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A method of diagnosing body control errors during a simple motor activity in relation to cognitive--behavioural influence on personal safety

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- **A** Study Design
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Abstract

Background & Study Aim: Ergonomic human activity during daily activities helps to ptotect against various health risks, but also makes the activity more effective. During ontogenesis, correct mechanisms are replaced by incorrect ones. A child of 3-4 years old uses lower limb flexion to pick up an object from the ground, while adults usually perform forward bending (putting undue strain on the spine). This is an important consideration from the perspective of personal safety concerns. The aim of this study is to find out body control during a simple motor activity in relation to cognitive-behavioural influence on personal safety.

Material & Methods: A total of 108 (80 females and 28 males) physiotherapy students aged 21.4 ±1.54 years (62.32 ±10.24kg, 170.9 ±8.21 cm) were studied. The students were randomly divided into groups educated on safe falling by the rigorous method (A), n = 54 and trained by a method that preferred playful forms of exercises (B), n = 54. In each of the six education groups, the exercises observed in this experiment were performed first by students A (and students B observed the events). Motor tasks were first performed without additional restraints, then with an object – a notebook – on their head. The task consisted of walking with a change of direction on an 8x5 metre mat while holding a tennis ball in the palm of the upright hand. At a signal, students vigorously dropped the ball and grabbed it with both hands, after bouncing off the ground at set heights – chin, hips, knees and below the knees, in sequence. After grasping the ball, the students remained motionless for 2-3 seconds. In the second series of exercises (with the object on the head), the grasping of the ball at chin height was eliminated and the remaining three "test heights" were asked alternately without a fixed key. It was a mistake to perform a forward bend instead of a half squat or a squat (according to the set height of the ball grasp), i.e. using the cushioning function of the lower limbs. In the second series of exercises, if the student performed the task correctly in an ergonomic sense, the fall of the notebook from the head was not considered an error.

Results: The smallest number of students (on average about 15%; A: 17.9%; B: 12.3%) erred in catching the ball at chin height. At hip height, errors averaged 97.2% (A: 98.8%; B: 95.7%). During the first series, no student correctly caught the ball at or below knee height. A modification of the second series of exercises (notebook overhead) resulted in an improvement in performance: grasping the ball at hip height errors were reduced, respectively A to 72.2%, B to 88.3% ($p<0.05$); at knee height A to 85.8%, B to 92%; at below-knee height A to 84.6%, B to 87%.

Conclusions: The opportunity of the B students to observe both series of exercises in advance (cognitive aspect) was not a sufficient stimulus to modify the quality of their repetition of the same motor tasks (behavioural aspect). Thus, there are grounds to argue – abstracting from the motor patterns in the family and in the everyday social environment – that a physical education formula modelled on sports techniques does not provide stimuli to stimulate this cognitive-behavioural layer of adaptation to rational (ergonomic) motor action.

Keywords: innovative agonology • motor safety • special motor skills

Conflict of interest: Authors have declared that no competing interest exists

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Motor safety – is consciousness of the person undertaking to solve a motor task or consciousness the subject who has the right to encourage and even enforce from this person that would perform the motor activity, who is able to do it without the risk of the loss of life, injuries or other adverse health effects [1].

Innovative self-defence – involves using verbal and/or behavioural methods and means along with available items in counteracting each attack on any good of an individual (honour, dignity, life, health, property, etc.), whereas a defender submits his/her actions to the criteria of prophylactic and therapeutic agonology, considering the most general directive of efficient leading of any struggles and also universal assumption of selfdefence training as absolutely paramount [13].

