Validation of the new version of "the susceptibility test to the body injuries during the fall" (STBIDF-M)

Authors' Contribution:
A Study Design
B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Background and Study Aim: The main premise of the modification of "the susceptibility test to the body injuries during the fall" (STBIDF) was the intention to increase the diagnostic power of this test and the motor safety of the tested person. In the three-task version of the STBIDF, the evaluation of body part control errors during a simulated back fall was not based on homogeneous criteria (points): legs 1, 2; hips, head, 1, 2, 3; hands 1, 2, 3, 4, 5, 6. Increasing the STBIDF-M tasks to six is a consequence of the assumption that the criteria for evaluating these errors must be relatively standardized for each of the observed body parts during a simulated fall. The aim of these studies is theoretical and empirical argumentation justifying the validity of the modification made.

Material and Methods: Pre-test (deep squat; therapist's hands are set in pronation, while patient's/client's hands are in supination – "hands to hands"). The first STBIDF-M task remained the same as in the previous one ("on the command GO as quick as possible lie down on your back"); second task (the same, but after jumping from the platform about 20 cm high); third task ("from the vertical posture, press the sponge with the chin to the chest, and on the command GO again lie on the back"); fourth task (the same, but after jumping from the platform); fifth task ("from the vertical posture, press the sponge with the chin to the chest, on the command READY start clapping hands, and on the command GO again lie on the back") sixth task ("all activities the same, but after command GO at first jump into the back"). As a consequence, errors in controlling the legs, hips and head were evaluated on a scale from 1 to 6, and for hands from 1 to 12 points (this score, divided by 2, makes it possible to compare the errors of control of the observed body parts on a homogeneous scale from 1 to 6). Total points is a general indicator of the susceptibility to body injuries during the fall (SFIpoints): very low (0), low (1-11) average (12-18), high (19-23), very high (24-27), extreme (28-30). Relatively for particular body parts (SFIlegs -hips, -head): very low (0), low (1) average (2-3), high (4), very high (5), extreme (6); SFIhands: very low (0), low (1-2) average (4-6), high (7-8), very high (9-10), extreme (11-12).

The empirical part of the validation was based on the test results of 36 female physiotherapy students, aged 20-22 (mean 20.69 years). The empirical frame of reference was the results of 68 female physiotherapy students tested during the validation of STBIDF (2011).

Results: A statistically significant difference concerns the proportion of people who committed foot control errors ($p<0.01$): during STBIDF-M 72%, during STBIDF 41%. Fewer students committed hip control errors (39%), while during STBIDF 56% ($p<0.20$). In both studies, hands and head control errors exceeded 91% in both groups.

Conclusions: Empirical evidence of the increase in the diagnostic power of the test is primarily a statistically significant difference of people who committed errors in controlling their legs during a simulated fall back. This is the effect of a threefold increase in the ability to observe this phenomenon during STBIDF-M. The reduction in the proportion of people who committed hips control errors during the modified test is further evidence of the increased motor safety of the test subjects. This phenomenon can be explained by the effectiveness of the pre-test. People who are unable to complete a deep squat are tested on a platform. We recommend STBIDF-M as a safe tool for diagnosing the susceptibility to injury during the fall (SFI) of children over 6 years of age and the people without age and health restrictions (not excluding neuro-cognitive patients) with the exception of some patients with spinal injuries.

Key words: innovative agonology • motor safety • neuro-cognitive patients • pre-test • safe fall

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Fall – is unintentional, a sudden change from vertical to horizontal posture [27]. Falling often leads to injury; that is why it is qualified in the International Classification of Disease (ICD). Codes include falls on the same or upper level, as well as others, unspecified falls. Falls results with a collision with walls, furniture, ground or other objects or obstacles [27, 36].

Fall (in sport) – ***noun*** in wrestling, a scoring move in which a wrestler forces the opponent's shoulders to the floor for a specific period ■ verb to drop or be dropped or lowered [68].

Disability – ***noun*** a condition in which part of the body does not function in a usual way and makes some activities difficult or impossible [68].

Flexible feasibility – power, intellectual or manipulative proficiency and knowledge (ability) and sufficient willingness to carry out given action; **situational feasibility** carrying out given action in determined circumstances is not prevented by this circumstances. Somebody has **full (completed) flexible** and situational possibility of action, i.e. has sufficient power, knowledge, and efficiency (intellectual or manipulative) in order to carry the given action out in the moment ***t***, possibility of the non-performance of it and has possibility of putting off until later moment of carrying the given act out [69, p.124].

INTRODUCTION

Four premises determined the modification of "the susceptibility test to the body injuries during the fall – STBIDF" [1, 2]. Firstly, the knowledge the authors gained from participant observation of physiotherapy students who, since 2009 (first in one and altogether in four Polish universities) performed the STBIDF as a preliminary diagnosis before starting the author's programme "Theory and methodology of safe falling of blind people and after amputation within limbs". Although the test is performed each time on a soft surface (tatami mats, gymnastic mattresses, etc.), some students did not perform the task according to the verbal instruction: "(...) after command GO jump back first and lie down on your back". The student, either after jumping off the platform (third STBIDF task), did not bend his legs at the knees and only after about 1 second performed a squat and lay down on his back, or after landing, with slightly bent legs at the knee joint, hit the ground with his buttocks and continued the command to lie down on his back.

Therefore, the first modification of the way to diagnose the susceptibility of the body injuries during the fall (in 2013) was the introduction of the non-apparatus safe falls preparations test (N-ASFPT [3]), whose first task is a deep squat (instructions and evaluation criteria see section 'Material and Methods' – '*Pre-test*'). Since 2014, during the first application of the STBIDF in the educational practice of physiotherapy students (when they did not know the purpose of the test or the evaluation criteria yet), we were limited to only this N-ASFPT task as a pre-test.

Secondly, multiple observation and analysis of video-recorded tests (STBIDF [1, 2], test for safe falls [4], modified safe fall test – applications for the blind [5]) and exercises belonging to the safe fall methodology as part of a research project culminating in the PhD Thesis defence of the first author of this work [6]. The most useful were the results of observation of motoric behaviour (in a way also emotional) of students during fun forms of safe fall (FFoSF), as well as motoric simulations enforcing desired adaptations (control of own body or its specific part) to situations provoked in laboratory conditions (actually in training room). For example, performing a backflip after a jump from an increasingly higher position (the fittest students even from a height of 2 meters), after repeatedly demonstrating that they correctly absorb the contact of their feet with the ground immediately after landing – like experienced parachutists – and are able, through a controlled squat, to slow down the moment of body contact with the ground and extend the braking distance while performing a backflip with a roll (the criteria of safe fall theory [7]).

Third, the results of direct participant observation of these events conducted by the authors independently. That is, each during exercises with physiotherapy students at different universities.

Fourthly, in the three-task version of the STBIDF, the evaluation of body part control errors during a simulated back fall was not based on homogeneous criteria (points): legs 1, 2; hips, head, 1, 2, 3; hands 1, 2, 3, 4, 5, 6.

Thus, we assumed that increasing the number of STBIDF tasks to 6 would multiply the possibility of observing the ways of controlling those body parts that constitute the criteria for evaluating *the susceptibility of the body injuries during the fall* – SBIDF indicators [2]: jumping off an elevation of about 20 cm three times, instead of one; the need to keep the chin against the upper torso during four tasks, instead of two.

As if the primary consequence of such an assumption is the equalization of the criteria for the evaluation of the control errors of legs, hips, head during a simulated backward fall on a scale from 1 to 6, while the possibility of estimating the control errors of hands (quantitative aspect) is increased to 12 points. Thus, one mathematical possibility to simplify the analysis of the results is to divide 12 by 2. This will result in the most precise measurement for the hands, however, on a scale of 1 to 6 homogeneous for all observations (mainly qualitative aspect). In other words, increasing the STBIDF-M tasks to six is a consequence of the assumption that the criteria for evaluating these errors must be relatively standardized for each of the observed body parts during a simulated fall.

However, this is not the only mathematical possibility to simplify the results of the evaluation (in a quantitative and qualitative sense) of a specific individual, rather than for the purpose of general characteristics of the collective studied. The application of this simple mathematical formula makes it possible to create an individual profile for use in comparing the quality of control of observed body parts during a simulated backward fall and in predicting the extent of injury during an unintentional fall in real circumstances. These are important methodological considerations, as invariably the overall STBIDF-M score is derived from the summation of scores, which are equivalent to the scale of errors of body control. The fewer the points, the more confident the empirical basis for inferring greater ability to protect distal body parts in the event of loss of balance and unintentional falls – and vice versa.

These elementary assumptions for the modification of the STBIDF imply the following hypothesis: A pre-test (squat according to N-ASFPT criteria) preceding the STBIDF-M and a multiplied opportunity to observe legs, hips, hands and head during a simulated backward fall will increase the diagnostic power of this test and the motor safety of the tested person.

The aim of these studies is theoretical and empirical argumentation justifying the validity of the modification made.

Table 1. Documentation sheet of research results (observations), quantitative and qualitative SFIs (1 = error I°, 2 = error II°) and variables obtained by the method of personal interview.

Pre-test result: 1; 2; 3 (circle the correct result); if **3** the need for a simplified version of STBIDF-M

Body part	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Total	Ratio body part	
								NE	CE
legs		0 1 2		0 1 2		0 1 2			
hips	0 1	0 1	0 1	0 1	0 1	0 1			
hands	0 1 2	0 1 2	0 1 2	0 1 2	0 1 2	0 1 2			
head	0 1	0 1	0 1	0 1	0 1	0 1			
	the quantitative and qualitative indicator SFI for Task						the indicator SFI		
total points							SFI points	ratio NE	ratio CE
ratio NE									
ratio CE									

profile CE: ……./……..//..……///…….
legs hips hands head

gender F/M (circle); age (years) ………; body height (cm)……….; body mas (kg)……..; BMI……; physical activity (type/frequency) …………; do you have knowledge about the performed motor test, Yes/No (provide the source) …..; have you suffered a Yes/No injury in the past as a result of: a) fall and collision with the ground or a vertical obstacle ……..…..; how old were you ……; how many such events do you remember ……; type of injury……………...; b) collisions with a moving object (thrown object, vehicle, etc.) ……..…; how old were you …..; how many such events do you remember ……; type of injury………………..

MATERIAL AND METHODS

Description of the STBIDF-M

Equipment, documentation and environment

A soft surface (tatami mats, gymnastic mattresses, etc.). A platform (elevation) of about 20 cm can be made, for example, from a pile of 5 tatami mats. A standard sponge for personal hygiene. Sheet for documenting the results of observations (Table 1). There must not be anything in the immediate vicinity of the test bench that threatens the safety of the person being diagnosed.

General criteria and principles

The subject performs six tasks that are simple simulations of falling backwards, with each subsequent task being more coordinatively complex than the previous one. In addition, three pairs of tasks are included (odd÷even: 1÷2; 3÷4; 5÷6) based on the principle that the even task in the pair is performed after first jumping off a 20 cm rise.

If the subject does not understand the task or asks for details, the investigator repeats the instruction until confirmation is obtained that the task is understood (note this fact on the sheet documenting the results of the observation).

When using the STBIDF-M for the first time, the person waiting is not allowed to watch how the test is performed by other test subjects. Those who have already performed the test may observe the next diagnosed (without interfering either verbally or with movement), but may not interact with those waiting for this procedure. These rules must also be observed during the test-retest procedure. In all other circumstances of repeated STBIDF-M use, observation of the test subjects by those waiting is even desirable. The analysis of the results will be enriched by the possibility of cautiously estimating the influence of a cognitive factor (stimulation is even the repeated observation of the motor tasks that the waiting person will perform himself in some time) on the possible reduction of errors of body control, or, on the contrary, to consider such observation as an insufficient stimulus.

The use of modern motion capture technology in research will increase the accuracy of a posteriori comparisons. However, an analysis based on the video verification standard requires that the criteria of the RODO are respected in a special way.

Structure of the STBIDF-M

Pre-test

Instructions and evaluation: "*hold out your hands and do deep squat*" (therapist's hands are set in pronation, while test person hands are in supination (Photo 1). If the angle between tights and shins is smaller than 90° (acute angle) during the squat and tested person is able to perform the task easily i.e. does not excessively support

Photo 1. Method of testing the possibility of performing a deep squat (condition to be admitted to the STBIDF-M).

himself on the therapist's hands (3 points in subjective scale from 1 to 3 points), there are not contraindications to perform STBIDF-M. If during the squat the angle amounts to 90° or more (obtuse angle), or supporting on therapist's hands is assessed in three-point scale, or both events occur, STBIDF-M should be performed in a simplified version [3, p. 257].

