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*Original research papers*

# RELIABILITY AND ACCURACY OF BATAK LITE TESTS USED FOR ASSESSING COORDINATION MOTOR ABILITIES IN WRESTLERS

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**Abstract**

***Introduction***. The aim of this work was to assess selected validity criteria of motor tasks included in Batak Lite. The tasks are used to control coordination motor abilities in athletes of different sports. ***Material and methods***. Twenty male Greco-Roman wrestlers from the sports school SMS in Radom were included in the study. They were 17-18 years of age and their training experience was 4-7.5 years long. The validity of motor tasks was determined on the basis of two criteria, i.e. reliability and diagnostic accuracy. To define the reliability of the tests, the research was carried out twice with an interval of 5-7-days (test-retest). Diagnostic accuracy of selected indices was determined with the help of three main criteria. The analysis included 6 motor tasks performed with the use of Batak Lite. ***Results***. Tests I, II, IV and V are characterised by reliability coefficients higher than 0.50 and, regardless of the assumed accuracy criterion, by coefficients higher than 0.30. Thus, they meet the validity requirements within the assessed criteria. The highest accuracy coefficients were observed in motor tests assessing quick reaction (r = 0.46-0.63), simple reaction including sensory (r = 0.61-0.78), motor (r = 0.33-0.46) and complex (r = 0.34-0.49) reactions as well as spatio-temporal orientation (r = 0.33-0.49) and movement coupling (r = 0.34-0.49). ***Conclusions***. Four Batak Lite tests displayed sufficient reliability and diagnostic accuracy. Therefore, they can be implemented in the training process of wrestlers. The strongest correlation was noted between Batak Lite tests and motor tests that assessed quick reaction, spatio-temporal orientation and movement coupling.

**Key words:** wrestling, reliability, accuracy, Batak Lite

## Introduction

Coordination motor abilities (CMA) belong to the group of factors that play an important role in achieving high competitive effectiveness by wrestlers. They form the basis for quick and effective acquisition of new motor skills and determine the possibilities of their application in a combat. The control of CMA levels is significant in the training process of wrestlers. If CMA levels turn out to be too low, it is possible to implement corrective changes in training plans [1-6].

There are a lot of different tests used in diagnosing CMA levels among wrestlers. The most common ones are those assessing general and special CMA [3-6]. The next group consists of various computer tests [7-10] including Vienna Test System (VTS) [6, 11]. A different approach to CMA was taken by Starosta, who used the turnaround jump [3].

In the case of most CMA tests currently applied (motor tests in particular) there is a risk of error regarding, inter alia, conditioning abilities or performance technique. As a consequence, it affects the objectivity of results and creates a less reliable image of CMA of a competitor [12]. In turn, despite being highly reliable, computer tests are not accurate [6].

It is difficult for a coach to choose an adequate battery of tests as a research tool. Furthermore, the variety of CMA tests makes it impossible to compare the obtained research results. An attempt at defining dominant CMA by various authors is a perfect example [2, 4-6, 13, 14]. Therefore, it is worth looking for precise diagnostic tools that could be applied in all conditions. Such tools would be sport-specific, easy to use and would provide reliable information quickly, which might turn out useful in supervising a training process.

Batak tests may prove to be an alternative to well-known and commonly employed motor or computer tests that evaluate CMA in a complex manner. Apart from diagnostic applications, different versions of Batak machines (Pro, Lite, Micro, Sprint, Evolution) may serve as training devices, while Batak Duel and Batak Jockeys can be used for fun [15, 16]. The advantages of Batak device are that it helps to improve reaction, hand-eye coordination, endurance and fitness. Batak equipment enables coaches to examine everybody regardless of sex and age. It is easily transportable and it requires minimal space. As well as being easy to use, it has an attractive design [16]. It is worth highlighting that when performing tests you have to demonstrate bilateral coordination which is immensely important in hand-to-hand combat and in team games. The development of bilateral movement coordination begins in childhood and forms the basis for further motor development [17]. It seems that Batak may add interesting variety to a training routine, which could be interpreted as a motivating factor. Moreover, the device makes it possible to create starting conditions in laboratory settings, while

the specificity and attractiveness of this equipment cause the examined individual to be more engaged. Professional analysis of the behaviour of athletes in such conditions may provide additional data regarding different aspects of their psychological (or even social) functioning and help to channel mental training.