INTRODUCTION

In ontogeny, motor skills or the realization of daily goals and self-service tasks (preparing and eating meals, toileting, cleaning, shopping, etc.) are formed mainly through imitation of people from the immediate environment (family members at the earliest). Spontaneous imitation fills the time of play with other children (not always peers), but already in the period of early school education (kindergarten, which, however, should be assigned an elite status) interventions of professional teachers appear. Motor patterns are also provided by electronic media and this educational channel only partly belongs to virtual reality. Instead, it has a significant impact on the sphere of special motor skills, which includes many of life's activities – precisely those that support daily self-care (cycling, scootering, etc.) and these skills are acquired by most children before they start school education. However, in ontogeny, special motor skills primarily include leisure, health recreation, gainful employment (so sports, dance, music and other arts, etc. fall into these categories, but the emotional background and motivation are different) and therapy and rehabilitation in the sense that the patient learns previously unknown motor activities. So we have entered this period of ontogenesis, which is successively subject to: compulsory schooling; training of professionals for various professions; performance of gainful employment. Individual physical activity remaining in connection with leisure activities, with the satisfaction of curiosity, sometimes with even the risk of losing one's life, as well as the need for therapeutic and rehabilitation services, affects, or may affect, everyone regardless of age.

Thus, the basic issue boils down to the question of those motor activities that provide personal safety (motor, exercise – see glossary [1]) depending on the environment in which a person operates. When operating on land, but also on board of a passenger plane, ship, ferry, etc. important skills include: safe fall skill [2-6], ability to avoid collisions [7] and many qualified for survival, especially self-defence [8-10]). When operating in an aquatic environment, the primary factor that increases the likelihood of survival is the ability to swim. While the above-mentioned special motor activities should be the content of school educational programs (not necessarily called physical education), already the activity of a person in the air space in various roles (pilot, parachutist, etc.) is closely related to individual choice and is not subject to the rigors of post-school education.

Our long experience of academic teachers of faculties of physical education and physiotherapy reassures us (the result of participatory observation) that there is a lack of concern in the family, and at the levels of education preceding higher education, for the formation of motor habits that are correct in the ergonomic sense, which primarily concern daily self-service physical activity.

The aim of this study is to find out body control during a simple motor activity in relation to cognitive-behavioural influence on personal safety.

MATERIAL AND METHODS

Participants

A total of 108 (80 females and 28 males) physiotherapy students aged 21.4 ±1.54 years (62.32 ±10.24kg, 170.9 ±8.21 cm) were studied. The students were randomly divided into groups educated on safe falling by the rigorous method (A), n = 54 and trained by a method that preferred playful forms of exercises (B), n = 54.

Study design

We assume that among the daily motor activities that can indicate respecting or ignoring ergonomic principles is the need to lower the center of gravity, taking a vertical posture as a starting point, such as to lift an item off the ground or to place it at the height of one's own knees or lower (Photo 1). However, empirical verification of this phenomenon in a laboratory setting is possible after eliminating factors that could be a source of injury in an ergonomically incompatible action (Photo 2). Such a criterion is fulfilled by a bouncing tennis ball (a small spherical mass traveling upward from the ground).

So, the essence of the experiment is to grasp a tennis ball bounced off the ground at a predetermined body height (hips, knees, below the knees), after learning the motor aspect of the common element of the set of exercises, that is, the need to grasp a tennis ball bounced off the ground. We called this first part of the experimental cycle of motor tasks "pre-test" (grasping the ball at neck height three times). The task consisted of walking with a change of direction on an 8x5 metre mat while holding a tennis ball in the palm of the upright hand (Figure 1). At a signal, students vigorously dropped the ball and grabbed it with both hands. After grasping the ball, the students remained motionless for 2-3 seconds.

Photo 1. Ergonomically compliant lifting of a tennis ball from the ground by a five-year-old girl.

Photo 2. An ergonomically incompatible attempt by an adult male to lift a tennis ball off the ground.

Students were randomly divided into groups educated on safe falling trained by the rigorous method (A), n = 54 and trained by a method that preferred playful forms of exercises (B), n = 54. In each of the six educational groups (functioning in an administrative sense), for research purposes, students were divided into two subgroups of 9 students each: A1, B1 up to A6, B6. In each of the six education groups (G1 to G6), the exercises observed in this experiment were performed first by students subgroups A. As a second step, the students of subgroup B observed and documented for more than 30 minutes the physical exertion (the content of the exercises, the number of repetitions, their intensity and the time of each effort) continued by the students of A [11].