Instructions to the test subject, criteria for correctness and evaluable errors I° (1 point) and II° (2 points) and how to document them

Task 1 *instruction: "on the command HOP, as quickly as possible lie freely on your back – READY, HOP".*

Correct execution: quick squat with simultaneous leaning of the head forward and positioning the hands in front – or supporting yourself with the hands in front – and roll gently onto the buttocks and back ("cradle") keeping the hands and head in front; chin attached to the upper torso. Only while lying on your back should you gently touch the ground with your heels and occiput. The task ends when the heels, buttocks, back and head are touching the ground. If the person is lying on his or her back and the chin is sticking to the torso, this indicates excellent head control during the simulated fall (Photo 2). *Evaluation:* "hips" – hitting the ground with the buttocks or, when changing posture from vertical to horizontal, maintaining a right or open angle between the thighs and shins 1 point/error; "hands" – supporting oneself with the hands behind or at hip level, or hitting the ground with the elbows 2 points, while with one hand 1 point (supporting oneself in front against the ground with one or both hands at the moment of squatting before rolling onto the back is correct); "head" – keeping the head tilted back during the change of posture from vertical to horizontal or banging the head against the ground instead of gently placing it while already lying on the back 1 point.

Task 2 (test subject stands on a platform approximately 20 cm high). Instruction: "*all steps identical, but after HOP, first jump backwards – READY, HOP".*

Correct execution: after feet contact the ground, immediately lie backwards according to the criteria described for Task 1 (Photo 3). Scoring: "legs" – landing with straight knees, or after a jump stopping for 1 second or longer 2 points, landing on one leg or stepping off the platform 1 point; "hips", "hands", "head" – criteria identical to Task1.

Task 3 *instruction: "while standing, press the sponge to the upper torso with your chin, and on the command HOP lie on your back again – READY, HOP".*

Correct execution: the test person, standing, this time presses the personal hygiene sponge to the upper torso with his/her chin and lies back again according to the criteria described for Task 1 (Photo 4). *Scoring:* identical to Task 1. Additional rigour: the sponge falls out or is held by the hand or, while lying down, ceases to be controlled by pressing with the chin, although there is no head impact on the ground 1 point (in the "head" row) – the event should be recorded on the documentation sheet to facilitate detailed analysis of the observational data.

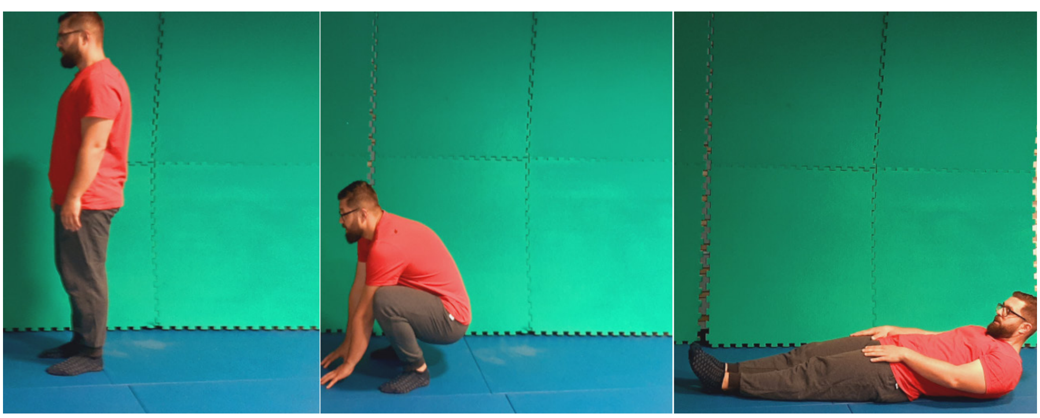

Photo 2. Proper execution of the Task 1.

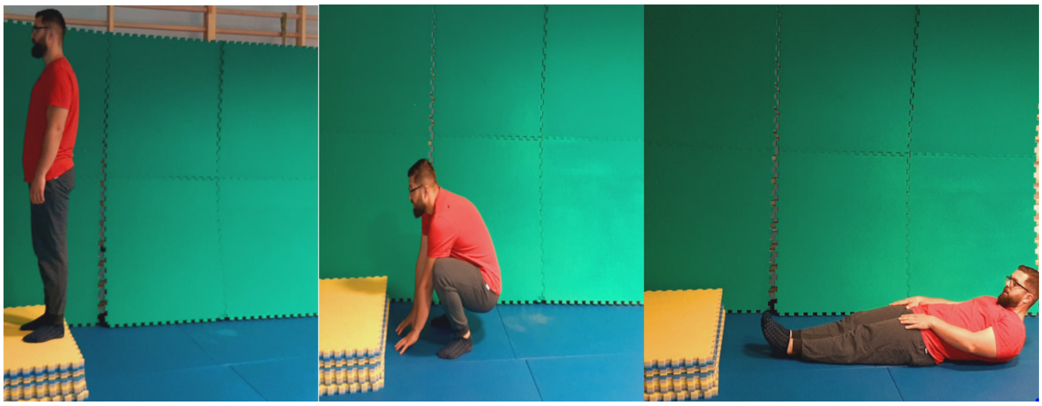

Photo 3. Proper execution of the Task 2.

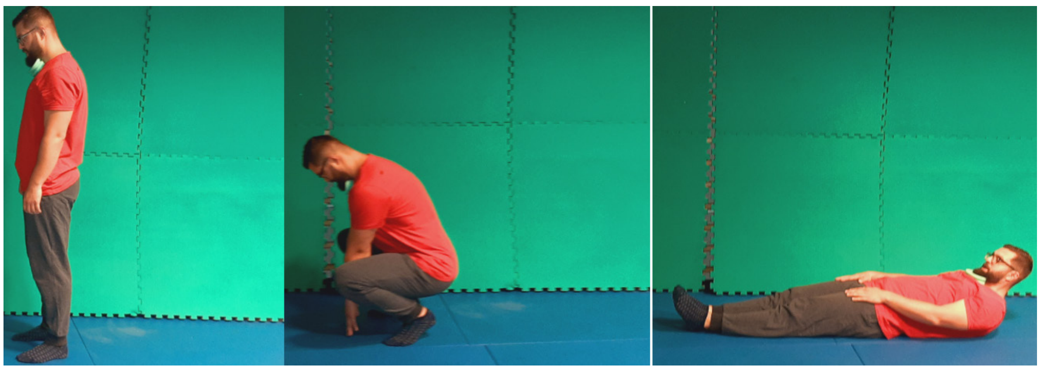

Photo 4. Proper execution of the Task 3.

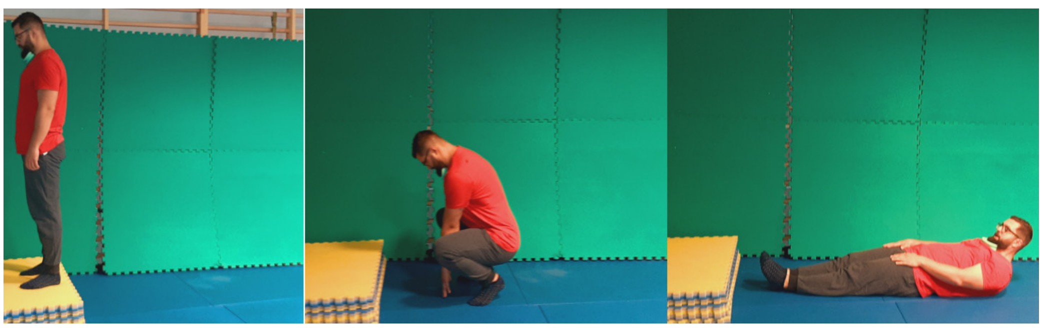

Photo 5. Proper execution of the Task 4.

Task 4 (test subject with sponge, as in Task 3, stands on a platform approximately 20 cm high). *Instruction: 'all actions identical to the previous task, but after HOP first jump backwards – –'READY, HOP'.*

Correct execution: after feet contact the ground, immediately lie backwards according to the criteria described for Tasks 1 and 3 (Photo 5). *Evaluation:* "hips", "hands" – criteria identical to Task 1, "legs" – criteria identical to Task 2, "head" – criteria identical to Task 3.

Task 5 *instruction: "from a standing posture, press the sponge to the upper torso with your chin, at the command READY start clapping your hands, and at the signal HOP lie on your back again – READY, HOP".*

Correct execution: the test person presses the sponge with the chin against the upper torso while standing and, clapping the hands, lies down on his/her back as quickly as possible - the clapping should stop only at the STOP signal (Photo 6). *Evaluation:* identical to the previous Tasks. Additional rigour – stop clapping even though there was no support (impact) of the hands on the ground 1 point (in the row "hands"); falling out of the sponge or holding it with the hand or, while lying down, stop controlling it by pressing with the chin even though there was no impact of the head on the ground 1 point (in the row "head") – in both cases, these events should be recorded on the observation record sheet to facilitate detailed analysis of the observation data.

Task 6 (test subject, with sponge as in Tasks 3, 4 and 5, stands on a platform approximately 20 cm high). *Instruction: 'all actions identical to the previous Task, but after HOP first jump backwards – READY, HOP.*

Correct performance: the test person presses the sponge with the chin against the upper torso and claps the hands. After the HOP command, the test person jumps back and lies down as quickly as possible – the clapping should only stop when the STOP signal is given (Photo 7). *Evaluation:* "legs" – criteria identical to Task 2 and 4; "hips" – criteria identical to Tasks from 1 to 5; "hands" and "head" – criteria identical to Task 5.

A simplified version of STBIDF-M

Each of six motor Tasks *"on the command HOP, as quickly as possible lie freely on your back – READY, HOP"* involves tested person to lie down on a platform of 45 cm or related height (e.g. on a pile of mats, typical couch or bed). Photo 8 present correct performance of Task 5 STBIDF-M. During Tasks 2, 4, 6 STBIDF-M jumping down is replaced with standing on one's toes. Evaluation of a simplified version of STBIDF-M does not change in relation to "hands" or "head". In the "STBIDF-M worksheet" near the variable "hips" in each task one should write "1", whereas in the Tasks 2, 4, 6 near the variable "legs" "2".

Criteria for interpreting STBIDF-M results

In order to make the scientific analysis of the phenomenon under study of *the susceptibility of the body injuries during a fall* more accessible, we used the three-part neologism *susceptibility fall injuries (SFI).* Thus, we have given the overall STBIDF-M

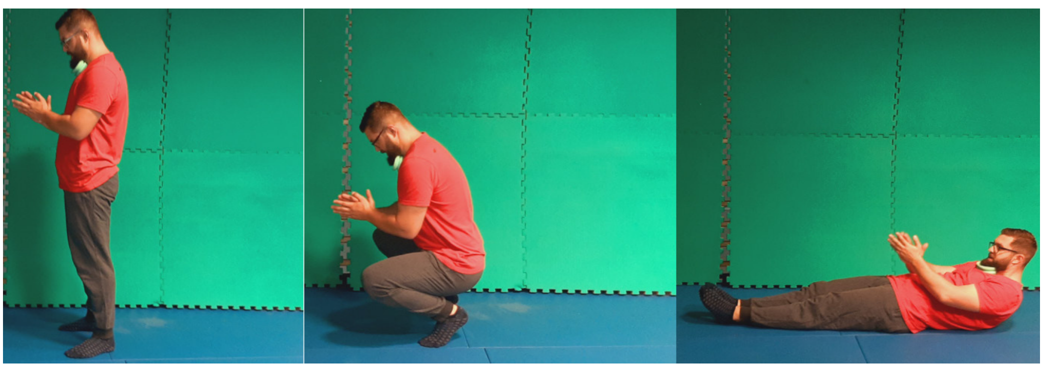

Photo 6. Proper execution of the Task 5.

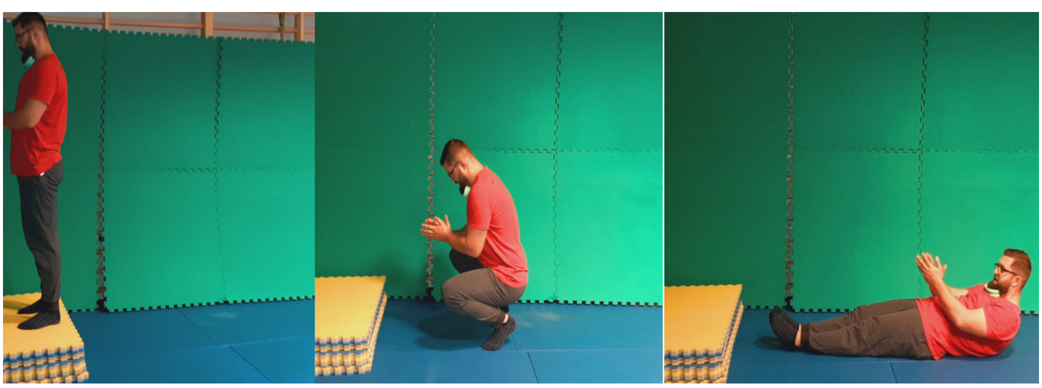

Photo 7. Proper execution of the Task 6.