Movement tests performed on Batak should meet specific requirements if they are to be applied in coaching practice. In order to assess validity of measurement tools, the main criteria (reliability, accuracy and objectivity) and the additional criteria (selectivity, standardisation, normalisation and economisation) are used. The tests (motor tasks) that meet the above-mentioned requirements may be called sports-motor tests which help to assess the level of a given ability in an examined individual [12, 18].

The aim of the research was to assess basic criteria of validity (reliability and diagnostic accuracy) of Batak Lite motor tasks which can be used to control coordination motor abilities of athletes practising different combat sports and combat systems.

## Material and methods

Twenty male Greco-Roman wrestlers from the sports school SMS in Radom were included in the study. They were 17-18 years of age ($\overline{x} = 18.2 \pm 0.62$) and their training experience was 4-7.5 years long ($\overline{x} = 5.8 \pm 1.04$). Nine subjects possessed the so-called first sports class, while eleven persons had the second sports class. The wrestlers voluntarily consented to participate in the study. Their motivation stemmed from their willingness to get to know their levels of coordination abilities.

The research was carried out at the beginning of the preseason period. The wrestlers performed the tests (motor tasks) twice in their free time in the morning hours. All the subjects were provided with detailed information concerning the test protocol and they took part in a pilot test. The tests were performed at 10-minute intervals.

The study included 6 Batak Lite motor tasks. The device, measuring 1143 (w) x 1800 (h) x 950 cm (d), has a steering unit (microcomputer) with 8 light signals (fig. 1). A microcomputer controls the sequence in which the light signals appear. Subjects have to use their hands to press the buttons which light up. The Batak Lite framework is a simple construction that can be transported easily, which is particularly essential when it comes to research, training and outdoor use.


**Figure 1.** Batak Lite [16]

The study included 6 motor tasks, which differed in duration or the number of light signals:

- test I – the participant stood in front of the device. Six lower buttons lit up randomly. The subject had to hit as many of them as possible in 30 seconds. As soon as one target was struck, the next one lit up. The score was the number of lights that were pressed;
- test II – standing in front of the device, the subject had to hit 8 buttons that lit up at a pace set by the programme. The duration of the test was 25 seconds. The score was the number of lights that were pressed;
- test III – standing in front of the device, the subject had to press 8 buttons that lit up. The test was finished after hitting 25 lights. The result was the duration of the test (s);
- test IV – standing in front of the device, the subject had to press 8 randomly lit buttons in 30 seconds. The score was the number of lights that were pressed;
- test V – standing in front of the device, the subject had to hit as many lights as possible in 2 minutes. The score was the number of buttons that were pressed;
- test VI – standing in front of the device, the subject had to press 4 randomly lit external buttons. The score was the number of lights that were pressed in 30 seconds.

Validity of the motor tasks was determined on the basis of two criteria, i.e. reliability and diagnostic accuracy (informativeness) [12]. A test-retest method was employed to assess the reliability of the tests. Therefore, the research was carried out twice with an interval of 5-7-days. The same group of competitors was included in the second set of tests. Analogous procedure and research tools were applied. The sequence of tests was the same as well. The data obtained from both measurements were compared by calculating Pearson's linear correlation coefficient (r). The tests used to assess accuracy included these in which reliability coefficients turned out to be statistically sig-nificant ($p < 0.05$) and higher than $r = 0.50$.

Diagnostic accuracy of selected tests was determined by means of three main criteria, i.e. rank assessment of technical and coordination levels defined by a coach (RN1), rank assessment taking into account sports achievements (RN2) and summary rank assessment of coordination preparation on the basis of the scores of motor and computer tests (RN3).

Spearman's rank correlation (rho) was applied to assess accuracy. Statistica 6.0 programme was used for calculations.

In order to identify predominant coordination abilities assessed with the use of Batak Lite, accuracy was determined. It was done by calculating Pearson's coefficients of correlation (r) between all indices of the third main criterion and the results of particular tests. Therefore, motor tests created by different researchers [12, 19] as well as highly reliable and accurate motor tests elaborated by the authors of this article [20] were used.