The observation cycle of the experiment „set of exercises diagnosing the body control errors

– BCE" included three stages: „pre-test" – three times grasping the ball at chin height (Figure 2); the first series (s1) – motor tasks were performed without additional restraints and the ball had to be grasped at the height indicated by the experimenter either hips (Figure 3), or knees (Figure 4), or below the knees Figure 5); second series (s2) – with an object (a notebook) on their head (Figure 6). In both series, two rules applied: diagnosis was based on catching the ball three times at each of the three conventional levels (hips, knees, below the knees); the grasping of the ball were asked alternately without a fixed key.

It was a mistake to perform a forward bend instead of a half squat or a squat (according to the set height of the ball grasp), i.e. using the cushioning function of the lower limbs (Figure 7 and 8). In the second series of exercises, if the student performed the task correctly in an ergonomic sense (Photo 1), the fall of the notebook from the head was not considered an error.

Statistical analysis

The estimation of the results is based on the following indicators: frequency (n); mean (M); minimum (min); maximum (max). In the studies, the level of at least p>0.05 also for a directional test) and higher was shown as statistically significant differences. Correlation coefficient was calculated between pairs of specified variables. The significance of the difference between two independent proportions and the chi-square test for testing the significance of the difference between proportions were recalculated according to the formula given by Ferguson and Takane [12].

The fixed time of remaining motionless for 2-3 seconds after grasping the ball was sufficient to determine in each of the observed subgroups the number of students who did not respect the elementary rules of ergonomics. During the "pre-test" each student performed 3 tasks; during s1 9; s2 also 3, the total extreme number of possible errors is 21. This extreme possible observation

Figure 1. Task starting position.

Figure 2. The correct way to grasp the ball at chin level (knees slightly bent).

Figure 3. The correct way to grasp the ball at hip height.

Figure 4. The correct way to grasp the ball at knee height.

Figure 5. The correct way to grasp the ball below the knees.

Figure 6. Properly perform the exercise with a notebook on your head.

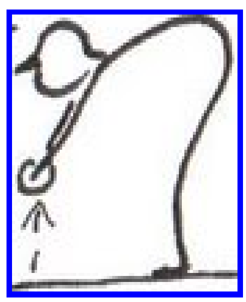


Figure 7. Incorrect way of catching the ball at knee height.

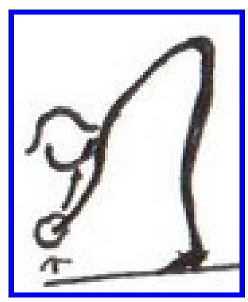


Figure 8. Incorrect way of catching the ball at below-knee height.

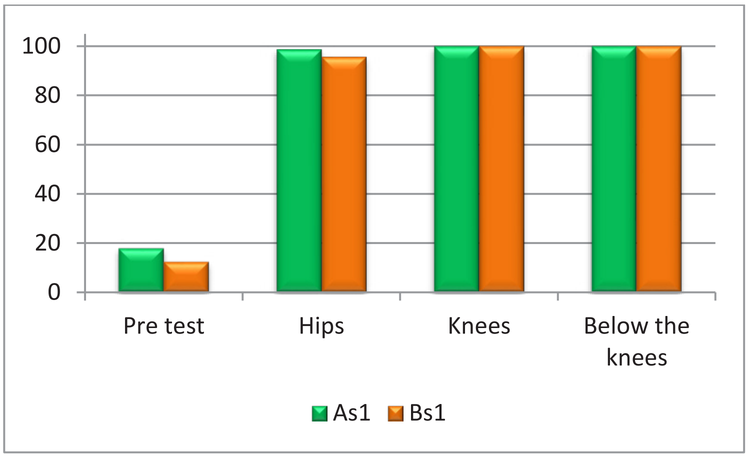


Figure 9. Proportion of students who incorrectly performed motor tasks during the "pre-test" (pt) and first series (s1) of experiments.

for each subgroup (A or B) is 189; so each of the educational groups identified by administrative division (G1 to G6) 378, and all six groups 2,268.