Photo 8. Correct performance of Task 5 STBIDF-M.

Table 2. The degree of risk of *SFI* evolution standards based on the STBIDF-M results.

Data for the individual SFI profile				Data for the individual SFI profile			
SFI points	the degree of risk SFI (name)	ratio CE	ratio NE or range	SFI points	the degree of risk of SFI (name)	ratio CE	ratio NE or range
30	extreme	**1**	**1**	**11**	low	0.36	0.28-0.52
29		0.96	0.95-1	**10**		0.33	0.23-0.47
28		0.93	0.90-1	**9**		0.30	0.23-0.42
27	very high	0.90	0.85-1	**8**		0.26	0.19-0.38
26		0.86	0.80-1	**7**		0.23	0.19-0.33
25		0.83	0.76-1	**6**		0.20	0.14-0.28
24		0.80	0.71-1	**5**		0.16	0.14-0.23
23	high	0.76	0.66-1	**4**		0.13	0.09-0.19
22		0.73	0.61-1	**3**		0.10	0.09-0.14
21		0.70	0.57-1	**2**		0.06	0.04-0.09
20		0.66	0.52-0.95	**1**		0.03	0.04
19		0.63	0.47-0.90	**0**	very low	0	0
18	average	0.60	0.42-0.85				
17		0.56	0.42-0.80				
16		0.53	0.38-0.76				
15		0.50	0.38-0.71				
14		0.46	0.33-0.66				
13		0.43	0.33-0.61				
12		0.40	0.28-0.57				

score, which measures the phenomenon of susceptibility fall injuries, the symbol *SFIpoints*. We describe the score relativised to the individual body parts with the ratio indices NE (number of errors) and CE (the accumulation of these points – as a qualitative equivalent of errors) and carry the general symbols, respectively: *SFIlegs*, *SFIhips*, *SFIhands*, *SFIhead*.

Quantitative and qualitative indicators of STBIDF-M individual and group evaluation

The equivalent of each first- (I°) or second-degree (II°) errors of body control are points – raw scores (Table 2). The I° category includes errors of hips and head control, while both categories (I° and II°) include errors of legs and hands control. The absence of an error is documented with the notation "0". The sum of the scores separately for each of the observed body parts is an overall measure (raw score) of *SFI* (Table 3).

The extreme number of possible errors of body control by hips, hands and head is 6 for each and by legs is 3. Thus, the extreme sum of these occurrences is 21 and the ratio for NE ranges from 0.04 to 1. In fact, the statistical range for ratio NE ranges from 0 to 1, as the criterion of no error (in relation to individual body parts and possible STBIDF-M score) is reached.

The maximum sum of points/errors in a qualitative sense for legs, hips and head is 6 for each and for hands 12. Using the raw results, the maximum accumulation of these points/errors (CE) is 30 and this is the extreme CE ratio for STBIDF-M. In individual calculations, as a ratio 30/30, CE = 1. That is, paradoxically, the number 30, as a raw score, is both an extreme qualitative indicator of cumulative I° and II° errors and an extreme quantitative indicator (ratio NE also takes the value 1).

The score of 21, on the other hand, although closely related to the extreme score of 30 calculated above, is not automatically equivalent to a truly extreme score of 21 elementary phenomena. These elementary phenomena are each errors, and their extreme number results from the frequency of observation of a given body

Table 3. The degree of risk of *SFI* evasion norms for the observed body parts based on the STBIDF-M results.

Variable the degree of risk of SFI		Quantitative and qualitative indicators of SFI for body parts			
		legs	hips	hands	head
		number of events (extremely possible)			
name	**symbol**	**3**	**6**	**6**	**6**
extreme	SFI points	6	6	11-12	6
	ratio CE or range	1	1	0.91-1	1
	ratio NE	1	1	1	1
very high	SFI points	5	5	9-10	5
	ratio CE or range	0.83	0.83	0.75-0.83	0.83
	ratio NE or range	1	0.83	0.83-1	0.83
high	SFI points	4	4	7-8	4
	ratio CE or range	0.66	0.66	0.58-0.66	0.66
	ratio NE	0.66-1	0.66	0.66-1	0.66
average	SFI points	2-3	2-3	4-6	2-3
	ratio CE or range	0.33-0.50	0.33-0.50	0.33-0.50	0.33-0.50
	ratio NE	0.33-1	0.33-0.50	0.33-1	0.33-0.50
low	SFI points	1	1	2-3	1
	ratio CE or range	0.16	0.16	0.08-0.25	0.16
	ratio NE	0.33	0.16	0.16-0.50	0.16
very low	SFI points	0	0	0	0
	ratio CE or range	0	0	0	0
	ratio NE	0	0	0	0

part: legs 3; hips 6; hands 6, head 6. The paradox is that a score of 30 points is derived from 21 events, each of which qualifies as an error, but refers to circumstances when the maximum limit of errors in the quantitative (NE = 21) and qualitative (21 of I° + 9 of II°) sense has been exhausted. In a situation where each of the persons being compared accumulates the limit of errors in the quantitative sense (n = 21), the ratio NE is identical for each of them and is 1. Since 21 divided by 21 equals 1, with one error committed (and it does not matter whether it is an I° or II° error) the qualitative ratio NE = 0.04, etc. What matters is the category of this one error when calculating the quality ratio for the cumulative error (CE) scale: for I° CE = 0.03, for II° CE = 0.06 (the divisor of the mathematical formula is the number 30).

These examples illustrate that both numbers (30 and 21) are the reference system (divisor in the mathematical calculation) for calculating the quality indicators of the observed phenomena. Individuals who make the same number of errors, e.g. 9 errors each, are evaluated with an identical ratio NE = 0.42, while they may differ even extremely in terms of the CE ratio (for the sum of 9 errors I° ratio CE = 0.30, and for the sum of 18 points from 9 errors II° CE = 0.60).

When the extreme evaluation conditions are met for the same person's performance of 21 errors and 21 points (NE = 21, while ratio NE = 1), and the qualitative ratio for the sum of the points equivalent to 21 I° errors is CE = 0.70. When comparing two people whose total scores (STBIDF-M raw score) are identical: 21 each (i.e. as in the example above, identical for each is ratio CE = 0.70), the number of errors (NE) may be different: for one 21 for the other 12 (3 I° errors and 9 II° errors) – ratio NE = 1 and ratio NE = 0.57 respectively.

Similarly, individual calculations of these indices should be carried out for the body parts observed. The extreme quantitative index of cumulative errors expressed in number of points (CE) is: legs 6; hips 6; hands 12, head 6 (total 30 points). It has been proved above that making all possible errors, but only category I°, the cumulative error score is 21 (ratio CE = 0.70) and for the observed body parts (except legs 3 and hands 6) does not automatically halve — it is: hips 6; head 6. This is a consequence of the STBIDF-M structure (legs are observed only during the performance of the three even tasks: 2, 4, 6, while hands are observed six times with the possibility of II° errors each time).

Evaluation of the simplified version of STBIDF-M

As a consequence of a kind of preliminary evaluation, the sum of the points, as the equivalent of potential errors (in fact the degree of danger) is 12 (*SFIhands* 6, *SFIhead* 6), so this is the final STBIDF-M score if the hand and head control is faultless. According to the adopted evaluation criteria, this result represents an average risk in a general sense, but a detailed analysis shows the extreme risk of injury to the hands and head during an unintentional fall.

Mathematical simplifications and individual profiles

We adopted the principle that we record individual qualitative ratios NE and CE less than 1 to two decimal places without rounding the results in the mathematical sense. In group calculations (summing the results of multiple individuals), we recommend using these ratios (NEG and CEG) as percentages (%) rounding the results in the mathematical sense.

We adopted the following method to record an individual profile based on the calculated ratio indices of either NE or CE in the order as above, separating each score by the slashes system: *SFIlegs/SFIhips//SFIhands///SFIhead*. As can be seen, the double shlash separates the *SFI* hips and hands, and the set of three slashes separates the hands ratio from the head ratio. Relevant examples based on some of the results from this research in the 'Discussion' section.

Ranking position (RP) as a method of qualitative analysis

A prerequisite for the application of this method is at least a two-stage outcome of any empirical variable described in words (e.g. Yes, No) or in single-digit numbers (the simplest is the "zero-one" notation: 0; 1) or multi-digit numbers (e.g. 0.1 versus 0.321) and involving at least two individuals. Meeting these criteria means that, in the example above, either two RPs are possible (1 and 2) or the result is not hierarchical (when it is identical for both individuals). If the outcome described verbally applies, as above, to only two people, it is necessary to determine which of these words denotes the desired state (i.e. higher in the hierarchy of quality of the phenomenon under study)

Table 4. Simulations of indicators of various variants of RP determination for detailed variables of the degree of risk of *SFI* phenomenon.

SFI degree (name)	Extremes of the continuum for:		Divider in calculating the ratio CE separately for SFI degree	Extremes of the RP continuum for SFI degree separations	
	SFI points	RP		NE	CE
extreme	28-30	1 to 3	30	0.33 to 1	0.93 to 1
very high	24-27	1 to 4	27	0.25 to 1	0.88 to 1
high	19-23	1 to 5	23	0.20 to 1	0.82 to 1
average	12-18	1 to 7	18	0.14 to 1	0.66 to 1
low	1-11	1 to 11	11	0.09 to 1	0.09 to 1
very low	0	not applicable			

and which is its opposite. If No means no disease, then the person so diagnosed occupies the first RP in the hierarchy of health, in which case the other should be assigned the second RP. If a larger number of objects is examined according to the "zero-one" formula and it is also an odd set, then the criterion of RP priority is determined by the larger representation (abundance) of a given outcome. Qualitative assessment is then based on the principle of dominance of the evaluated phenomenon. Remaining with the example of an odd set of people assessed most generally either as healthy or as ill, each of these states of affairs, for each specific circumstance of the study, can be classified either on the first RP or on the second RP.

When STBIDF-M is used, 31 RPs are possible for the *SFIpoints* variable (the continuum of raw scores is between 0 and 30) under the condition of at least 31 study subjects. At any higher N, there must be a cumulation of some of the results at least one *SFIpoints* value, or spread over more. An extreme accumulation of results is also possible irrespective of the number N – when each result will be identical. The greater such a distribution of scores, the greater the likelihood (although not in all circumstances) of them being subdivided into multiple subsets of the accepted STBIDF-M score distribution according to the degree of risk of *SFI* (*SFIdegree*) criterion. Moreover, it is possible to designate continuum RPs within five (from low to extreme) of the adopted six levels of the degree of risk of *SFI*. However, due to the possible accumulation of results within six *SFIdegree* (from very low to extreme) – obviously when the minimum condition N = 6 is met – the most general ranking of this empirical variable is in the continuum from 1 to 6.

Determining the RP for specific empirical variables depends on the intelligence of the researcher, but above all on the logic of the interpretation of the results, the specific cognitive objectives of the research and even the applications useful in different areas of practice. In an in-depth analysis of RP for empirical variables, it is possible to use the ratio NE and CE.

Helpful for such calculations, based on STBIDF-M results, are the simulations included in Table 4. The closer both ratios (for NE and CE) are to unity, the evidence that the cumulative outcome(s), in the case of N>1, is closer to the lowest *SFIpoints* of the higher *SFIdegree*. The closer these ratios are to the other pole of the continuum the relationship is reversed – evidence of proximity to the highest score of the lower level *SFIdegree*. These remarks do not apply to the extremes of the continuum for *SFIpoints* (0 in total, while 30 only the highest possible accumulation of points).

Persons

In the purposeful selection of persons to empirically verify the hypothesis set out in the introduction and to meet the methodological criteria of the defined stage of the STBIDF-M validation procedure, we were guided by three categories of constants (in the statistical sense of the term). First, gender identity. Second, the concordance of the declaration that individuals had no knowledge of STBIDF at the time the STBIDF-M was performed. Thirdly, the sameness of the standards of recruitment due to the systematicity, timing and quality of the intellectual stimuli concerning the knowledge of strengthening and restoring health – the students were recruited from three Polish universities of the fourth semester of physiotherapy.

