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Relationship the body balance disturbation tolerance skills with susceptibility to the injuries during the fall of young women and men

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

Robert Bąk

Faculty of Physical Education, University of Rzeszow, Rzeszow, Poland

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Abstract

Background & Study Aim: Loss of balance is a common cause of the fall, which could result in body injury or even death. The aim of the study was the relationship between the body balance disturbation tolerance skills and susceptibility to injured during the fall of young women and men.

Material & Methods: Two non-apparatus tests were studied 51 students of the 4th year in the field of tourism and recreation (27 women, 24 men, aged 22). Rotational Test (RT – non-apparatus version) measures the body balance disturbation tolerance skills (BBDTS). RT consists of six tasks (consecutive jumps with body rotation of 360° alternately to the right and to the left). The overall result is the sum of the six tasks and includes 0 to 18 stipulated points. Criteria of an individual level of BBDTS are as follows: very high (0-1), high (2-3), average (4-9), low (10-12), very low (13-15), insufficient (16-18). The susceptibility test to the body injuries during the fall (STBIDF) – total points is a general indicator of the susceptibility to body injuries during the fall (SBIDF): low (0), average (1-3), high (4-8), very high (9-14). Relatively for particular body parts (SBPIDF): low (0), average (1), high (2-6).

Results: In total, 50% of men and 33% of women were diagnosed as very high and high BBDTS. On average, 37% of women and 29% of men, while low and very low 30% women and 21% men. Almost 75% of the surveyed women and men were characterized by low or average SBIDF, and 7% of women and 8% very high risk of injury when falling. A statistically significant relationship SBIDF with the high BBDTS was found (men $r = 0.639$, $p<0.01$; women $r = 0.583$, $p<0.01$).

Conclusions: Easy to use non-apparatus tests can be used in broadly understood, continuous fall prevention and injuries prevention (including also necessary education). These three occurrences related to the cause-effect relationship. Unfortunately, despite the unique achievements of Polish scientists, they still remain beyond the perception of the entities responsible for public health.

Key words: fall prevention • injuries prevention • non-apparatus test • public health • Rotational Test

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Author's address: Robert Bąk, Faculty of Physical Education, University of Rzeszów, Towarnickiego 3, 35-959 Rzeszów, Poland; e-mail: rbak@ur.edu.pl

INTRODUCTION

Body balance disturbation tolerance skills – the ability to maintain the vertical posture in circumstances of the fall hazard [17].

Non-apparatus test – that motoric test (exercise endurance test) of the required reliability (accurate and reliable), which use does not require even the simplest instruments [43].

Health – *noun* the fact of being well or being free from any illness [44].

Healthcare – *noun* the provision of medical and related services aimed at maintaining good health, especially through the prevention and treatment of disease [45].

Public health – *noun* the study of illness, health and disease in the community => **community medicine** [44].

Community medicine – *noun* the branch of medicine devoted to the provision of public health care [44].

Preventive – *adjective* used for describing an action taken to stop something happening, especially to stop a disease or infection from spreading [44].

Loss of balance is a common cause of the fall, which could result in body injury or even death. Although a fall has raised its position in the classification of causes of years lived with disability as well as years lost to premature death and still poses a global issue for public health [1, 2], rational systemic solutions have still not been developed (in the field of coherent diagnostics, prevention and treatment) [3, 4]. Epidemiology of this phenomenon is well-described. Unique methods used to diagnose susceptibility to body injuries during the fall [5-8], effectively prevent body injuries sustained due to a fall [9-13] as well as effectively treat individuals at increased risk of fall who declare unpleasant experiences related to a fall or collision with vertical obstacles or objects in motion [4, 7, 14] are being promoted; yet it is surprising that entities representing public health, preventive healthcare, preventive medicine institutions, etc. implement no initiatives in this area.

In the cognitive and application-related sense, interdisciplinary research focused mostly on experiences associated with combat sports and martial arts from various cultures is one of important factors for developing coherent diagnostics, prevention and treatment of susceptibility to body injuries during the fall [15]. Perhaps exacerbating pathology that involves promotion of martial arts as modern gladiatorship [16] remains the most crucial barrier for anticipated implementations. Study reports based on well-documented knowledge of sport science, physical exercises, kinesiology, neurophysiology, biomechanics, etc. are certainly not a mental obstacle.

The aim of the study was the relationship between the body balance disturbation tolerance skills and susceptibility to injured during the fall of young women and men.