We took the proportion of the sum of errors expressed in % (subgroups A and B) from smallest to largest as the ordinal variable of the presented results of each educational group. The leader is denoted by the code RP1GX (where the group number is inserted after the X, and the symbol RP denotes the ranking position), and the code RP6GX is for the last ranked group, provided that there are no at least two of the same so-called raw results. Analogous rules are adopted in establishing ordinal variables for the results of each stage of the experimental cycle, however, the last member of the code is the symbol of the group according to its RP of the ordinal variable based on the aggregate results of this experiment: RP1ptGX (and can be Y, V, etc.), analogously RP1s1GX etc.

RESULTS

When grasping the tennis ball during the "pre-test", errors were made by 15.1% of students (A17.9%, B 12.3%) the proportion difference of 5.6% is not statistically significant (Figure 9). The spread of errors among educational groups according to administrative division is 14.8% (max 24.1%, min 9.3%), and these raw scores order the groups into 5 RPs (Table 1). The spread of raw scores among A subgroups is 22.2% (7.4% to29.6% and each score is different, six RPs), while among B subgroups it is 14.8% (3.7% to 18.5% and in this case the scores are spread over four RPs).

Table 1. BCE phenomenon differentiating physiotherapy students of subgroups A and B during the "pre-test" experiment.

RP by pre-test result (pt)												Comparison of results		
1		2		3		4		4		5		A (n = 54)	B (n = 54)	A+B (n = 108)
Apt	Bpt	Apt	Bpt	Apt	Bpt	Apt	Bpt	Apt	Bpt	Apt	Bpt			
7.4	11.1	11.1	11.1	22.2	3.7	14.8	18.5	22.2	11.1	29.6	18.5	**17.9**	**12.3**	
9.3		**11.1**		**13**		**16.7**		**16.7**		**24.1**				
group codes by ordinal variable												**differences**		**15.1**
RP1ptG6		RP2ptG5		RP3ptG4		RP4ptG1		RP4ptG2		RP5ptG3		**5.6**		

Table 2. BCE phenomenon differentiating physiotherapy students of subgroups A and B during the „first session" of the experiment.

RP by first series result (s1)												Comparison of results		
1		2		2		3		3		4		A (n = 54)	B (n = 54)	A+B (n = 108)
As1	Bs1	As1	Bs1	As1	Bs1	As1	Bs1	As1	Bs1	As1	Bs1			
100	**96.3**	**100**	**97.5**	**97.5**	**100**	**100**	**98.8**	**100**	**98.8**	**100**	**100**	**99.6**	**98.6**	
98.1		**98.8**		**98.8**		**99.4**		**99.4**		**100**				
group codes by ordinal variable												**differences**		**99.1**
RP1s1G1		RP2s1G4		RP2s1G3		RP3s1G5		RP3s1G6		RP4s1G2		**1**		

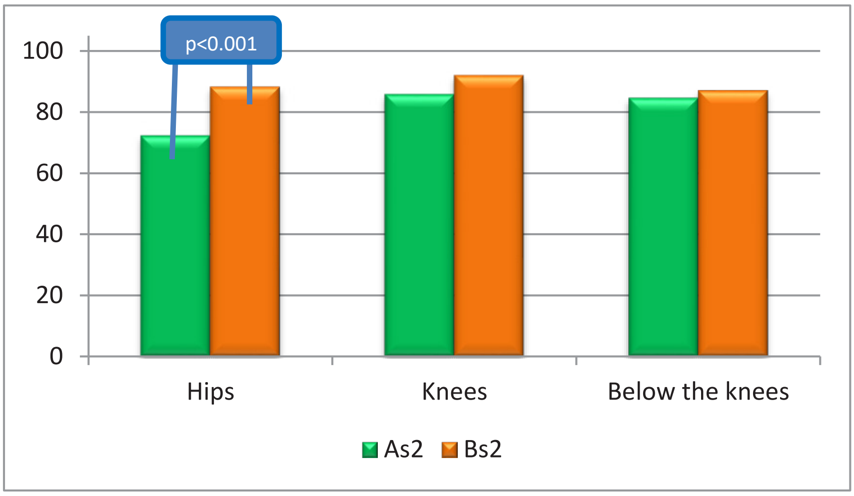


Figure 10. Proportion of students who incorrectly performed motor tasks during the second series (s2) of experiments.

