THE ASSESSMENT OF THE BODY BALANCE OF MUAY THAI COMPETITORS

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Abstract:
Introduction: Because of the specifics of disciplines including martial arts, the research on the body balance of Muay Thai competitors is of enormous cognitive importance. Although, there are many publications in circulation on the subject of balance, including static and dynamic balance of people training martial arts, there are still questions appearing for which there are no answers. Retaining a proper, vertical posture during fights is an enormous challenge, where the help offered by the scientific research is priceless. **Material and methods:** The analysis of the body balance in 48 people using the Flamingo and the rotational test have been done. The results of the research were prepared using basic statistical method, Shapiro-Wilk test and Pearson's linear correlation. **Results:** In the case of Flamingo test and the rotational test, average values of the studied groups differ significantly ($p<0.005$). It appeared that the competitors training Muay Thai are in general twice as successful than the group of students studied. It happened so that in individual cases the results obtained by the competitors were worse that those of the students. **Conclusions:** As a result of the analysis, it was shown that there are no any significant differences in somatic terms between the groups tested. The Flamingo and the rotational test result analysis has shown a surprisingly large difference between the static and dynamic balance of the tested groups, as well as in the groups themselves. The results obtained by the competitors twice exceeded those of the students. The results obtained by the competitors training Muay Thai point out that there are similarities in the results achieved by the competitors of different martial arts.

INTRODUCTION

In many works concerning motor skills the balance is mentioned as one of the most important coordination skill [Singer1985, Szopa 1988, Hirtz 1989, Raczek 1991, Starosta 1993, Raczek 2010, Sobera 2010]. However, there is a lack of consequence in looking at testing trials schemes of recommended motor skills tests. In a popular publication [Szopa and others 1996], among the 13 tests described, only one *Eurofit*[1] includes an attempt to measure this coordination skill (static balance).

[1] European test of physical fitness. Brussels, 1988.

Due to the methods used hitherto, the research of the human body balance, can be divided into two main groups. The first group includes the research concerning the usage of more or less refined apparatus [Golema 1981, Juras and Waśkiewicz 1998, Kruczkowski 2000, Sobera et al. 2001, Mayagoita et al. 2002, Held-Ziółkowska 2006b, Grigorea et al. 2011, Tonnessen et al. 2013]. The second group consists of the research with the usage of rudimentary motor skill tests [Kalina et al. 2001, Kalina et al. 2002 Raczek et al. 2002, Kalina et al. 2013], possibly to be used in an everyday pedagogical practice, coaching or therapeutic.

Each body weighted down with any spatial force system will remain in equilibrium, if it does not move along any of the axis. For this to exist, the force resultant and the resultant of the moment of force acting upon a body must be equal zero:

$$\sum F = 0 \qquad (1) \qquad\qquad \sum M = 0 \qquad (2)$$

Although, each immovable positioning of the body is the result of the balance of forces and the moments of forces, the balance might be different. We differentiate among the neutral, stable and unstable. The neutral balance of a physical body manifests itself in that the body can be positioned in any given position and it will always remain in equilibrium. We encounter neutral equilibrium when with any movement of the body the moment of the force arises which causes the body to return to its previous balanced position. The unstable balance, however, is characterized by the fact that even with the smallest change in a body's position, the body is accompanied by the moments of force causing further deviation of the body from the position of balance. Based on [Raczek 1991] the ability to balance itself which allows retaining the body's position (the static balance) and retaining or retrieving the state (the dynamic balance) in the time of movement or after its completion. The dynamic balance may concern movements done in one direction or, as well as around the body's axis. This ability is connected with the activities done, which ensure the balance of devices or partners manipulated. He points out that the importance of the ability to retain balance is particularly significant in the case of small planes of support [Piestrak 2000, Piestrak 2001], unstable base surface or also in the conditions of frequent interference, such as acrobatic evolutions, gymnastics, ice-skating, skiing, dancing figures or grips and strikes during the fight. In the phenomena of these balance systems, stimuli coming from the surroundings are used and reshaped into the answers reaching effector organs, such torso muscles and limbs, as well as eyeballs, causing their involuntary movements coordinating the body posture. Along the mechanisms responsible for balance control according to [Held-Ziółkowska M., 2006a], we can differentiate two distinct, but cooperating together systems. The aim of the first system is stabilizing the glance through the direction control and eyesight focus during the body and head movement. The second system is responsible for stabilizing the basis, as well as keeps the body in the state of balance both during the state of inaction and movement.