MATERIAL AND METHODS

Participants

Two non-apparatus tests were studied 51 students of the 4th year in the field of tourism and recreation (27 women, 24 men, aged 22). Criterion for inclusion in the research: consent of the person, no health contraindications, performing the squat without the help of the researcher (see Figure 1 & 2 in the paper [17]).

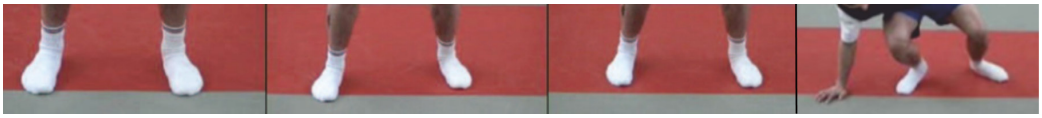
Design

'Rotational Test' (RT – non-apparatus version) measures the body balance disturbation tolerance skills (BBDTS). RT consists of six tasks (consecutive jumps with body rotation of 360° alternately to the right and to the left). The overall result is the sum of the six tasks and includes 0 to 18 stipulated points (the criterion is contact or no contact with the feet with the "take-off and landing line"). Criteria of an individual level of BBDTS are as follows: very high (0-1), high (2-3), average (4-9), low (10-12), very low (13-15), insufficient (16-18) points [18] (Figure 1).

The structure of the susceptibility test to the body injuries during the fall (STBIDF) is: three motoric trials (tasks) performed on a mats. A manner of the body parts protection (head, hands, hips, legs) was being assessed, the most exposed to damage during the fall. Any incorrect collision – simulated by the fastest possible change of the posture from vertical to horizontal (lying on the back), were documenting by the mistakes of the first- ("1") or the second grade ("2"), and no mistakes "0". STBIDF – total points are a general indicator of the susceptibility to body injuries during the fall (SBIDF): low (0), average (1-3), high (4-8), very high (9-14). Relatively for particular body parts (SBPIDF): low (0), average (1), high (2-6) [5, 6].

Task 1. Instructions for the test subject: "on the command GO as quick as possible lie down on your back". Performance: tested person safely and as quick as possible should lie down on back – an attempt ends when the heel, buttocks, back and head adhere to the ground. **Task 2.** Instructions for the test subject: "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". **Task 3** (tested person with sponge like in the Task 2, stands on a platform about 25 cm height, arranged from i.e. mattresses). Instructions for the test subject: "all activities the same, but after command GO at first jump into the back". Performance: after the command READY tested person has to start clapping hands, after the command GO has to jump into the back and after the feet is contact with the ground should immediately lie on the back clapping hands – clapping should stop on the command STOP (Figure 2 – more information in [6]).

the RT starts jumps with body rotation of 360° to the right



landing assessment criteria after the jump with trading ("penalty" points):

1 2 3 4

Figure 1. Visualization of the 'Rotational Test' (RT – non-apparatus version) – the criterion for the assessment of each jumps with body rotation of 360°.

Statistical analysis

Hypothesis testing: 1 significance test – independent proportion (RT and STBIDF results for women and men); 2 significance test – independent correlation coefficients between RT and STBIDF tests.

RESULTS

In total, 50% of men and 33% of women were diagnosed as very high (0-1 points) and high (2-3) BBDTS. On average, 37% of women and 29% of men, while low (10-12) and very low (13-15) 30% women and 21% men (Figure 3).

Almost 75% of the surveyed women and men were characterized by low or average SBIDF, and 7% of women and 8% very high risk of injury when falling (Figure 3). In people with low and average SBIDF a statistically significant relationship with the high BBDTS capability was found (men $r = 0.639$, $p<0.01$; women $r = 0.583$, $p<0.01$).

Almost 75% of the surveyed women and men were characterized by low or average SBIDF, and 7% of women and 8% very high risk of injury when falling (Figure 4).

A statistically significant relationship SBIDF with the high BBDTS was found (men $r = 0.639$, $p<0.01$; women $r = 0.583$, $p<0.01$).

DISCUSSION

The issue of having to overcome numerous administrative barriers and primarily mental obstacles related to innovative aspects of physical education and sport for all has been raised for a decade. Such situation is associated with the dissolution of the Union of Soviet Socialist Republic (1991) and social transformation, in central and eastern Europe in particular, which were under Soviet influence after the Second World War. This unique knowledge, not only classified as sport science, is available for scholars and practitioners who speak Russian and other languages of countries, which used to be behind the Iron

Figure 2. Visualization of a non-apparatus the susceptibility test to the body injuries during the fall (STBIDF).