Table 3. BCE phenomenon differentiating physiotherapy students of subgroups A and B) during the „second session" of the experiment.

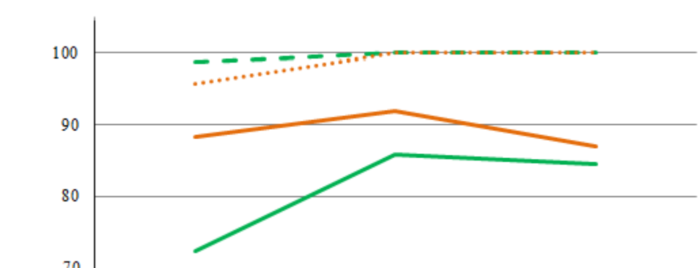
RP by second series result (s2)												Comparison of results		
1		2		3		4		5		6		A (n = 54)	B (n = 54)	A+B (n = 108)
As2	Bs2	As2	Bs2	As2	Bs2	As2	Bs2	As2	Bs2	As2	Bs2			
72.8	**88.9**	**86.4**	**80.2**	**81.5**	**87.7**	**75.3**	**96.3**	**85.2**	**87.7**	**84.0**	**93.8**	**80.9**	**89.1**	
80.9		**83.3**		**84.6**		**85.8**		**86.5**		**88.9**				
group codes by ordinal variable												**differences**		**85**
RP1s2G1		RP2s2G3		RP3s2G6		RP4s2G4		RP5s2G5		RP6s2G2		**8.2****		

**p<0.01

During s1, students made 99.1% of possible errors, and the proportion difference between Group A and Group B students was 1% (Figure 9, Table 2). Groups by administrative division occupy four RPs and also subgroups of B, while subgroups of A occupy two RPs. The performance gap between the groups is 1.9%, and the subgroups: A 2.5%, B 3.7%.

During s2, students reduced errors at each level of CBR phenomenon identification (Figure 10), to a total of 85% of possible errors, and the difference of 8.2% between groups A (80.9%) and B (89.1) is statistically significant, p<0.01 (Table 3). The score spread between groups is 8%, dividing them into six RPs. The score spread between subgroups is larger (A 13.6%, B 16.1%), but the RPs are not identical: A six, B five (Table 3).

A synthetic visualization of the results analyzed above provides evidence that the cognitive predisposition of students randomized to group A is higher, as compared to students in group B (who observed the experiment before they themselves at a statistically significant level reduced more errors (Figure 11).



Group/series/ difference	Hips	Knees	Below the knees
As1	98.8	100	100
As2	72.2	85.8	84.6
As1 – As2	**26.6****	**14.2****	**15.4****
Bs1	95.7	100	100
Bs2	88.3	92	87
Bs1 – Bs2	**7.4****	**8****	**13****
As1÷Bs1	3.1	0	0
As2÷Bs2	**16.1*****	6.2	2.4

Figure 11. Synthetic visualization of the BCE phenomenon during two series of the experiment. **p<0.01; ***p<0.001

Table 4. Results of educational groups tabulated by ordinal variable (totals of errors made in %).

RP of educational groups according to the ordinal variable		Proportion of errors made in the cycle [%] raw score (summary and stepwise)			
RP	**group**	**sum[ordinal variable]**	**pt**	**s1**	**s2**
1	G6	**193.3**	9.3	99.4	84.6
2	G5	**195.1**	11.1	99.4	86.5
3	G1	**195.7**	16.7	98.1	80.9
4	G4	**197.6**	13	98.8	85.8
5	G2	**205.6**	16.7	100	88.9
6	G3	**206.2**	24.1	98.8	83.3
estimation of the results of the experimental cycle		**M**	**15.1** ±	**99.1** ±	**85** ±
		Min	9.3	98.1	80.9
		Max	24.1	100	88.9

All differences between the results of each stage of the experimental cycle are statistically significant at the p<0.001 level: pt versus s1; pt versus s2; s1 versus s2 (Table 4).