Consequently, it is plausible that during the performance of the STBIDF-M, associations and projection (in the psychological sense) concerning the decipherment of the purpose served by this non-apparatus test may occur, which may result in the correction of body control errors while still continuing with subsequent tasks of STBIDF-M (this would be indirect evidence of the strength of the influence of the cognitive sphere of the subject on brain plasticity). The veracity of such an assumption is reinforced by the fact that the female students performed STBIDF-M as part of the exercises of either *the adaptive physical activity subject or the theory and practice of safe falling*. Given these circumstances, it is also reasonable to assume that the female students were optimally motivated to perform STBIDF-M. However, the comments in this paragraph already address the likely impact of these nonetheless sensitive constants on the differential performance of STBIDF-M.

The frequency distribution of age variable of students (from 20 to 22) with a negative g_2 value indicates a platykurtic distribution of this trait, which, given the methodological aspect of the research, is a desirable phenomenon. However, in the case of body weight, a positive g_2 value of 2.026 indicates that the distribution is leptokurtic. Also, the most pronounced positive skewness (1.170) of the variable of body weight indicates that the longer part of the graph is on the side of the scale with higher values. The variables with the most symmetrical distribution are body height and BMI, as evidenced by the values of g_1 and g_2. The distribution of BMI is steeper than the normal distribution (72% of female students meet the health criteria of the norm, with 14% each qualifying for either scrawniness and underweight combined or excess weight). Body height, body weight and consequently BMI are varied to the extent desirable from the perspective of the specific objectives of this research project (Table 5). Equally desirable is the variation in declared daily physical activity, traumatic experiences of a mental or physical nature due to a fall or falls in the past, and the absence of this category of experience.

Out of necessity, which comes from the order in which the sections (chapters) of this original work are published, we supplement the knowledge of the subjects with information on the methodological implications of measuring the *SFI* phenomenon based on the observations of 36 subjects.

Thus, for N = 36 study subjects, the minimum error accumulation (number of errors) for the three odd-numbered STBIDF-M tasks is 108 errors/points (1 error × 3 tasks = 3 × 36 measurements in the set), while the maximum is 324 errors/points (3 errors × 3 tasks = 9 × 36). Correspondingly, for the three even tasks, the cumulative minimum value is 144 and the maximum value is 432. The cumulative minimum value for the six tasks of STBIDF-M is 36 (1 error × 36) and the maximum value is 756 (21 errors × 36). This maximum value is the reference system (divisor of the mathematical formula) for calculating the ratio NEG (%) for the study group.

Under these circumstances, the calculations for the cumulation of I° errors are identical to those above: for 6 tasks: minimum = 36 and maximum = 756. When the accumulation takes into account the II° errors for legs and hands, then the maximum score for the three odd tasks is 432 (4 points × 3 tasks = 12 × 36) and for the even tasks 648 (6 points × 3 tasks = 18 × 36). The sum of the measurements 432 + 648 = 1080 points and is the reference system (the divisor of the mathematical formula) for calculating the ratio CEG (%) for the entire study group.

Statistical analysis

The estimation of the results is based on the following indicators: frequency (N, n); mean ($\bar{x}$); minimum (Min); Maximum (Max); standard deviation (SD or ±); measure of skewness (g_1) and measure of

Table 5. Estimation of age and main body indices of 36 female physiotherapy students diagnosed with *SFI* using STBIDF-M.

Variable	$\bar{x}$	SD	Min	Max	Skewness (g_1)	Kurtosis (g_2)
age [years]	**20.7**	0.58	20	22	0.110	−0.510
body height [cm]	**168.4**	6.49	157	183	0.037	0.080
body weight [kg]	**63**	12.09	42	100	1.170	2.026
BMI [kg/cm^2]	**21.95**	3.09	16.41	29.86	0.820	0.974

kurtosis (g_2). Pearson correlation coefficient (coefficients of determination) between pairs of specified variables. We base the analysis of the correlation coefficient on the Gilford's classification. In the studies, the level of at least p<0.05 and higher was shown as statistically significant differences.

RESULTS

Theoretical research layer

The main STBIDF-M validity criteria are identical to those used during the STBIDF validation procedure: (1). Criterion oriented validity — concurrent validity and predictive validity; (2). Content validity); (3). Construct validity [2]. The rationale articulated in the introduction adds new threads to this argumentation.

Empirical research layer

Reliability (accuracy) of the STBIDF

In line with methodological recommendations that the creator of the test (an individual or a team — in the case of the STBIDF, the creator is RM Kalina [1] should not carry out verification of its reliability, we refer to the results of such a procedure that meets this condition [8]. Earlier (2011), the authors of the STBIDF validation, in making recommendations for further research, stressed that "Research projects in the near future (...) should first of all verify the accuracy of this test. The condition is certainty that perception of people using STBIDF and awareness of the observed phenomena do not raise objections. We recommend each investigator that carefully studied the instructions of STBIDF and content of the above paragraph." [2, p. 215]. This condition was also met by Klimczak et. al [8], as the STBIDF reliability investigators used a test-retest method relying on the possibility of multiple direct secondary observations warranted by video motion capture. All correlations between test and retest scores as determined by the experts together were significant (p<0.001). The very highest correlation coefficient was observed for IndexSBIDF scores (r = 0.865), while the lowest correlation coefficient (but high according to Gilford's classification: r = 0.572), was observed between the scores obtained from the third task [8]. This is therefore a preliminary recommendation of reliability for the non-apparatus STBIDF-M.

Pilot studies with the use of STBIDF-M

Of the 36 female physiotherapy students tested, none either performed the STBIDF-M flawlessly or accumulated, quantitatively and qualitatively (the equivalent for this empirical variable is the total score), so many errors as to warrant the conclusion of extreme *SFI* risk during such an event outside the laboratory simulation conditions. A consistent finding is that each time during the even-numbered tasks, more people made errors in the control of the observed parts of the body than during the preceding easier (in relation to each pair) odd-numbered tasks. This phenomenon is most strongly demonstrated by the observations of Task 1 (n = 34, ratio NEG 94%) and Task 2 (n = 35, ratio NEG 97%). A marked reduction in events (number of female students who made errors) occurred during Task 3 (n = 31, ratio NEG 86%), i.e. under circumstances forcing the sponge with the chin to the upper torso for the first time (Figure 1). Most female students (33, or 92%) made errors in hands and head control during a simulated backward fall; 26 (72%). Least (n = 14, ratio NEG 39%) hips (Figure 2).

The most general evidence that errors in the control of the observed parts of the body are shared by the majority of female students surveyed is the concordance of the ratio NEG calculations (54%) derived from the rows and columns of Table 6. However, a deeper analysis of the rows provides evidence that the deviation (it was the minority who made the errors) concerns the hips — the ratio *NEGhips* ranges from 19% to 30% in relation to the individual Tasks, and 25% for body parts. Ratio *NEGlegs* calculated for these events during Task 2 is 44% and ratio *NEGhands* 50% during Task 3. The highest accumulation of events (errors) concerns the head: highest (92%) during Task 2; lowest (61%) during Task 5 — in column ratio NEG also highest 74%. In relation to the data in columns the deviation (44%) only applies to Task 3 (Table 6).

The difficulty of the simulated backward fall involving a preceding backward jump from an elevation of 20 cm (Task 2) resulted in more students making errors in the control of the observed parts of the body: hands by 11%, head by 3%, hips by 2%. During this Task, legs were observed for the first time (44% of the students made errors — in a qualitative sense, three times more I°). During Task 3 (the modification forced the sponge to be pressed with the chin against the upper torso), the number of female students making errors was drastically reduced in relation to Tasks 1 (89%) and 2 (92%): head, respectively, from 92% to 64%; hands from 67% to 50%; hips from 33% to 19%. Increasingly complex in terms of motor

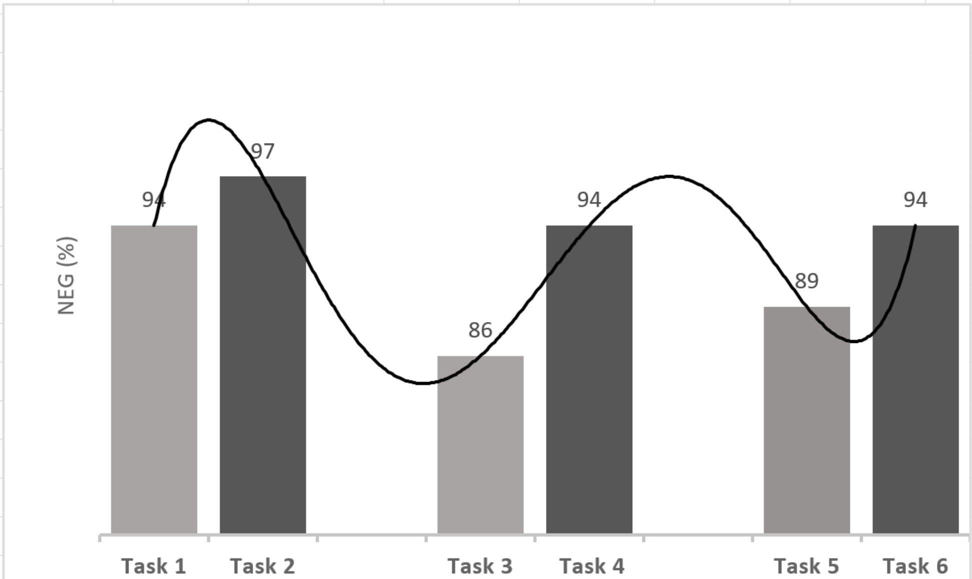

Figure 1. Proportion of female physiotherapy students (n = 36) who made at least one error while performing individual pairs of STBIDF-M tasks (ratio NEG).

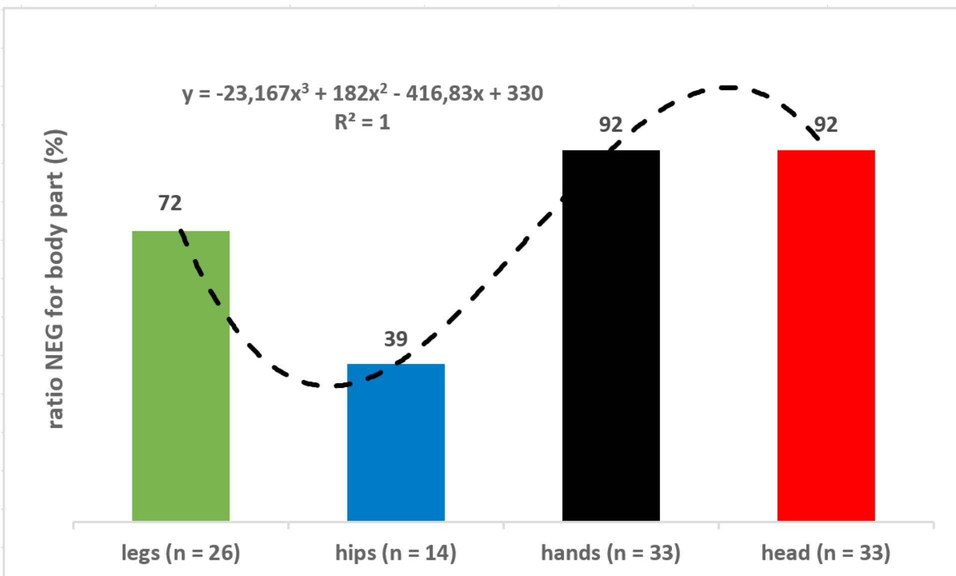

Figure 2. Proportions (%) of female physiotherapy students (n = 36) committing errors in controlling different parts of the body (ratio NEG) during a simulated backward fall under STBIDF-M.

skills, Tasks 4 to 6 saw a gradual increase in the proportion of female students making hands errors (61%, 72%, 83%), while hips errors stabilised at 22% and head errors alternated with a decreasing trend relative to each of the previous odd and even Tasks: 69%, 61%, 66% respectively. During even Tasks 4 and 6 the ratio of *NEGlegs* was 61% and 58% (Table 7, Figure 3).

An in-depth qualitative analysis of the phenomenon of motor responses (simulated backward fall) to a multidimensional modification of the empirical Tasks (each successive odd Task and each successive even Task is more coordinatively complex than the previous one, and successive pairs of "odd÷even" Tasks differentiate the jump from an elevation of 20 cm during the even Tasks)

Table 6. Number and proportion of physiotherapy students (n = 36) who made body control errors during a simulated backward fall on STBIDF-M.