Curtain that no longer exists [19]. Other aspects (with one exception) are not as closely related to historical division of the world into two hostile camps. These aspects are embedded in the paradigm of science favouring analytical approach, which also prevails in sport science. Paradoxically, an interdisciplinary approach is needed to solve the most significant practical issues related to physical education, sport for all, professional sport and physiotherapy, rehabilitation, geriatrics. Such approach is also required in case of studies and applications associated with science of martial arts in the context of increasing health and personal safety [20, 21] as well as implementation of the extreme forms of physical activity in the educational system for students [22]. Lack

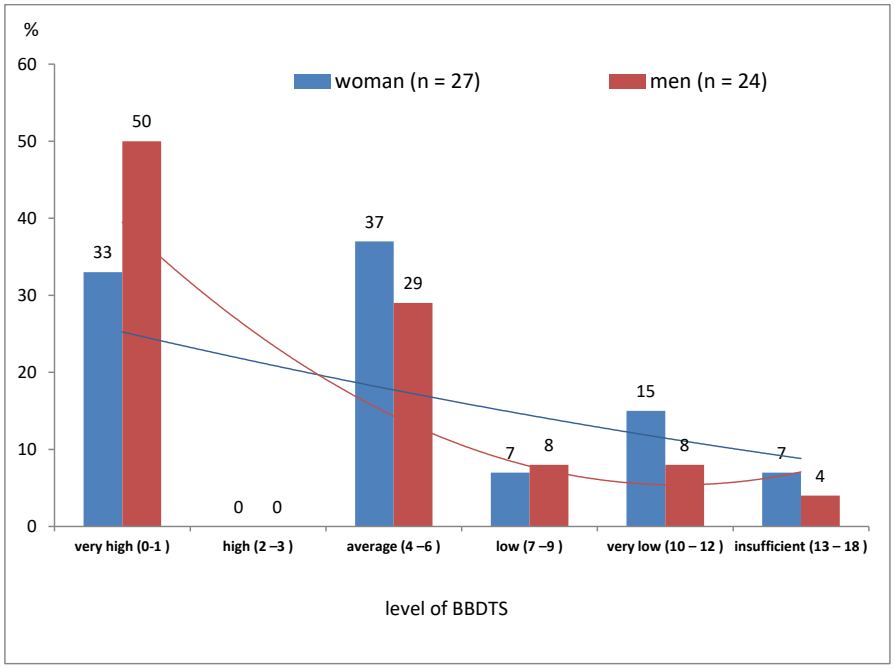


Figure 3. Proportions of adult women and men that revealed different levels of BBDTS.

of understanding of these relations results in the fact that supervisors and students at departments of physical education at some Polish universities choose subjects of their theses (bachelor thesis) that are non-specific for this profession. Such theses account for as much as 48% [23].

The aforesaid exception (related to the history of divided world after the Second World War) pertains to agonology – a deeply esoteric science about struggle [24-26]. Although agonology was established in 1938 by Tadeusz Kotarbiński [27], an outstanding Polish scholar, the majority of