No RP stability was found for any of the educational groups participating in the experiment. Only in the case of leader G6 (the smallest error sum during the three stages of the experimental cycle) did a random compilation of two pairs of RP stability appear: RP1 between error sum and pt; RP3 between s1 and s2. Single pairs of stable RPs were found in each of the other educational groups. The various RP migration patterns do not suggest any regularities (Table 5). On the other hand, the results of the RP correlation studies of the educational groups in each stage of the experimental cycle confirm that the selection of students was randomized (Table 6).

DISCUSSION

Three important elements and two findings of this experiment authorize the implication that the empirical exercise setup used meets the methodological criteria for turning it into a non-apparatus test diagnosing the elementary ergonomic predispositions (EEP). First, the selection of individuals into educational groups (A and B) was random, that is, neither any indicator of intellectual/mental nature (cognitive sphere) nor motor nature (behavioral sphere) was an eligibility criterion. Secondly, the results are based on 2,268 observations under circumstances of increasing task difficulty in each of the successive stages of the experimental cycle. As stages of the EEP test, designed to diagnose one person, will provide reliable information based on observations of 21 events, after all, multiplied in this experiment and analyzed in the „Results" section of this work guarantee that this

Table 5. Stability and migration of RP of educational groups based on administrative division between the different stages of the experimental cycle.

Groups by ordinal variable	RP from the smallest proportion of errors			
	error sums	cycle stage		
		pt	s1	s2
G6	1	1	3	3
G5	2	2	3	5
G1	3	4	1	1
G4	4	3	2	4
G2	5	4	4	6
G3	6	5	2	2

Table 6. Correlation coefficients between RP of educational groups according to the different stages of the experimental cycle (see Table 5).

Variable	sum of errors	pt	s1
sum of errors	1		
pt	**0.908***	1	
s1	− 0.051	− 0.324	1
s2	0.028	− 0.254	**0.866***

prospective research tool is based on true assumptions. Third, the experiment used (similar to other non-apparatus and quasi apparatus test recommended by innovative agonology [13-15] – see in glossary "innovative self-defence") used a simple measure (in this case, keeping a notebook on one's head while exercising) to force a motor response that either conforms to the model (pattern), but informs about deviations, and therefore indirectly about the quality of the cognitive-behavioral potential of the person being diagnosed.

Of the scientific findings, we consider two complementary facts to be the most significant. Approximately 15 minutes of observation of attractive motor tasks by a representative sample from a population of physiotherapy students (n = 54) is not enough of an incentive on its own not to make the identical errors previously revealed by those observed. Meanwhile, the "pretest" result could even provide a rationale suggesting that precisely the opposite is true, since students, in a general sense, from group B made 5.6% fewer errors precisely because they observed the exercises performed by students from group A – but during s1 although they also made fewer errors, they made only 1% fewer errors.

The second finding, the s2 result, provides empirical evidence that the statistically significant ($p<0.01$) difference of 8.2% fewer errors made by Group A students is due to the fact that individuals with higher cognitive-behavioral potentials remaining in relation to the body control errors (BCE) phenomenon were randomly selected to part of the A subgroups. These predispositions were only revealed during the most difficult stage of the experimental cycle (s2).

The experiment described in this paper and, in a sense, also the results are consistent with the observations of other authors. "In a sense" because, firstly, although the objectives of the study were different, the results have to do precisely with the quality of cognitive-behavioral potential and with the BCE phenomenon; secondly, the authors of most of the works cited below used proportions of people who made mistakes, less often proportions of mistakes, as in the case of our experiment.

