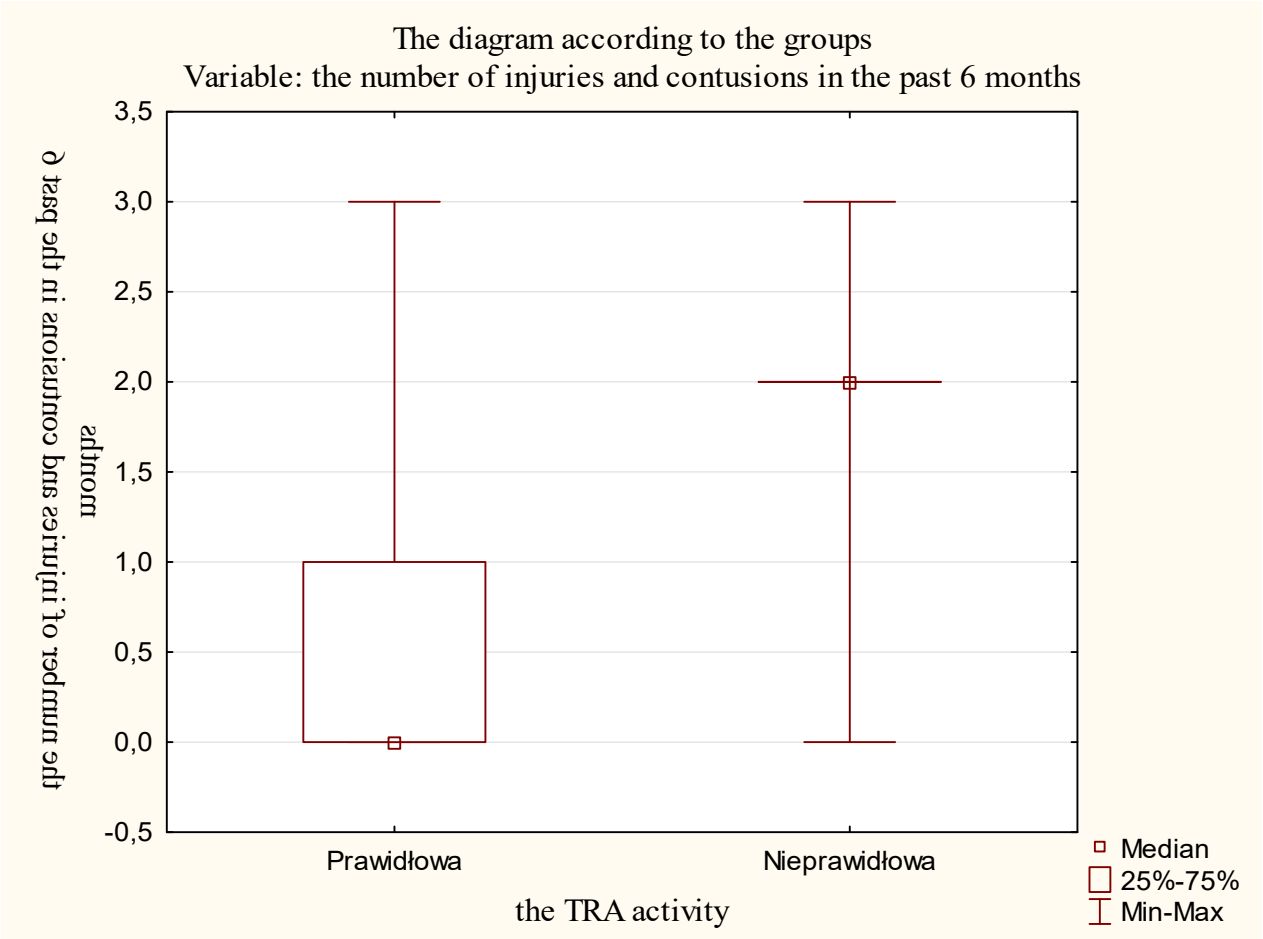

Fig. 2. The comparison of the number of injuries and contusions in the past 6 months between the groups.

The assessment of the relation between the TRA activity, the FMS test results, the number of injuries and contusions and the number of spine pain episodes in the past 6 months.

The correlation between the TRA activity and the number of injuries and contusions in the past 6 months was evaluated. The analysis was based on the Spearman's rank correlation. The statistically significant relation – **p<0,05** was showed between the TRA activity and the number of injuries and contusions in the past 6 months.

Tab. V. The Spearman's rank correlation – the TRA activity vs the number of injuries and contusions.