Physical activity is conducive to building suitable body stability, and therefore among others, doctors and therapists draw inspiration from sport in an attempts to effectively improve balance deficiencies in patients [Cancela Carral and Ayán 2007, Jakson et al. 2012]. For this purpose, sports disciplines where balance has a unique significance, such as gymnastics, judo, football, dancing and others are very effective [Perrin and et al. 2002, Schmit et al. 2005, Paillard and Noé 2006, Bressel et al. 2007, Rynkiewicz et al. 2009, Bieć and Kuczyński 2010, Kuczyński et al. 2011, Kalina et al. 2013]. It appears that out of the ordinary physical fitness is connected with the ability of retaining static and dynamic balance which is possessed by the martial arts competitors [Kalina et al. 2002, Perrin et al. 2002, Witkowsaki et al. 2004, Jakson et al. 2012, Fong et al. 2012, Juras et al. 2013, Kalina et al. 2013, Witkowski et al. 2014]. The above supposition is based on the Muay Thai. The choice of this martial art arises from the fact that the Muay Thai competitor does numerous number

of strikes combinations done with the upper and lower limbs during fights. Many a time techniques are done in the air and the competitor loosing touch with the ground must characterize him/herself with great versatile coordination.

THE AIM OF THE WORK

The aim of this work was to show that doing martial arts, such as Muay Thai contributes towards the development of static and dynamic balance in people practicing them. Besides, sports people who overall have a longer training show higher level of balance abilities.

MATERIALS AND RESEARCH METHODS

The research was done on the group of 48 men between the ages 16 - 32. Half of them are the competitors of the sports club Muay Thai Millenium in Rzeszow, the rest of them are the students of The University of Technology and The University in Rzeszow. Their data concerning the age and somatic characteristics is show in table 1.

Tabele 1. Characteristics of the research group based on their age and somatic features

Group	Feature	The age [years]	Body mass [kg]	Height [cm]	BMI[a] [kg/m^2]
Students	$\overline{x}$[b] min – max $u_r(x)$[c] [%]	21,5 (10) 19 – 24 4,6	77,7 (82) 63 – 100 10	179,9 (61) 165 – 190 3,4	24,0 (18) 20,7 – 29,2 7,7
Competitors	$\overline{x}$ min – max $u_r(x)$ [%]	22,6 (45) 16 – 32 20	71,8 (68) 62 – 86 9,5	177,3 (65) 168 – 190 3,7	22,8 (15) 20,2 – 25,8 6,7

[a] Body Mass Index
[b] Arithmetic average with the standard deviation in brackets
[c] Variable factor

The measurements of the level of body's balance was measured using two tests. The first of them (photo 1) was **the Flamingo test** (TF), which allows to built the static balance. To carry out the test one needs a stop watch, a result sheet as well as a wooden beam (measuring 4 cm in height, 3 in width, 50 cm in length placed on to stable supports).

The studied person places any foot along the beam, the other bent in the knee joint and supported with a hand. The free upper limb serves the purpose of stabilizing oneself leaning on the person doing the measurement. Once the studied person releases the arm of the person conducting the measurements, the moment of the test begins and along with it the time is measured on the stop watch. The stop watch is stopped only when the studied person looses balance and releases the limb held or supports him/herself on the base or finishes the test which is held for 60 seconds. The test lasts until the person studied finishes standing on a beam in the correct Flamingo posture in one minute. If the studied person looses balance 15 times in the duration of the first 30 seconds of the test the study is considered incomplete.

The second test proposed by Kalina [Kalina et al. 2013] that is **the rotational test** (RT) which serves the purpose of studying the dynamic balance (photo 2). An even base such as parquetry of a gym or a special mat with plaster (measuring 1.25 cm x 50 cm) is needed to carry out the test.

Photography 1. The correct Flamingo posture on a platform

Photography 2. The correct posture before starting the rotational test

The test consists of doing six jumps in the air rotating 360 degrees (alternatively both right and left) and landing after each such jump and rotation in such a way that both feet again touch the base with the previously set line from which the person started the test lasting around 12 seconds. The testing should be carried out preceding with a thorough explanation of rules and allowing the studied people doing few trial jumps with the rotation. Once the test participant lands correctly with both feet on the previously set line he/she gets a note of 0, if the set line is in a contact with only one foot the studied person receives the note 1, when the line is not in contact with both feet receives the note 2, the support means note of 3. Such evaluation scheme is used after each of the performed jumps. The participant who lands incorrectly is allowed to correct his/her body arrangement on the line set. One is allowed to redo the test after 5 minute break and the better score is taken into account.

The study of the data was done using basic statistical methods. The average, standard deviation and the variable factor for each feature in both groups was calculated. Also, the significant difference average was calculated with t-Student test, as well as the correlation factor among the significant variables.