Kalina et al. [16] during the validation procedure of "the susceptibility test of the body injuries during the fall" (STBIDF) found that physiotherapy students (n = 68), despite having repeated the STBIDF multiple times during the two semesters, knowing the evaluation criteria and their stage achievements, and having been educated on the use of the test, among other things, made at least one error in each of the test's consecutive tasks during the exam ending the two-semester education, respectively: 17.7%; 22%, 30.9%. During the test before the safe fall courses, 100% of the students made mistakes. That test, like our experiment, was based on the principle of graded difficulty of tasks (stages). However, in the case of our experiment, a significant reduction in errors occurred during the last stage. Some parallels with this result appear when interpreting the results of a modified version of the STBIDF, the STBIDF-M based on six tasks [17]. However, the peculiarity of STBIDF-M is that the even tasks (2, 4, 6) are a hindered version of each of the odd tasks (1, 3, 5), each of which is more difficult than the previous one. Even-numbered tasks first involve jumping off a platform approximately 20 cm high onto soft ground, and this is the moment when the correctness of the use of cushioning functions of the lower extremities is diagnosed. This very element of the diagnosis provides some analogy with our results. Students made the fewest errors (44%) under circumstances when the task was easiest, the most when the degree of difficulty increased dramatically (61%), and reduced errors to 58% during the last task (stage) of the study, when the degree of difficulty was highest – jumping off the platform while clapping and pressing the sponge with the chin against the torso [17].

In addition, the STBIDF-M developers found two different regularities, both relative to those described above (concerning legs), and concerning controlling hands and head during a simulated backward fall. However, there was an analogy in the hands and head comparison, and it consisted of a relatively higher proportion of students who made errors during the paired tasks. However, the distributions were different. For hands the distribution during odd-numbered tasks was as follows: 55%, 50%, 72%; during even tasks: 67%, 58%, 82%. For head, the values (%) were descending – the more difficult the task, the fewer students made mistakes: distribution during odd tasks: 89%, 64%, 61%; during even: 92%, 69%, 66% [17]. During both tests (STBIDF and STBIDF-M), the motor activities that were supposed to force the distal parts of the body to protect them from damage during the fall and collision with the ground were: clapping hands, pressing the sponge with the chin against the torso head. The jumping off the platform, we emphasize again, was a task to diagnose the phenomenon of "use of cushioning functions of the lower extremities," and it is this phenomenon that is close to the EEP.

In the sense of actively influencing the cognitive sphere (with a clear emphasis on the intellectual layer), using the STBIDF, the experiment of Mroczkowski et al. [18] draws attention. Female physiotherapy students (n = 37) aged 20 to 23 first performed the STBIDF accordingly to the original instruction of test, where participants are not aware of assessment criteria of the test. Before the second trial (after two weeks), all assessment criteria were presented (on the day of the research). After that, second test was conducted. Results were significantly different between trial 1 and trial 2 for the sum of points, as well as for errors in control over hands and head (were partially reduced). Nevertheless, a significant part of participants commits error despite knowing how to perform the test correctly. The authors stated the highest repeatability of motor habits was shown for control over hands in task II (89%), while the lowest for control over head in task III (59%).The highest persistence of committed errors was shown for control over head in task II (79%), while the lowest for control over hips task I and III (17%). In conclusion, the authors emphasize that high persistence of committing the error of controlling head during test indicates STBIDF diagnostic value in detecting susceptibility to head injuries during a fall. [18]. The persistence of entrenched errors in controlling vulnerable parts of the body at risk of damage during a fall is further demonstrated by the results of the STBIDF test-retest verifying its reliability [19].

The opposite pole of the head is the feet, i.e., the parts of the body that are closest to the ground when performing the cushioning functions of the lower limbs (not only in circumstances of loss of balance and falling. Thus, frequent repetition of exercises involving grasping a bouncing ball (of any kind) at knee height or below the knees, keeping a gym bag on the head, for example, can form the habit of compensating for loss of balance precisely by lowering the center of gravity while maintaining the vertical position of the torso. This is the motor aspect of this category of exercises. In addition, through such exercises (properly performed) there is a strengthening of the muscles of the lower limbs, which can translate into improved balance (especially in the elderly).

The advantage of such exercises, moreover, is the activation of the cognitive layer – understanding the reason why the thing falls off the head when the ball is grabbed can become an impetus to consciously choose physical activities that will strengthen personal security. Competing with such reasoning are unreflective incentives to learn sports motor activities from the perspective of a sports career, often combined with economic status in the future. Focusing attention on the correctness of sports technique of specific sports or competitions, pointing out and eliminating mistakes, especially from early childhood, is generally associated with the neglect of opportunities for comprehensive stimulation of the child's cognitive-behavioral sphere also from the perspective of strengthening his personal security. A prominent example is the core curriculum of physical education in Poland dominated by sports motoric.