Variable	The Spearman's rank correlation Indicated correlation coordinates are statistically significant with p <,05000	
	The TRA activity (mmHg)	The number of injuries and contusions in the past 6 months
The TRA activity (mmHg)	1,000000	**0,490751**
The number of injuries an contusions in the past 6 months	**0,490751**	1,000000

DISCUSSION

There is no definite answer whether motor control disorders initially cause spine pain or spine pain causes changes in the motor control. There are reports which indicate that processes mentioned above may exist simultaneously. The dysfunction of local system stability develops very often after first episode of pain and pathology in the spine area [13]. It is particularly important that system stability disorders may occur even when the pain in the spine area ceased entirely [14,15]. These disorders may cause bigger tendency to the ailments recurrence, a faster progress of the degenerative changes, the occurrence of the muscle global imbalance, which may lead to a higher number of injuries and contusions [13].

The modern science of anatomy and physiology treats human organism more as a single, homogenous system than single groups of muscles and joints, which have specific mobility and role. Particular muscles, tissues and nerves join smoothly with next group of muscles, fascia and connective tissue forming a single locomotor system. The whole organism is interdependent: the incorrect functioning of one element has an impact on functioning of remaining elements [16]. Our own research showed, inter alia, that people who activated the transverse abdominal muscle properly gained better results in the Functional Movement Screen test in trials: a relocation of the upper limb over the hurdle, a squat in a slight step position and a spine rotary stability. Furthermore, it was stated that people with the improper TRA activity in the past 6 months had more injuries and contusions than people who activated the transverse abdominal muscle properly. A human organism may be compared to a masterful musical instrument, which when used improperly, eventually becomes out of tune. Every part of the tissue, the nervous system, which is functioning incorrectly constitutes a challenge for the functioning of a human, his integrity and may

become a source of frustration. Most of the lifestyles and life attitudes are reflected in human bodies. Even among people who exercise regularly some disproportions may occur: some parts of the muscle become excessively tensed and require muscle relaxation (i.e. a strength training or bodybuilding), other muscles are too frail, weak and requires strengthening (i.e. an excessive stretching or gymnastics), both cases may result in pain ailments, injuries or contusions. There are many conditions and determinants of presence of the same ailment and no conventional set of exercises will guarantee the success of the therapy. The process of the treatment should start from the basics: the equalization of the left and right body sides disproportion, the acquisition of awareness and control of the movement by the patient till the moment when one is able to distinguish a gentle difference in particular muscles work, and subsequently, according to the needs, work on the central stabilization [17].

The analysis of 10 most important basic life support systems of human body — cardiovascular (CVS), respiratory (RS), nervous (NS), digestive (DS), endocrine (ES), immune (IS), excretory (EXS), brain (BS), musculo-skeletal (MSS), hematopoietic (HS) was carried out. Based on this analysis two levels of ensuring the reliability of organism's work were revealed: sequential and parallel.The system of logical equations for reduced sequential system is: Ys1 = CVS RS BS, where is the notation for the conjunctions of set elements. The system of logical equations for the reduced parallel system is: Ys2 = NS DS ES IS HS EXS MSS, where is the disjunction of the scheme elements. Visualization of human STC changes the concept of the kinetics of age-related changes in the organism and the role of determinants of health as a stable factor accompanying a uniform, smooth transition from the most pronounced functions of the body to their gradual extinction. For human STC is formulated the following regularity kinetics of involutionary processes: after 30 years of age in the human body morphological changes regress in arithmetic progression, and the functions of organs in a geometric one. Assumption of health as a state redundancy of functions is suggested [18].

The research is devoted to the fundamental issue of medicine and biology – the study of factors limiting the life span of a person. As a model, the system of adaptation of the human body to the forces of natural gravity is chosen, the disadaptation to which manifests itself in falls and everyday injuries. The object of the study was the selection of severe fractures of bone tissue due to fall, taken in the age aspect. Statistical and meta-analytical research methods were used. It is shown that the age-related increase in mortality due to household falls, coming to severe bone fractures, is non-linear and increases in geometric progression. As a result of the coincidence of the age characteristics of bone fragility and age-related kidney function, an assumption is made about the role of involution of the renal tissue in the development of osteoporosis in the elderly and the need for a new approach to the prevention of osteoporosis and domestic injuries [19].

CONCLUSIONS.

1. The TRA activity has a statistically significant impact on risk of injuries and contusions occurrence. According to the FMS test, it is higher among people with the improper TRA activity.
2. People with the improper TRA activity have a statistically significant higher number of injuries and contusions in the past 6 months than people with the proper TRA activity.
3. A statistically significant relation between the TRA activity and the number of injuries and contusions was demonstrated.

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