DISCUSSION AND RESULTS ANALYSIS

On the basis of the research results presented in table 1 and the calculations used pertaining to the significant average values ($p<0,05$), it was determined that the age and somatic features of the researched groups do not differ in relation to each other. The group of competitors is older, lighter, lower and characterizes itself with the lower body mass index – BMI. One of the objections is little cohesion among the competitors practicing Muay Thai in relation to age, as to which big standard deviation gives evidence. In table 2 there are results of studies concerning the Flamingo test shown, the rotational test, as well as the period of training and weekly exercise load (WEL).

Table 2. Characteristics of studied people in respect to characteristics connected with the balance tests

Feature	Group	Flamingo test [points]	Rotational test [points]	Period of training [years]	WEL[a] [number]
Students	$\overline{x}$[b] min – max $u_r(x)$[c] [%]	3,8 (9) 2 – 5 23	7,8 (18) 3 – 11 23	3,6 (29) 0 – 9 81	2,2 (16) 0 – 6 74
Competitors	$\overline{x}$ min – max $u_r(x)$ [%]	2,0 (11) 1 – 4 53	3,0 (17) 0 – 7 56	3,0 (31) 1 – 15 103	2,9 (13) 2 – 7 44

[a] Weekly Exercise Load – how many times a week exercises take place.
[b] Arithmetic average with standard deviation in brackets
[c] Variable factor

In the case of Flamingo test and the rotational test, average values of the studied groups differ significantly ($p<0.005$). It appeared that the competitors training Muay Thai are in general twice as successful than the group of students studied. It happened so that in individual cases the results obtained by the competitors were worse that those of the students. So, in TF two competitors obtained 3 pts, and four of them 4 pts. However, in TR detached competitors were ones who obtained 7 pts, one 6 pts and one 4 pts. The results obtained in the case of the training period of particular discipline practiced, as well as the weekly result of exercise load do not bring in significant information. The reason being is that large standard deviations contribute to the variable index. It shows a large dispersion and a vary little

cohesion of the results gathered by the group. A weekly exercise load concerning the competitors might be the only exception, where $u_r(x)$ [%] = 44.

Based on the Shapiro-Wilk test it was determined that only the results of the rotational test fulfill the norm required. The summary pertaining to that train of thought is presented in diagram 1, where Shapiro-Wilk value parameters were presented, the norm chart, statistics values and box plots.