Meanwhile, the essence of the exercises used in this experiment is a simple motor activity of everyday use, which is also a basic element of many sports techniques (e.g., during weightlifting [20], kettlebell exercises [21] with ball scrambling in many team games [22-24], multi-person gymnastic circuits, etc. [25-27]). Thus, patiently posing the question "why the thing falls off the head" to students, as long as they do not discover the cause themselves, is one of the simplest recommendations for opening the minds of participants in this type of exercise (age cannot be a barrier) to a sense of concern for their own motor safety – in the broader sense of personal safety.

The simple motor activity used in the study and its modification (keeping a notebook on one's head) can be equated, in a sense, with the placebo effect. Klimczak and Kalina [28] state that "placebo" in an agonology language is a special case of "bluff". Described in their work placebo effects in proposed interdisciplinary interpretation (in a mental and motor sense) is in agonology language known as master techniques (masterful trick) ... motor effects triggered by creating some imaginary situation are proof, that placebo-based interventions can cause improvement in motor functioning, even temporary. In the case of our study, the "bluff" was to focus the students' attention on grasping the ball. In fact, the goal was correct (in ergonomic, and therefore health-related terms) posture during this activity.

However, the most important element is the health function of the exercises used in our experiment. It is known that the spine is prone to mechanical damage, the cause of which may be improper posture when performing activities, especially lifting heavy weight in an incorrect manner. Knowledge of the basics of biomechanics and adherence to the rules of ergonomics are factors qualified for the cognitive sphere, but such knowledge is not enough to protect the spine from overload and damage. To apply these rules effectively in everyday life (work, leisure, sports, recreation, etc.) habits are necessary [29]. The proper areas of education are firstly correct motor patterns in the family, then in kindergarten, school, etc. According to many authors, the onset of back-related ailments is most often sudden, associated with lifting excessive weight or making a sudden, abrupt movement [30-37].

The prospect of decomposing this experiment into an EEP test and only a cursory discussion of the results of our research against the background of diagnosing the phenomenon of the susceptibility the body injuries during the fall [16, 18, 38, 39, 17, 19] stimulate the imagination. A secondary analysis of the results of Dariusz Boguszewski's research contained in a monograph dedicated to the health benefits of combat sports and martial arts [40] provides evidence that despite many years of practice of this category of combat sports, where athletes perform many falls (judo, wrestling), not a single person performed STBIDF flawlessly. Meanwhile, a physiotherapy student who did not practice any sport during the first application of STBIDF made all of the possible errors (raw score of 14 points), and after two-semester safe fall courses made none [41] – gave testimony to the very high cognitive-behavioral potential identified with the BCE phenomenon.

Thus, expanding the unique tools of innovative agonology to include the EEP test opens up new possibilities for their use in complementary diagnosis, prevention and therapy [42-45]. Researchers and practitioners who are open to combining, sometimes only seemingly mutually exclusive methods and measures, coming from different cultures, but with universal applications in rehabilitation, education, sports [18, 4, 46, 15, 24, 27, 47, 48], etc. face new opportunities to influence personal security.

CONCLUSIONS

The opportunity of the B students to observe both series of exercises in advance (cognitive aspect) was not a sufficient stimulus to modify the quality of their repetition of the same motor tasks (behavioural aspect). Thus, there are grounds to argue – abstracting from the motor patterns in the family and in the everyday social environment – that a physical education formula modelled on sports techniques does not provide stimuli to stimulate this cognitive-behavioural layer of adaptation to rational (ergonomic) motor action.

In ontogeny, concern for personal safety begins with providing the child with correct motor patterns (in the ergonomic sense) starting from the family through the subsequent levels of formal education. Although vocational training often does not exclude the need to perform motor activities that in practice will endanger health and even pose a risk of loss of life (military, police, emergency services training, etc.), correct ergonomic habits are part of elementary prevention throughout life.

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