The following tests were employed to evaluate particular coordination motor abilities: kinaesthetic differentiation – long jump at 50% of maximal capabilities; movement adaptability – standing long jump forwards and backwards and 3x10 m run forwards and backwards; rhythm – rhythm imitation and differentiation of the test of 5 cycles; spatio-temporal orientation – aimed jumps and the run towards colourful balls; movement coupling – walking over a gymnastic baton and standing long jump with and without a swing; static balance – standing with calves raised; dynamic balance – turns on an inverted gymnastic bench; quick reaction – "grabbing Ditrich's stick"; simple and complex reaction – RT test (version S1) and DT test (version S1) of the Vienna Test System [11].

## Results

Research results concerning the reliability of the Batak Lite tests for wrestlers are presented in table 1. Differences between mean scores of two tests turned out to be statistically insignificant ($p>0.05$), while result variability coefficients (V%) in both trials (set I and II) ranged between 3.5% and 10%.

**Table 1.** Coefficients of the reliability of Batak Lite motor tasks performed by wrestlers

| Motor task (unit) | $\bar{x} \pm SD$ | | V (%) | Δ % | r |
|---|---|---|---|---|---|
| | series I | series II | | | |
| 1. Test I (number) | 57.6±5.1 | 58.8±4.1 | 8.9 – 7.0 | 2.1 | **0.83*** |
| 2. Test II (s) | 25.4±1.5 | 26.1±2.1 | 5.9 – 7.7 | 2.8 | **0.67*** |
| 3. Test III (number) | 16.4±0.8 | 16.7±1.1 | 4.9 – 6.6 | 1.8 | 0.43 |
| 4. Test IV (number) | 52.7±4.4 | 54.8±5.5 | 8.4 – 10.0 | 4.0 | **0.58*** |
| 5. Test V (number) | 184.4±7.3 | 187.3±6.6 | 4.0 – 3.5 | 1.6 | **0.68*** |
| 6. Test VI (number) | 39.8±3.3 | 41.2±3.6 | 8.3 – 8.7 | 3.5 | 0.44 |

* – coefficients meeting the reliability criteria.

The majority of motor tasks under investigation were sufficiently reliable. Four tests (I, II, IV and V) displayed reliability coefficients higher than $r = 0.50$ ($p<0.05$), thus meeting validity requirements within a given criterion. As for tests III and VI, coefficient values were lower than $r = 0.50$, which shows that they are not useful when assessing CMA of wrestlers.

The highest reliability was observed in the case of test I, where the correlation coefficient was $r = 0.83$, while the lowest (but still sufficient) reliability was noted in test IV, where $r = 0.58$ and the results were the most diverse in the retest (V=10%).

The results of diagnostic accuracy of four tests that met the reliability criterion are illustrated in tables 2 and 3.

**Table 2.** Correlations between the main criteria of dividing the subjects and the results of Batak Lite motor tasks

| Main classification criteria | Test I | Test II | Test IV | Test V |
|---|---|---|---|---|
| RN1 | **0.46*** | **0.35*** | **0.31*** | **0.49*** |
| RN2 | **0.48*** | 0.28 | **0.37*** | **0.54*** |
| RN3 | 0.27 | **0.32*** | **0.36*** | **0.31*** |

* – the level of accuracy meeting the adopted criteria.

Regardless of the established criterion, in nine cases the verified motor tasks (tests I, II, IV and V) displayed clear correlations (accuracy coefficients higher than 0.30), thus meeting the assumed validity criterion. In the case of test V (pressing the lights in 2 minutes) accuracy coefficients (rho) ranged from 0.31 to 0.54 for all the criteria (RN1, RN2 and RN3).

As far as the rank assessment taking into account sports achievements (RN2) is concerned, accuracy coefficients of particular Batak Lite tests were the highest and ranged from 0.28 to 0.54. Very similar accuracy correlations (rho = 0.31-0.49) were noted between the tests and technical and coordination preparation of wrestlers. As for summary assessment of coordination preparation, accuracy coefficients ranged between 0.27 and 0.36.