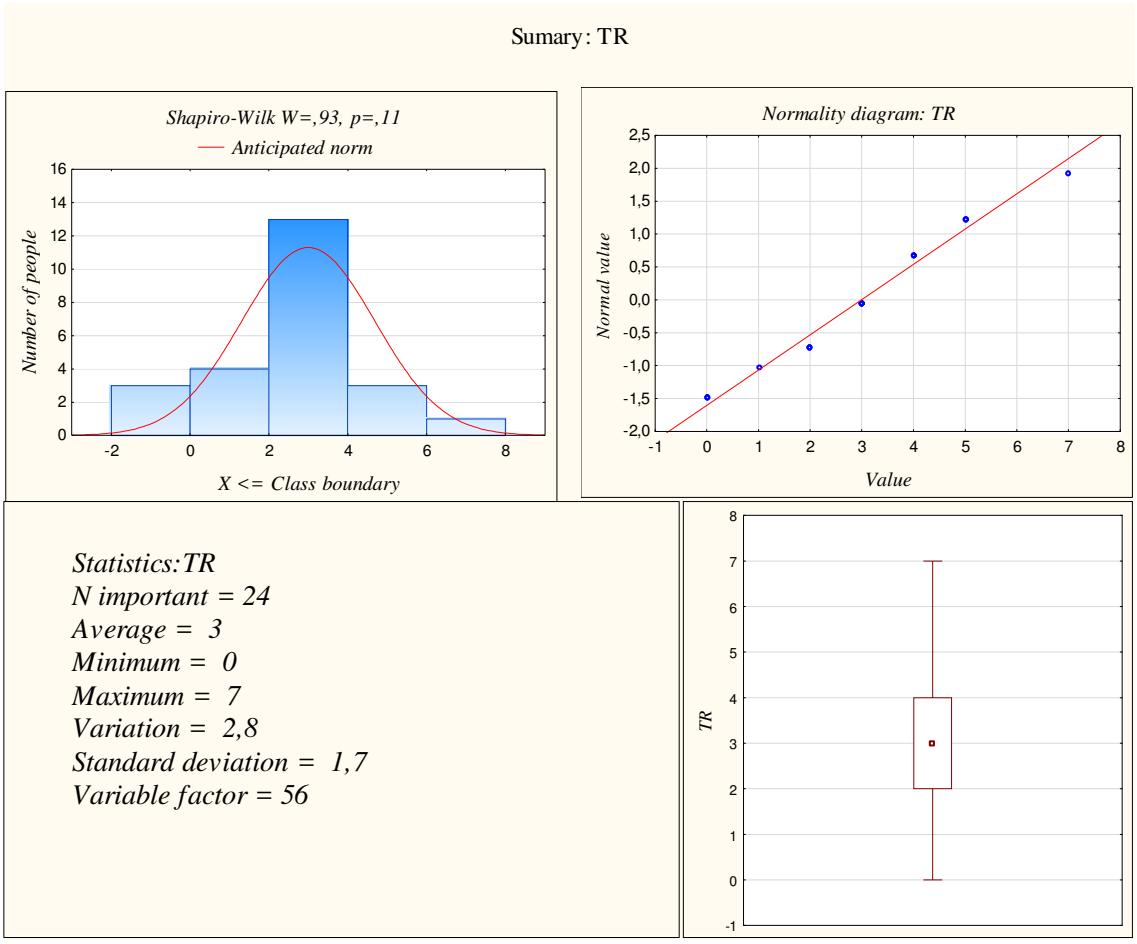

Diagram 1. Statistical characteristic of competitors' rotation test

Another analysis concerned the linear regression which is possible among the variables. For this purpose the Pearson's linear correlation method was used. The results of the calculation shown as the matrix of factors and the value p giving evidence to the significances are presented in table 3. What follows from it is the fact that a significant and high correlation between the time of practice and a weekly load of exercises appears. Quite high and significant correlation appears also between the rotational test and the Flamingo test. It was not possible to find a satisfactory connection between the results of the TF and TR tests TF, for example WEL – the weekly load of exercises, however, values of factors, the period of training and TF, as well as WEL and TF are on the average level of correlation, however, their significance is doubtful.

Table 3 The matrix of Pearson's correlation factor concerning competitors testing

	TF	TR	Period of training	WEL
TF	1	**0,427 (0,038)**[a]	0,338 (0,107)	0,290 (0,169)
TR		1	- 0,149 (0,486)	0,020 (0,925)
Period of training			1	**0,535 (0,007)**
WEL				1

[a] Factors of correlation are significant with p<0,05

SUMMARY

The Flamingo test is a recognized test for the static balance. The rotational test had its beginnings in the 1970s of the previous century during the judo training [Kalina et al. 2013]. During the warn up the judo trainee carried out numerous exercises consisting of 360^o degree rotation, and even 720^o in both direction, which interested the author of the test so much, that he decided to work out a rotational test based on that phenomenon which was used in the presented work.

Currently there are tests based on the advanced technology, however, the tests used by the authors of the research can be characterized as simple and can be used in almost any conditions. Such conditions mainly determined the choice of the tests and not any other. Based on the Flamingo test and the rotational test 24 regularly training Muay Thai competitors were tested and 24 students of the two main Rzeszow Universities. As a result of the analysis, it was shown that there are no any significant differences in somatic terms between the groups tested. The Flamingo and the rotational test result analysis has shown a surprisingly large difference between the static and dynamic balance of the tested groups, as well as in the groups themselves. The results obtained by the competitors twice exceeded those of the students. In order to obtain an objective evaluation of the tests, the results obtained in the rotational test of this work were compared with the results [Kalina et al. 2013] shown in table 4.

Tabela 4 The characteristics of the rotational test martial arts competitors

Dyscyplina	Number of tested	Age of tested	Rotational test
Muay Thay[a]	24	22,6	3,0 (17)
Judo[b]	16	21,5	2,7 (24)
Kick boxing[b]	30	23,6	2,5 (24)
Wrestling[b]	24	21,5	3,3 (30)
Box[b]	30	20,6	3,2 (27)
Aikido[b]	22	27,9	4,5 (23)
Students[a]	24	21,5	7,8 (18)

[a] Ones own research
[b] The results obtained by [Kalina et al. 2013]

The comparison of the results obtained by the competitors training Muay Thai point out that there are similarities in the results achieved by the competitors of different martial arts. It is here where the results of the students' achievements present themselves very badly.

Both tests, the Flamingo test and the rotational test as well, are quite a good diagnostic tool of body's balance. They can quite widely be used in rehabilitation, the training pertaining to health and motor controls (sport, physical education etc.). They can serve as well as the element of military, police or medical rescue selection tests.

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