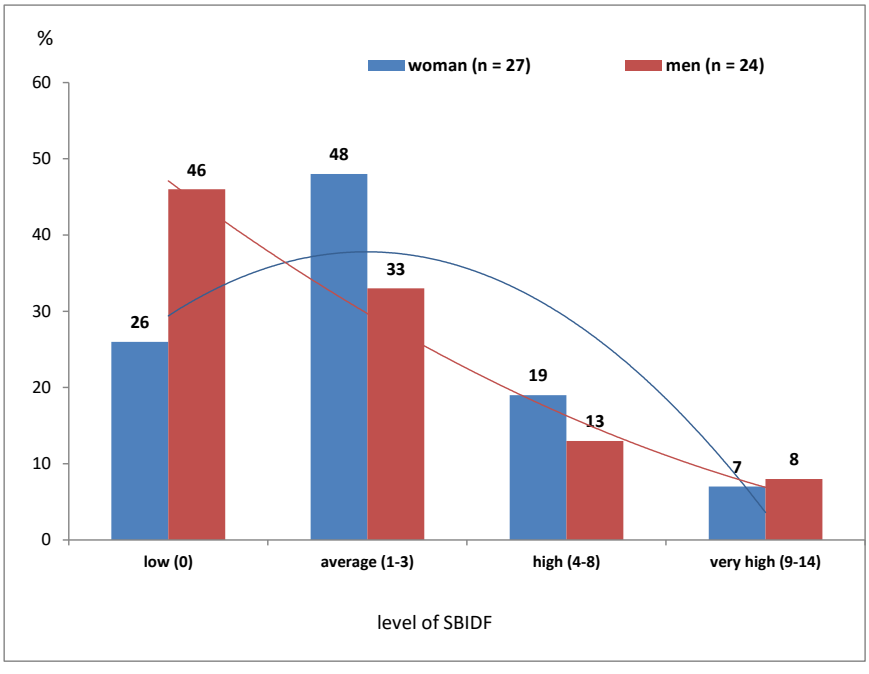


Figure 4. Mapping the proportion of control errors of individual body parts during a simulated fall back (STBIDF).

theories were developed beyond Iron Curtain. They are published only in Polish [28-31]. Since 2011 this science has been promoted in English [32]. Innovative agonology is an abbreviated name of (or a synonym for) prophylactic and therapeutic agonology [33]. This is an evidence-based science about struggle that investigates human actions in circumstances described using the word "struggle" or its synonyms ("fight with nature", "fight with oneself", "struggle with gravity", "fight with violence", etc.) [34, 35].

As emphasised in the introduction, a fall most frequently results from loss of balance. This may be considered as a typical example of the first stage of "struggle with gravity", and when "gravity wins" hard ground and inability of colliding with it become the main opponents of an individual. People have no impact on ground quality when they lose balance and a fall becomes inevitable. However, there is indisputable empirical evidence that an individual may learn how to fall safely, regardless of age, sex, general physical fitness [9] or even advanced disability, such as limb amputations, eye diseases, etc. [4, 7, 8, 14].

Discovery of high correlation of both phenomena studied (BBDTS and SBIDF) by the author implies meaningful explanatory hypotheses and new premises for further research. The results of both tests (RT and STBIDF) published so far have not been correlated by any investigator. Mroczkowski [36] studied 88 children aged 10 to 12 (53 boys and 35 girls) but revealed solely a negative correlation between the results of body balance disturbation tolerance skills (measured 'Rotational Test' [17]) and global coordination (measured with the use of Starosta coordination test [37]): boys, $r = -0.612$ and girls, $r = -0.578$. An important discovery during another experiment carried out by Mroczkowski et al. [38] is that "Knowledge about assessment criteria of STBIDF has a significant influence on results of the test" (37 female physiotherapy students). This means that having an impact on human cognitive sphere by explaining assessment criteria of STBIDF before repeating the test two weeks after the first attempt is the simplest way to reduce some errors committed while moving individual body parts during a fall. During the first validation procedure of STBIDF Kalina et al. [6] found that both having an impact on human cognitive sphere (studying the theory of safe fall and methodology of using STBIDF) and teaching safe fall techniques are strongly determined by bad motor habits acquired in the past. After two semesters of professional education referred to above, the following percentage among 68 young, healthy, physically active female physiotherapy students have still committed body control errors while performing individual STBIDF tasks: 17.7% during task 1; 22% during task 2; 30.9% during task 3 (this is the most difficult task) [6].

The specific nature of the 'Rotational Test' lies in the fact that the basic criterion for taking the test is to explain the assessment criteria to the subject. The results of innovative studies on changes in the body balance disturbation tolerance skills due to survival training [39-42] that lasts many hours or days provide us with evidence that sleep deprivation and increasing physical effort worsen BBDTS. This means that psychoorganic substrate of motoric actions absolutely prevails over the cognitive sphere (intelligence). Knowledge of how to perform RT without errors will not reduce their number. An appropriate adaptive training (spread out in time) is necessary.

The study results referred to above constitute important premises that diagnostic, preventive and therapeutic capacities of both non-apparatus tests applied have been discovered only partially. As long as validation procedure of RT may be deemed sufficient [18, 43], a similar conclusion in relation to STBIDF would be justified in the sense of the reliability test (the criteria are met: oriented validity, content validity and construct validity [6]). There are still no test results confirming the accuracy of STBIDF using the test-retest method on a sample sufficient in terms of its size.

CONCLUSIONS

Easy to use non-apparatus tests can be used in broadly understood, continuous fall prevention and injuries prevention (including also necessary education). These three occurrences related to the cause-effect relationship. Unfortunately, despite the unique achievements of Polish scientists, they still remain beyond the perception of the entities responsible for public health.

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