Body part	Number (n) of events for body part and Tasks and ratio NEG (%) for body part													Events for body part	
	Task 1		Task 2		Task 3		Task 4		Task 5		Task 6		sum of events	theoretical number (n)	ratio NEG (%)
	n	%	n	%	n	%	n	%	n	%	n	%			
legs			16	44			22	61			21	58	59	108	55
hips	11	30	12	33	7	19	8	22	8	22	8	22	54	216	25
hands	20	55	24	67	18	50	21	58	26	72	30	83	139	216	64
head	32	89	33	92	23	64	25	69	22	61	24	66	159	216	74
sum of events (n)	63		85		48		76		56		83		411	756	54
	theoretical number of events during the Task and total													54% for STBIDF-M results	
	108		144		108		144		108		144		756		
	ratio NEG for Task (%)														
	58		59		44		51		52		58		54		

resulted in the discovery of three, partly opposing, discrete relationships. On the one hand, they relate to reducing the errors in head control during a simulated backward fall, even though the tasks are more complex in a coordinative sense each time. On the other hand, increasing the number of errors under specific circumstances. Firstly, during odd-numbered tasks (the simulated fall is at foot-support height) the original ratio *NEGhead* = 89%, next 64% and next 61%. Secondly, during even tasks (the simulated fall is made after jumping backwards from an elevation) the original ratio *NEGhead* = 92%, next 69% and next 66%. Thirdly, female students repeating the motor programme of the odd-numbered task each time during the nearest even-numbered task (after jumping backwards from an elevation) make more errors; for the pair Tasks 1 and 2 the ratio *NEGhead* equals 89% and 92% respectively; for Tasks 3 and 4 this ratio 64% and 69%; for Tasks 5 and 6 this ratio 61% and 66%. In the case of hands, only the last of the correlations shown above is fulfilled and, moreover, from Task 3 to Task 6 the trend in error progression is linear (Table 6, Figure 3).

Female students more often committed errors of hands of the II° (n = 80) than I° (n = 59), which means that 73% of points, as equivalent to the category of errors is the share of errors of II°. The reverse and on a smaller scale is true for errors of legs: the I° (n = 43) than II° (n = 34). The number

Table 7. The number of first (I°) and second degree (II°) body control errors during a simulated fall by physiotherapy students (n = 36) and estimation of the scale of these errors in relation to the theoretically maximum value (TMSE) for body part and for task.

Body part & indicator	The number of errors I° and II° and the cumulate of errors												Events for legs and hands				
	Task 1		Task 2		Task 3		Task 4		Task 5		Task 6		sum of errors & points		points		ratio CEG (%)
	I°	II°	I°	II°	I°	II°	I°	II°	I°	II°	I°	II°	I°	II°	total	theoretical	
legs			12	4			16	6			14	7	42	17			
points			20				28				28		42	34	76	216	35
ratio CEG (%)			28				39				39						
hands	4	16	5	19	5	13	5	16	18	8	22	8	59	80			
points	36		43		31		37		34		38		59	160	219	432	51
ratio CEG (%)	50		60		43		51		47		53						

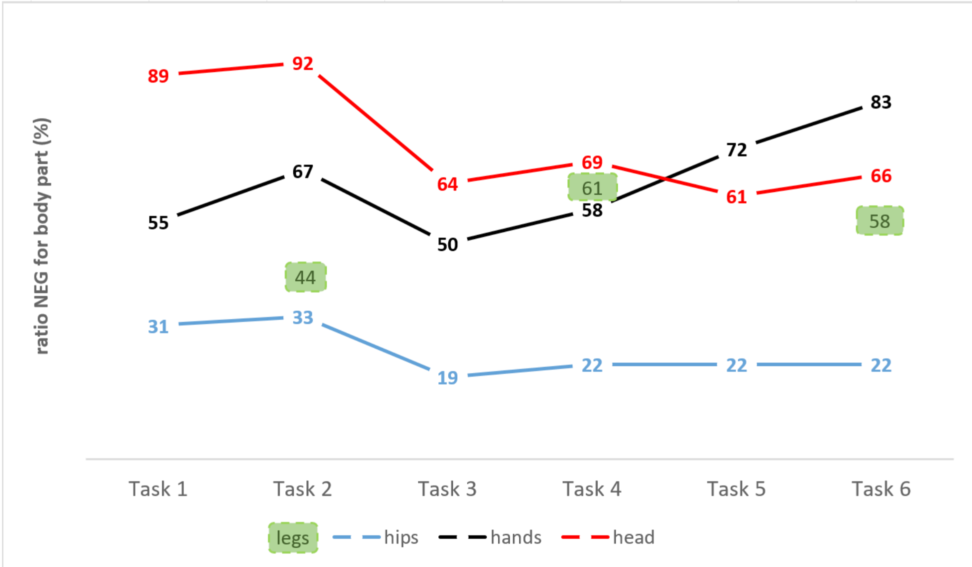

Figure 3. Proportion of people (n = 36) who made at least one error while performing individual of *STBIDF-M* Tasks (ratio NEG).

of errors of legs of the II° increased slightly during successive even Tasks, while no such regularity was found for errors of hands of the II°. From Task 1 to Task 4 the number of errors of hands of the I° remained basically the same (4, and during subsequent Tasks each time 5). There is a marked increase in the number of errors of hands of the I° during Tasks 5 and 6, i.e. the most complex coordination modifications (apart from the need to keep the sponge with the chin against the torso, there is also the requirement to clap the hands during simulated backflips). It is characteristic that female students made errors of legs and hands bots I° and II° during all Tasks. As a consequence of the qualitative assessment of these errors, more than half (51%) of the scores indicate the degree of risk of students (as a whole) being injured during a fall with hands and in 35% with legs (Table 7).

Inter-correlations of the main empirical variables

The correlations of the indicators reporting the qualitative dimension of *susceptibility fall injuries* of individual body parts with the overall STBIDF-M score, i.e. the variable *SFIpoints*, are stronger (as is

Table 8. Inter-correlations of the overall STBIDF-M score (indicator *SFIpoints*) with quantitative and qualitative (shaded box) indicators of the body parts.

Inter-correlations points (the qualitative dimension SFI)					
body part	**legs**	**hips**	**hands**	**head**	**SFI points**
legs	-	0.141	−0.173	0.177	**0.358*** $R^2 = 13$
hips	−0.141	-	0.008	−0.331	**0.371*** $R^2 = 14$
hands	0.262	0.034	-	0.074	**0.736**** $R^2 = 54$
head	**0.486**** $R^2 = 24$	−0.172	0.273	-	**0.366*** $R^2 = 13$
body part	**legs**	**hips**	**hands**	**head**	
SFI points	0.263	0.311	**0.431*** $R^2 = 19$	**0.469**** $R^2 = 22$	
Inter correlation errors (the formula „zero÷one")					

evident). The strongest is the very high correlation of *SFIpoints with SFIhands* (r = 0.736, p<0.01, coefficient of determination 54%). With the other body parts indices, the correlations are average (p<0.05, coefficients of determination 13-14%). The lack of statistically significant inter-correlations between the qualitative body parts indices is an important indication of the likely lack of a common mental substrate for the *SFI* (shaded part of Table 8). The average statistically significant correlations (p<0.05 and p<0.01, coefficients of determination 19-22%) with *SFIpoints* only *SFIhands* and *SFIhead* (light part of Table 8) are consistent with the most general result that female students were most likely to make errors of body control with just hands and head (Figure 1, Table 6). The average correlation of statistically significant (p<0.01) legs and head errors made is rather coincidental.

For the quantitative and qualitative inter-correlations of committed errors of legs control during the exclusively paired Tasks of the STBIDF-M, all are positive and statistically significant (p<0.01). Slightly stronger relationships occur between the qualitative indicators of errors (shaded part of Table 9). Most similar are the very high correlations of quantitative and qualitative error indices (coefficients of determination 51% and 50%) between Tasks 2 and 4. The decreasing strength of the association of these indices in the compared pairs Tasks 4 versus 6 and 4 versus 6 is more pronounced for the formula "zero÷one" (light part of Table 9).

Six-fold observation of committed errors of hands control during all Tasks of the STBIDF-M although confirms the similarity that all inter-correlations of quantitative and qualitative indicators are positive, not all are statistically significant. More frequent and of greater strength are the inter-correlations of qualitative indicators, expressed in points (shaded part of Table 10). There is no statistically significant relationship between points Task 3 versus 5. No such correlations were found three times for the formula "zero÷one": Tasks 2 versus 6; 4 versus 5 and 4 versus 6 (light part of Table 10). Quantitative and qualitative indicators of committed errors of hand control during the easiest Task 1 have the strongest inter-correlations with Tasks 2 and 3 (coefficients of determination for the formula "zero÷one" 63% and

Table 9. Inter-correlations between the quantitative and qualitative (shaded box) errors indicators of the *SFIlegs* committed during the STBIDF-M tasks that diagnose this phenomenon.

Task	Inter-correlations points (the qualitative dimension SFIlegs)		
	2	4	6
2	-	**0.709**** $R^2 = 50$	**0.566**** $R^2 = 32$
4	**0.714**** $R^2 = 51$	-	**0.637**** $R^2 = 41$
6	**0.529**** $R^2 = 28$	**0.482**** $R^2 = 23$	-
Inter correlation errors (the formula „zero÷one")			

Table 10. Inter-correlations between the quantitative and qualitative (shaded box) errors indicators of the *SFIhands* committed during the all Tasks of the STBIDF-M.

Task	Inter correlations points (the qualitative dimension SFIhands)					
	1	2	3	4	5	6
1	-	**0.714**** $R^2 = 50$	**0.771**** $R^2 = 59$	**0.508**** $R^2 = 26$	**0.585**** $R^2 = 34$	**0.569**** $R^2 = 32$
2	**0.791**** $R^2 = 63$	-	**0.500**** $R^2 = 25$	**0.456**** $R^2 = 21$	**0.408*** $R^2 = 17$	**0.474**** $R^2 = 22$
3	**0.783**** $R^2 = 61$	**0.589**** $R^2 = 35$	-	**0.592**** $R^2 = 35$	**0.503**** $R^2 = 25$	**0.598**** $R^2 = 36$
4	**0.491**** $R^2 = 24$	**0.478**** $R^2 = 23$	**0.620**** $R^2 = 38$	-	0.342 $R^2 = 12$	**0.479**** $R^2 = 23$
5	**0.444*** $R^2 = 20$	**0.351*** $R^2 = 12$	**0.372**** $R^2 = 17$	0.105 $R^2 = 1$	-	**0.832**** $R^2 = 69$
6	**0.350*** $R^2 = 12$	0.316 $R^2 = 10$	**0.447*** $R^2 = 20$	0.227 $R^2 = 5$	**0.721**** $R^2 = 52$	-
Inter correlation errors (the formula „zero÷one")						

61%, while for points 50% and 59%). The reduction of the above demonstrated strength of the association of these quantitative indicators Tasks 4 versus 5 and 4 versus 6 to statistically insignificant seems to explain the significant migration of errors of the II° up to the I° found earlier (Table 7). This phenomenon explains the very high correlations of Tasks 5 with 6 of both qualitative (points) and quantitative indicators according to the formula “zero÷one” — coefficients of determination, respectively: 69%; 52% (Table 10).

The strongest positive, very high inter-correlations of committed errors of hips control during the STBIDF-M occur between Task 4 and the other five (r from 0.750 to 1). Since each error is equivalent to the qualitative equivalent of 1 point, a full correlation (r = 1) between Tasks 4 and 6 implies that errors were made by the same individuals (Table 11).

Although 92% of female students made at least one error of head control very high inter-correlations are not as frequent as for hips. The strongest correlations are (p<0.01) errors between Tasks 1 and 2 (r = 0.853); 4 and 5 (r = 0.810); 5 and 6 (r = 0.766). The source of the average correlations of errors during Task 2 (92% of students) with the errors of Tasks 3, 4, 5, 6 (from 61% to 69% of students) and only one high Task 1 (89%) with the 4 (69%) is the radically reduction in the number of persons who made errors of head control (see Table 6). This is empirical evidence that the modification introduced from Task 3 onwards to keep the sponge with the chin against the torso separates STBIDF-M performers into those who can do this more successfully each time and those who find this modification difficult — hence the very high and high inter-correlation between errors during Tasks from 3 to 6 (Table 12).

In general, there is no inter-correlation between quality indicators errors of body control separately for each of the STBIDF-M Tasks. The exception is the statistically significant negative correlations of hips with head during Task 3 (r = −0.507, p<0.01) and during Task 4 (r = −0.371, p<0.05). That is, those individuals who do not make errors of hips control do so head and vice versa. The same is the reason for the statistically significant negative correlations of hips during Task 1 with head during Task 3; hips during Task 3 with head during Task 4; hips during Task 3 with head during Task 6. Other correlations of errors concerning different body parts with others concerning different

Table 11. Inter-correlations between errors indicators (simultaneously quantitative and qualitative) of the *SFIhips* committed during the all Tasks of the STBIDF-M.

Task	Inter correlation errors/points (all p<0.01)				
2	0.810	-			
3	0.741	0.695	-		
4	0.806	0.756	0.750	-	
5	0.661	0.614	0.750	0.839	-
6	0.806	0.756	0.750	1	0.839
Task	1	2	3	4	5

Table 12. Inter-correlations between errors indicators (simultaneously quantitative and qualitative) of the *SFIhead* committed during the all Tasks of the STBIDF-M (*p<0.05, **p<01).

Task	Inter correlation errors/points				
2	0.853**	-			
3	0.470**	0.401*	-		
4	0.533**	0.455**	0.757**	-	
5	0.443*	0.378*	0.587**	0.708**	-
6	0.500**	0.426*	0.695**	0.810**	0.766**
Task	1	2	3	4	5

Table 13. Inter-correlation matrix of all quality indicators errors of body control (equivalent in points) during each of the STBIDF-M Task (p<0.05 r = 0.349, p<0.01 r = 0.449).

Task and body part		Task 1			Task 2				Task 3			Task 4				Task 5			Task 6			
		hips	hands	head	legs	hips	hands	head	hips	hands	head	legs	hips	hands	head	hips	hands	head	legs	hips	hands	head
Task 1	hips	1																				
	hands	−0.064	1																			
	head	−0.149	0.188	1																		
Task 2	legs	−0.010	0.086	0.287	1																	
	hips	**0.810**	0.000	−0.125	0.115	1																
	hands	−0.275	**0.714**	0.076	−0.129	−0.087	1															
	head	−0.236	0.107	0.853	0.245	−0.213	0.175	1														
Task 3	hips	**0.741**	−0.074	−0.050	0.011	**0.695**	−0.183	−0.106	1													
	hands	−0.031	**0.771**	0.139	−0.098	−0.086	**0.500**	0.064	−0.002	1												
	head	**−0.380**	0.184	**0.470**	0.103	−0.327	0.097	**0.401**	**−0.507**	0.075	1											
Task 4	legs	0.122	−0.166	0.138	**0.709**	0.138	−0.105	0.330	0.153	−0.217	−0.154	1										
	hips	**0.806**	0.142	−0.024	0.152	**0.756**	−0.041	−0.081	**0.750**	0.008	−0.294	0.167	1									
	hands	0.045	**0.508**	**0.392**	−0.112	−0.148	**0.456**	0.334	−0.015	**0.592**	0.023	−0.075	0.056	1								
	head	−0.345	0.064	**0.533**	0.186	−0.298	−0.057	**0.455**	**−0.436**	−0.035	**0.757**	−0.038	**−0.371**	−0.045	1							
Task 5	hips	**0.661**	0.142	−0.024	0.152	**0.614**	0.033	−0.081	**0.750**	0.081	**−0.433**	0.167	**0.839**	0.128	**−0.371**	1						
	hands	−0.033	**0.585**	0.098	−0.224	0.056	**0.408**	0.119	0.039	**0.503**	0.023	**−0.357**	0.137	0.342	−0.052	0.137	1					
	head	−0.213	0.000	**0.443**	**0.397**	−0.161	−0.206	**0.378**	−0.328	0.003	**0.587**	0.071	−0.122	−0.038	**0.708**	−0.122	−0.063	1				
Task 6	legs	0.036	0.039	0.131	**0.565**	0.131	−0.059	0.313	0.146	−0.085	−0.069	**0.637**	0.069	−0.071	0.045	0.069	−0.023	0.144	1			
	hips	**0.806**	0.142	−0.024	0.152	**0.756**	−0.041	−0.081	**0.750**	0.008	−0.294	0.167	**1.000**	0.056	**−0.371**	**0.839**	0.137	−0.122	0.069	1		
	hands	−0.059	**0.569**	0.174	−0.268	−0.063	**0.474**	0.189	−0.044	**0.598**	0.067	**−0.349**	0.060	**0.479**	0.059	0.167	**0.832**	−0.020	−0.152	0.060	1	
	head	−0.298	0.125	**0.500**	**0.401**	−0.250	0.022	**0.426**	**−0.397**	0.021	**0.695**	0.110	−0.189	0.085	**0.810**	−0.189	−0.139	**0.766**	-0.052	−0.189	0.032	1

tasks are sporadic. This result reinforces the likelihood that there is no common organic or mental substrate for *SFI* (Table 13).

Qualitative analysis based on rank position (RP) scores within the degree of risk SFI

The overall STBIDF-M score as measured by the *SFIpoints* index divides the 36 female students surveyed into 15 ranking positions ranging from 2 to 24 points. The highest accumulation of scores relates to average (n = 17) and low (n = 11) of the degree of risk of SFI. The largest cumulation of one third raw scores is distributed over three of the degree of risk of *SFI*, low, average, high and concerns: 4 RP and *SFIpoints* 9 (n = 4); 11 RP and *SFIpoints* 18 (n = 4); 13 RP and *SFIpoints* 20. Three female students, each with a score of 15 points (half of the possible accumulation of scores), are classified as having 9 RP. Half of the female students (n = 18) are classified on RPs 1 to 8 (Figure 4). Analysis of the RPs found in each degree of risk of *SFI* provides evidence that the majority (55%) are situated either in the middle or above the RP of particular *SFIdegree* (Table 14).

Trend analysis of the groups of the degree of risk *SFI*

In a sense, the synthesis of the results analysed so far is a combination of quantitative and qualitative indicators at the level of algebra and geometry. Although the average STBIDF-M score (*SFIpoints* = 14.11) measured by the sum of the scores (which are only to a limited extent equivalent to the scale of the errors committed – as has already been shown) indicates a value close to the arithmetic mean of the maximum score, it does not indicate a symmetrical distribution. The distribution of these scores is asymmetrical and g_1 = −0.501 indicates that there is a slight negative skewness, i.e. the longer part of the graph is on the side of the scale where the smaller values are (Table 15). This asymmetry is highlighted, in an inverted way as it were, by the arrangement of the proportions of the results indicating the degree of risk of *SFI*. 44% are at risk, in a general sense, average and 39% low (Figure 5).

All values of the kurtosis measure are negative (g_2 from −0.150 to −1.190) testifying that the sets are platykurtic, including the most sets of results reporting *SFIdegree* hands and hips. However, while the former (hands) is a bimodal set, the latter is J-shaped, as evidenced by the 61% of results indicating no errors of hips control in any of the six backward fall simulations, and the distribution of the remaining from 3% to 17% (Figure 6).

Furthermore, the diversity of the trends of the groups of the degree of risk *SFI* of each of the observed body parts is noteworthy. One in two of the female students surveyed is at extreme risk of head injury in a real rather than simulated fall situation. The likelihood of extreme risk is lower for

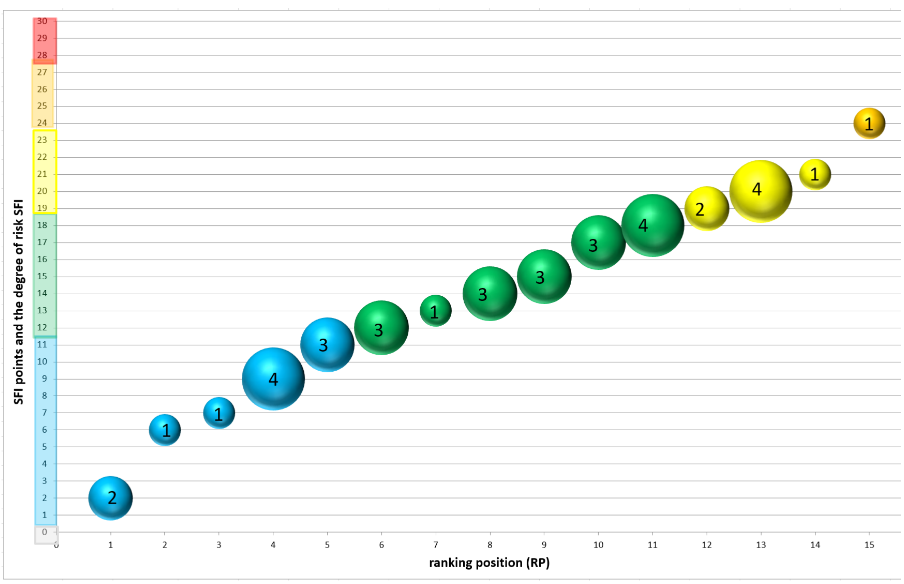

Figure 4. Accumulation of female physiotherapy students (numbers in circles) per RP row score (*SFIpoints*) of results of STBIDF-M.

Table 14. RP layout of female students (n = 36) by quantitative and qualitative indicators of results of STBIDF-M.

SFIdegree			Raw scoreor range SFI (points)	Ratio for RP of SFI degree		≥midpoint particular SFI degree*
name	N of RP	N of students		NE	CE	
very high	1	1	24	0.25	0.80	0/1
high	3	7	19 to 21	0.20 to 0.60	0.82 to 0.91	1/7
average	6	17	12 to 18	0.14 to 1	0.66 to 1	10/17
low	5	11	2 to 11	0.18 to 1	0.18 to 1	9/11
STBIDF-M for n = 36						
N				%		
4	4	36	15	48	48	55

Note: *in numerator the number of female students who meet the condition equal to higher ratio *SFIdegree*

Table 15. Estimation of the main qualitative indicators of the *SFI* phenomenon found in female physiotherapy students (n = 36) who performed STBIDF-M.

Variable	$\bar{X}$	SD	Min	Max	Skewness (g_1)	Kurtosis (g_2)
SFIpoints	**14.11**	5.287	2	24	−0.501	−0.150
legs	**2.11**	1.89	0	6	0.659	−0.263
hips	**1.50**	2.35	0	6	1.248	−1.190
hands	**6.08**	4.05	0	12	0.147	−1.321
head	**4.42**	2.08	0	6	−1.022	−0.404

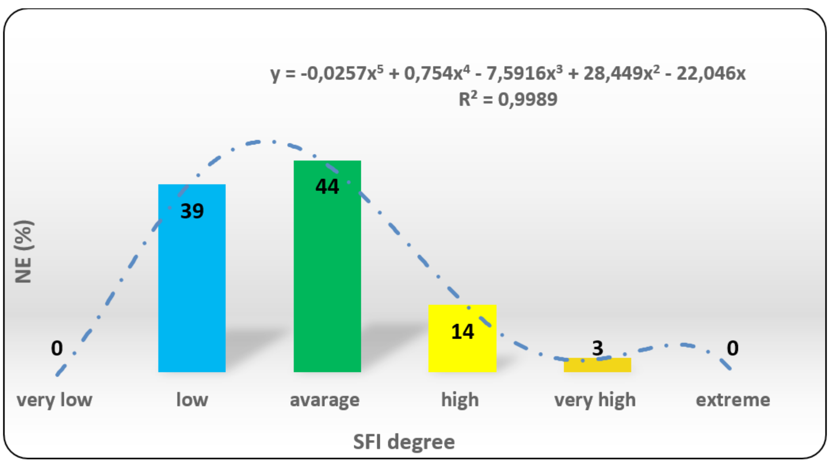

Figure 5. *SFIdegree* score of STBIDF-M for 36 female physiotherapy students.

hands 19%, hips 17% and legs 11%. Group averages (errors) increase linearly significantly with increasing manipulation variable (coordination complexity of subsequent Tasks) only for hands (see Figure 6, as this finding is not documented in the set of trend graphs dedicated to *SFIdegree* for body parts – Figure 6).

Comparison of STBIDF [1, 2] versus STBIDF-M results

However, the main reason for the two graphical models of the *SFI* phenomenon under study (Figure 7), derived from two independent samples of a population of female physiotherapy students and made over a ten-year interval, is the modification applied to the tool that measures

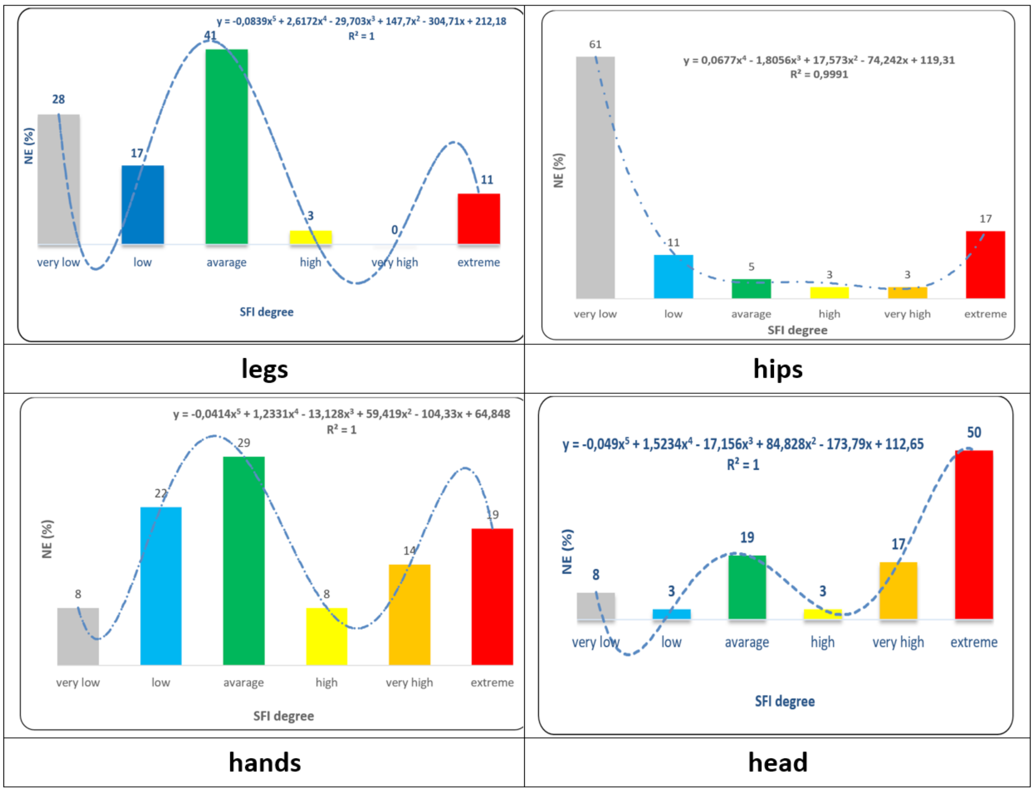

Figure 6. *SFIdegree* score for observed body parts during STBIDF-M performed by 36 female physiotherapy students.

this phenomenon. Doubling the number of Tasks from three to six primarily resulted in an increase in the proportion of subjects who committed at least one error of leg control during a simulated backward fall after jumping backwards from an elevation of 20 cm (even tasks in STBIDF-M, while in STBIDF only during Trial 3). The proportion difference of 31.05% is statistically significant ($p<0.01$) — after test modification 72.22%, before 41.17% (Figure 7).

However, there is not only a similarity in the trend of the proportion of errors made with the rest of the body parts in a qualitative sense (the further away from the centre of the body, the higher the probability of *SFI*), but also a lack of statistically significant proportion differences. The relationships are as follows (STBIDF, indicator %max [2] versus STBIDF-M, indicator ratio CEG): hips 37.3% vs 25%; hands 71.1% vs 50.7%; head 84.8% vs 73.5%. However, an important effect of the greater number of observations provided by the modification of the test is, on the one hand, the clear trend towards a reduction of especially the errors of II° mentioned in the last sentence of body parts. On the other hand, it gives credence to the knowledge that *SFIlegs* are more likely in situations where, as a result of a fall from some height, the first contact with the ground is made by the legs (not necessarily the feet). This conclusion is supported by the observation result based on repeating such a simulation three times during STBIDF-M, as the risk of misdiagnosis based on only one simulation is significantly reduced.

There is another similarity and two differences between both versions of the test. The increasing coordination demands of the modified Tasks (Trials [2]) result in increasing errors of hand control (measured by the proportion of individuals who make at least one error) when using both tests. When using STBIDF-M, the trend in error progression from Task 3 to Task 6 is linear: 50%; 61%; 72%; 83% (Figure 3), while for STBIDF this trend from Trial 1 to Trial 3 is as follows: 45.5%; 82.2 %; 92.6% [2]. From Task 3 onwards STBIDF-M maintains a slightly alternating proportion of those who made at least one error of head control (from 61% to 69%), while highly stable (from 19% to three times 22%) are errors of hips control (Figure 3). Meanwhile, during the application of STBIDF, the progression of errors concerns head control: 72%; 82.2%; 92.6% and on the contrary hips control: 50%; 38.2%; 25% [2].

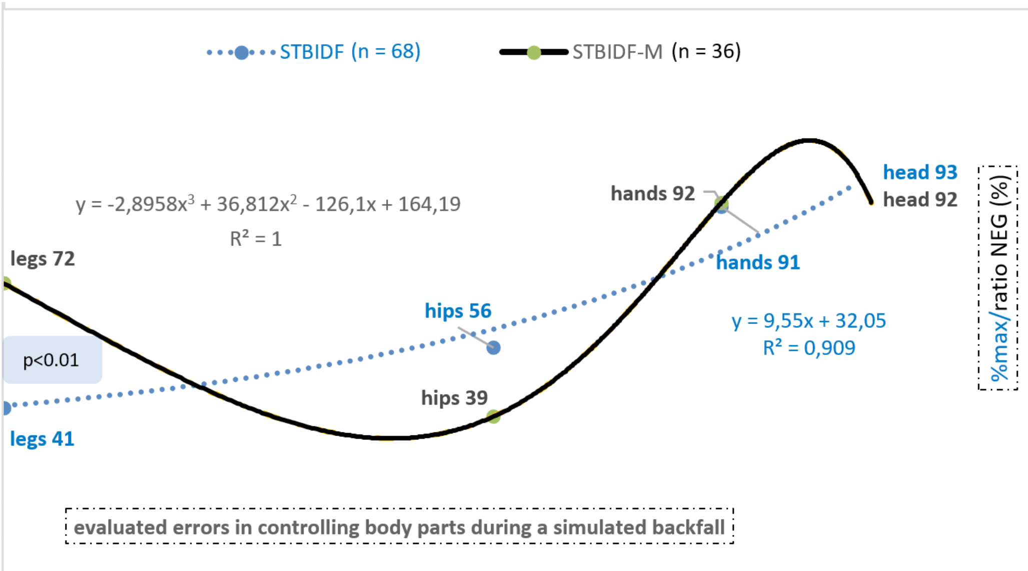

Figure 7. Polynomial *SFI* trend lines based on the proportion of subjects who made at least one error of body control during a simulated backward fall when using two versions of STBIDF.

DISCUSSION

In this work, we have based the presentation of the results of our observations on the method of alternating references to algebra and geometry, without, however, specifying a priority of precedence. The imminent provision of empirical evidence of STBIDF-M reliability by an independent team of researchers (who are not the authors of the test) will complete the validation procedure. Meeting these methodological standards in accordance with ethical research criteria is the final condition for recommending the STBIDF-M for diagnostic practice of the *SFI* phenomenon. This diagnostic should be applicable to all categories of activities in close relation to health care: promotional, preventive, therapeutic, rehabilitative. In other words, the STBIDF-M, due to its simplicity, non-apparatus category (the video verification standard is not a prerequisite for the use of this unique *SFI* diagnostic tool), guaranteed motor safety and multidimensional cognitive qualities, can be applied in all circumstances where a person moves independently, understands verbal commands and follows them. That is, in the language of praxeology, it is a person who meets the criteria of full (completed) flexible and situational possibility of action (see glossary).

An obvious limitation of the STBIDF-M is the lack of simulation of forward and lateral fall (abstracting from intermediate directions). This is not only a matter of concern for the safety of the person being diagnosed. A loss of balance in the aforementioned directions would inevitably risk injury if it resulted in a fall even under laboratory conditions. What about in all other circumstances, or when the loss of balance would result in a collision with a vertical obstacle. There are more of studies analysing collisions involving cars, motorbikes or bicycles [e.g. 9-11] but less concerning human movement, except sports collisions [12, 13]. The comments in this paragraph are also important in another methodological aspect. In possible comparisons of the epidemiology of the location of fall injuries with laboratory findings using either STBIDF-M or STBIDF, it should be taken into account that facial injuries may result from a forward fall, whereas unilateral injuries in the hands, hips, knees from a fall to the side (right or left, with more or less rotation in intermediate directions).

The perspective of universal diagnosis of *SFI* also has implications for recommendations in the area of didactics (effective safe fall teaching [4, 6, 14-25]). It may be helpful to compare individual profiles of female students, those with identical STBIDF-M results and those with extreme results. For the purpose of this discussion, we present the profiles of the *SFI* basic on ratio CE for students: A: 0/0.33//0//0; for B: 0/0//0.33///0; for H: 0.33/0//1///0.33; for K: 0/0//1///0.33; for M: 1/0//1///1; for L: 0.66/0.83//0.66///1. Despite some similarities and even identities, each of these profiles is different (Tables 16 and 17). They are empirical evidence of the need to respect at the highest possible level an elementary pedagogical principle when teaching safe fall — namely the principle of individualization.

The findings on different aspects of *SFI* presented in this thesis are — somewhat paradoxically – firmly rooted in the experience of teaching safe fall and self-defence as integral skills, and over time safe fall as a key skill of broader survival, which includes injury prevention, rather than the other way around. The second author of this work 50 years ago dedicated his first series of publications to popularising self-defence among soldiers. At the same time, he taught both skills: first to commandos (1971-1993); next of military cadets (1974-1994), physical education students (since 1997); until only safe fall of physiotherapy students and the programmes are dedicated to the prevention and therapy of various groups of patients and people with an increased risk of falling and its even extreme consequences (since 2009). The second author (also the originator of the modification of the original STBIDF-M), as a graduate of a physiotherapy faculty, began his own academic career in 2009 and at the same time his safe fall practice by diagnosing *SFI* in combination with safe fall teaching effects [2, 5, 6, 8, 15, 22, 24, 26]. Thus, it took as many as 37 years for the idea of measuring the *SFI* phenomenon not necessarily in conjunction with safe fall teaching to be born, and only 12 years to make modifications to the test measuring this phenomenon. For the sake of argument, let us add that the Spanish authors' 2018 study [23] is only somewhat similar to the idea of measuring the *SFI* phenomenon according to the STBIDF-M methodology. The authors observed – using the technology of a video-graphic record – five parts of the body (neck, trunk, knees, hip, hands) during a forced backward fall, with a 'zero-one' assessment (YES or NO) as to the correctness of the motor response, based on the opinions of five pre-trained experts.

Table 16. Indicators of general profiles of female students with average (n = 3 shaded areas) and extreme (n = 2 and n = 1) STBIDF-M scores.

Person code	Age (years)	Body height (cm)	Body weight (kg)	BMI	STBIDF-M results			Personal index of cumulating of errors in the task (ratio NE)						Ratio CE for body part			
					SFI points	ratio		Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	legs	hips	hands	head
						CE	NE										
A	20	157	57	23.1	**2**	**0.07**	**0.09**	0.33	0.25						0.33		
B	20	183	85	25.4	**2**	**0.07**	**0.09**					0.33	0.25			0.33	
H	20	173	63	21	**15**	**0.50**	**0.42**	0.66	0.50	0.33	0.25	0.33	0.50	0.33		**1**	0.33
K	21	163	45	16.9	**15**	**0.50**	**0.42**	0.66	0.50	0.66	0.25	0.33	0.25			**1**	0.50
M	21	175	90	29.4	**15**	**0.50**	**0.71**	0.66	0.75	0.66	0.75	0.66	0.75	**1**		**1**	1
L	21	170	80	27.7	**24**	**0.80**	**0.90**	**1**	0.75	0.33	**1**	0.75	**1**	0.66	0.83	0.66	**1**

Note: **ratio NE** the proportion of the sum of body control errors to the theoretically possible (21) when performing STBIDF-M; **ratio CE** proportion of the sum of the error scale (points) to the theoretically possible (30 points) when performing STBIDF-M

Table 17. Personal identification of I ° and II ° body control errors during a simulated fall of students with different degrees of risk of *SFI*: low (personal code: A, B); average (H, K, M) and very high (L).

Body part	Task 1		Task 2		Task 3		Task 4		Task 5		Task 6	
	degree of error											
	I°	II°	I°	II°	I°	II°	I°	II°	I°	II°	I°	II°
legs			M				L, M				L, H, M	
hips	A, L		A, L				L		L		L	
hands	M	L, H, K	L, M	H, K	M	H, K	M	L, H, K	B, M	L, H, K	B, M	L, H, K
head	L, H, K, M		H, K, M, L		L, K, M		L, M		L, M		L, M	

However, a more surprising issue is that the scientific exploration of the *SFI* phenomenon, to the extent that it is known since the 2009 publication [1], is only in the current century. And yet, while *SFI* is neither a disease, let alone a pandemic, it affects every human being – without exception – throughout ontogeny. A new born baby can fall (even from a height of more than 1 meter) as a result of a practical error by the person or persons currently caring for it. The risk of a person of any age falling, for the same reasons and above all under different circumstances, cannot be disputed [27-29]. Admittedly, neither *SFI* is a disease entity (as highlighted above) nor the flawless performance of any of the tests for diagnosing *SFI* (STBIDF or STBIDF-M and those yet to be developed) means that there are people who are not at risk of losing their lives, let alone their health, as a result of falling and colliding with the ground or a vertical obstacle. Such consequences are determined in each case by specific circumstances and a compilation of concomitant events that is often difficult to foresee. In other words, each person, as a result of a certain category of falls and the combination of events mentioned above, can either die or spend the rest of his or her life in disability. In the population of people moving independently, everyone will fall at least once in their lifetime. For a certain proportion of individuals, this is the first and also the last fall – in extreme circumstances it ends in death. According to some epidemiological data, around 30 per cent of people over 65 fall at least once a year, while 15 per cent fall at least twice [30]. Within a year, half of the surveyed men and half of the surveyed women of the Polish population over 65 years of age experienced a fall, and among them, more than 40% suffered an injury [31].

Since *SFI* is not a disease, yet affects every human being with me or more limited physical activity (abstracting from cases of neurodegenerative diseases condemning such a person to a bedridden existence) and has been going on for millennia, there is still no logical or semantic basis for classifying this phenomenon as a pandemic according to its medical definition. This logic is not altered by the fact that falling rises in the hierarchy of causes of premature death and years spent in disability [28, 29]. For it is not only the fall (an external event) that is the cause, but also the specificity of the organic substrate of *SFI* (an internal factor), but also the established habits of lack of control over distal parts of the body during a fall (admittedly an internal factor, but with a substrate already more determined by the mental layer) has been demonstrated in this work. Paradoxically, in certain circumstances, an intentional fall (not necessarily performed in a professional manner – for example, to avoid colliding with an object in motion) saves health and even life. It is an open dilemma how to name these essentially two interconnected phenomena (the inevitability of falling and the specificity of each person's *SFI* – micro-scale) in order not to violate the existing semantic order, but to influence a radical change in the perception of this global public health problem. Moreover, to solve it precisely in this dimension – the macro scale.

In slightly different words about the problem from a micro-scale perspective: (a) two phenomena are evident, both the inevitability of a fall and the limited resistance of soft and hard tissues to the effects of collision with a hard object (this, in our opinion, is the simplest explanation of the organic basis of *SFI*); (b) since, under laboratory conditions (i.e. during simulated falls provided by the use of STBIDF-M), the result of repeated observations provides evidence that the initial contact with the ground is repeated with the most vulnerable parts of the body, the greater the risk of loss of health and even life due to a fall in everyday physical activity (see Figure 6) and this is the empirical justification for the important role of the mental factor of *SFI*; (c) about a person with a high NE and CE ratio of the events mentioned in "b", there are empirical grounds for believing that he or she is neither able to correct his or her own motor actions so as to feel the compliance of the execution with the investigator's command, nor is it likely that he or she is aware of the basic recommendations of safe fall theory [7, 32] – large impact area, extension of impact time and braking distance, use of cushioning functions of muscles and musculoskeletal system (it is enough to adjust to them and even before the appropriate course can be reduced).

Such a preliminary conclusion is mandated by both the quantitative and qualitative results of our research. However, our findings would not have been possible without the innovative modification of the STBIDF [1, 2] precisely in the quantitative and qualitative dimensions. The former involves doubling the tasks of the test in the diagnostic part of the *SFI* hips, hands, head (from three to six) and multiplying the observations of the *SFI* legs three times (from one Task to three). The qualitative dimension has to do with increasing the coordinative complexity of each subsequent Task relative to the immediately preceding one and the Tasks performed earlier.

These modifications of a methodological nature have contributed significantly to strengthening the evidence on two inferential phenomena. First, the replication of control errors with distal body parts during a simulated backward fall in subsequent Tasks by adults is evidence of the strong influence of established habits. Secondly, the cognitive-behavioural competence of the test subject is comprehensively informed by observations from the three types of interventions made in the structure of the modified test: the need to perform even Tasks (2, 4, 6) precedes the jump from a platform of about 20 cm; the need to keep the sponge with the chin against the torso from Task 3 to 6; the need to clap the hands while controlling the sponge with the chin during Tasks 5 and 6. A key element of each Task is to change from a vertical stance to a horizontal stance as quickly as possible (in Tasks 2, 4, 6 preceded by jumping backwards off the platform). It is this constant factor (a simple, safe simulation of a backward fall), repeated six times under constantly modified external and internal circumstances combined, that, in our opinion, makes STBIDF-M (for all its simplicity and generality) also a unique tool with qualities of complementary evaluation of the human cognitive-behavioural sphere, albeit in a simplified and very general sense.

This combined modification of external and internal circumstances takes place as a function of time, and the main determinant is the changing coordination complexity of Tasks with an identical end goal (horizontal posture). The modifiable internal factor (forced by this dynamic of changing Tasks) is the increased activation of that layer of the nervous system which should ensure coordinated movements of the body and its individual parts according to the goal. Since the structure of the motor responses of individuals (who have not observed others before performing the test) is multipolar – and these phenomena are subject to direct observation – it is helpful to synthesise the results of the observations. Methodological support for such a synthesis was provided by research according to the video verification standard, and we therefore recommend this method as very useful in research and practice. On the other hand, the results of this synthesis imply the possibility of identifying individuals (creating individual profiles) with different cognitive-behavioural potential and it is not a mere mapping of the adopted classification of the degree of risk of *SFI* annotated with standard sets of exercise methodology.

This means, on the one hand, that the results of each application of this innovative STBIDF-M provide an empirical basis for the creation of individual learning paths, and on the other hand, especially from the expert safe fall, one should expect complementary methodological competence and a sense of mission in the fight against *SFI* – with the emphasis on the word "fight" [33-37].

The complementary methodological approach is a separate, complex interdisciplinary issue at the interface with everyday practice and the systemic fight against *SFI*. At the same time, it is just an example of current challenges having to do with health and survival from the micro scale (the individual) to the macro scale (the human population). There are still intermediate levels between both scales: intermediate lower scale (e.g. an isolated group at increased risk of falls and adverse effects); intermediate scale (population of a country), intermediate higher scale (population of a continent). Although the phenomenon of *SFI* covers the entire globe, the specificity of certain regions of the world significantly translates into epidemiology, and this knowledge should imply specific solutions aimed at promotion, prevention and therapy based on safe fall exercises and crash avoidance. According to a 2013 report by the *Institute For Health Metrics and Evaluation* [28] "within 20 years (1990-2010) a fall rose on a global scale high in the rankings comprising causes of years lived with a disability as well as years lost to premature death. Among 25 causes of those negative phenomena, the fall is ranked tenth. The highest positions in the ranking are occupied by Europe (Western and Central — third position, Eastern — ninth position). Central and Eastern Sub-Saharan Africa (25) and Western Sub-Saharan Africa (23) occupy the lowest positions in the ranking." [21, p. 240].

Only in the margins of this discussion do we draw attention to two more issues, which, clearly, do not portend hope for the liberation of the human population from *SFI*, even if technological progress has accelerated in ways and at rates unimaginable. Instead, they have to do with the possibility of radically reducing the effects of unintentional falls and collisions with vertical or moving objects, that is, in fact, making people immune to the highly health-destructive phenomenon of *SFI*.

Firstly, recommendations to practise combat sports, even those that programmatically include the teaching of safe fall techniques as a reliable means of prevention, should be considered questionable. This statement is based on empirical arguments of a more general, epidemiological [38-41] and decidedly specific, experimental nature. Dariusz Boguszewski, in his habilitation monograph [42], provided evidence that in none of the groups of combat sports athletes studied (judo, karate, wrestling, etc.) was there even one person who performed STBIDF flawlessly. But Boguszewski et al. [43] also provided important knowledge based on other empirical evidence, namely: a) individuals who scored high on the *Functional Movement Screening* (measuring functional limitations of the musculoskeletal system, with a maximum positive score of 21 points [44, 45]) made the fewest errors performing STBIDF, the negative correlation being statistically significant $p<0.01$; (b) those who made more errors performing the STBIDF were more likely to have a history of fall-related injuries – the positive correlation is statistically significant $p<0.01$ [43].

In turn, Andrzej Mroczkowski et al. [46] demonstrated that simply informing 37 female physiotherapy students (age 20-23 years) about the STBIDF assessment criteria before repeating the test after two weeks has a significant impact on test results. However, "the STBIDF can detect motor habits during its performance to some degree because a significant part of participants commits error despite knowing how to perform the test correctly" [46, p. 60]. But Mroczkowski, in another important experiment, proved that practicing selected sports disciplines in which the fall backwards occurs can protect one against head injuries by acquiring appropriate motor habits [47]. Thus, simply repeating the STBIDF-M (or tests with a similar purpose), preceded each time by familiarisation with the assessment criteria, will already reduce errors. On the other hand, combining this opportunity, as early as possible in ontogenesis, with programmed physical activity based on frequent repetition of safe fall exercises and collision avoidance in attractive forms [48, also: 4, 6, 14-16, 19, 22-25, 47, 49- 52], is precisely the simplest way – as we articulated above – of immunizing people against the highly health-destructive phenomenon of *SFI*.

Secondly, one of the basic conditions for the fulfilment of the social mission of science, in the first instance by the scientists themselves, is the reliable documentation of the recommended tools for measuring the phenomena for which these tools are intended. The fulfilment of these elementary methodological criteria is a guarantee that any researcher, or team, interested in further exploration of a given issue can replicate not only in the details of the experiment, but also in the ways of analysing the results and their presentation. The empirical data presented in this thesis illustrate the evidentiary usefulness of statistical indicators of the same kind, although at one time there is multiplied evidence, at other times there is only a little evidence, but it is crucial for the discoveries made. In this work, correlation matrices illustrate this methodological problem. These seemingly obvious statements relating to the methodological canons of scientific work are intended to draw attention to the incomprehensible practice — precisely because of the social mission of science – of rushing to publish research results with even extreme liberalisation of the ways in which empirical data are presented. To justify the use of the word "incomprehensible" above, let us refer to the encouragement published in one of the most renowned scientific journals to publish a lot and quickly after obtaining the Ph.D. degree [53]. This incomprehensible recommendation is a blatant denial of the social mission of science and perhaps most clearly demonstrates only one aspect of these seemingly obvious statements. The second aspect has direct references to the expected results completing the STBIDF-M validation procedure. It mainly concerns the verification of the reliability (accuracy) of the STBIDF-M. Challenging expectations in methodological terms are placed before this component of validation procedures (especially simple tools measuring phenomena that are closely related to the ongoing monitoring of various variables of any or all dimensions of health) [e.g. 54-66]. In our opinion, this issue (also for economic reasons) should be treated with increasing seriousness – if only not with haste (!). The third aspect draws attention to that part of the social mission of science for which the entities charged with the obligation to implement, first and foremost, scientific achievements of global significance, in the broadest sense of the word, into various spheres of public life are directly responsible. That is, without excluding anyone from the people.

If we are wrong, then why has the perennial problem of *SFI* not lived to see a countermeasure based on scientifically and practically verified effective methods of diagnosing and reducing *the* *susceptibility of the body injuries during a fall* – an isolated positive example being Japan [21, 67]. It does not change the essence of the matter that, in scientific terms, this problem is admittedly only partially solved, but sufficiently so to record significant progress in immunizing the modern human population against *SFIs*. But it is equally undeniable that, despite the incredible advances in science and the knowledge that has been available for many years in the global science space about these phenomena and the realisation that *SFI* is neither a disease nor a pandemic, the tragic consequences of falls (as measured by increasing numbers of premature deaths and people who will spend the rest of their lives in disability) will be a growing public health problem on Planet Earth. The reader is entrusted with the opportunity to answer the question: which of the entities responsible for fulfilling the social mission of science (see paragraph above) is to free current and future human populations from this somewhat stalemate situation.

CONCLUSIONS

Empirical evidence of the increase in the diagnostic power of the test is primarily a statistically significant difference of people who committed errors in controlling their legs during a simulated fall back. This is the effect of a threefold increase in the ability to observe this phenomenon during STBIDF-M. The reduction in the proportion of people who committed hips control errors during the modified test is further evidence of the increased motor safety of the test subjects. This phenomenon can be explained by the effectiveness of the pre-test. People who are unable to complete a deep squat are tested on a platform. We recommend STBIDF-M as a safe tool for diagnosing the susceptibility to injury during the fall *(SFI)* of children over 6 years of age and the people without age and health restrictions (not excluding neurocognitive patients) with the exception of some patients with spinal injuries.

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