While analysing diagnostic informativeness of the verified tests with particular CMA assessed with the use of motor tests (tab. 3), it may be stated that the highest accuracy coefficients were noted in indices evaluating quick reaction (grabbing Ditrich's stick; r = 0.46-0.63), simple reaction including sensory reaction (VTS, r = 0.61-0.78) and motor reaction (VTS, r = 0.33-0.46), as well as complex reaction (VTS, r = 0.34-0.49), spatio-temporal orientation (r = 0.33-0.49) and movement coupling (r = 0.34-0.49).

**Table 3.** Correlation between the results of motor tests and Batak Lite tests in Greco-Roman wrestlers

| Assessed CMA | Examined index (variable) | Test I | Test II | Test IV | Test V |
|---|---|---|---|---|---|
| Kinaesthetic differentiation | Long jump at 50% of maximal capabilities (%) | 0.14 | 0.14 | 0.23 | 0.23 |
| Movement adaptability | Standing long jump forwards and backwards (%) | 0.14 | 0.09 | 0.21 | 0.07 |
| | Run forwards and backwards 3x10 m (%) | 0.20 | 0.28 | **0.33*** | 0.28 |
| Rhythm | Test of 5 cycles – rhythm imitation | **0.36*** | 0.25 | 0.23 | **0.32*** |
| | Test of 5 cycles – rhythm differentiation | **0.32*** | 0.12 | 0.27 | 0.22 |
| Spatial orientation | Aimed jumps (%) | 0.15 | **0.34*** | 0.29 | 0.12 |
| | Run towards colourful balls (s) | **0.33*** | **0.46*** | **0.49*** | **0.40*** |
| Movement coupling | Walking over a gymnastic baton (s) | 0.28 | **0.49*** | 0.28 | **0.34*** |
| | Standing long jump with and without a swing (%) | 0.27 | 0.20 | **0.34*** | **0.35*** |
| Balance | Turns on an inverted gymnastic bench (n) | 0.14 | 0.21 | **0.34*** | 0.07 |
| | Standing with calves raised (s) | 0.16 | **0.33*** | 0.23 | 0.25 |
| Quick reaction | Grabbing Ditrich's stick (cm) | **0.47*** | **0.63*** | **0.46*** | **0.51*** |
| Simple reaction | Sensory reaction (ms) | **0.77*** | **0.61*** | **0.74*** | **0.78*** |
| | Motor reaction (ms) | 0.21 | **0.35*** | **0.46*** | **0.33*** |
| Complex reaction | Number of correct reactions | **0.40*** | 0.27 | **0.39*** | **0.46*** |
| | Number of incorrect and omitted reactions | 0.13 | 0.06 | 0.20 | 0.06 |
| | Reaction time (s) | **0.35*** | **0.49*** | **0.45*** | **0.34*** |

* – the level of accuracy meeting the adopted criteria.

## Discussion

Valid results of controlling post-training effects as well as their skilful interpretation endorsed by knowledge and experience play a key role in coaching. Tools used to control training are more and more available, which makes it possible to implement various measurement procedures in real training and competitions. Batak belongs to the group of such devices. It was constructed at the beginning of the 21st century. Apart from diagnostic applications, it can serve as a training machine [15]. It is functional, safe, elegant and easy to use. Therefore, it provides clear feedback. Depending on motor tasks, it can complement exercises concerning selected movement phases or the energetics of performance.

Due to the specificity of competition, in combat sports it is necessary to obtain early information regarding the current level of performance components, which are noticeable only in a sports fight. In martial arts and combat systems it is even more difficult, as it is only in extreme situations that training effects can be verified. Therefore, Batak can be used in a selection process, in training and in controlling particular CMA. When performing tests it is possible to increase motivation of the subject (verbal encouragement), which is an essential element of precise motor tasks [21]. Controlling a training process and monitoring an athlete's body are crucial professional activities of coaches of martial arts and combat sports [22-25].

The assumption was that Batak Lite motor tasks can be used to control CMA in wrestlers. However, the analysis revealed that not all motor tests meet the requirements of metrology and thus cannot be called motor tests. Reliability coefficients of tests I, II, IV and V (ranging between 0.58 and 0.83) as well as accuracy coefficients (in most cases above 0.30) indicate that these tests meet the validity requirements within the applied criteria [12]. It shows they are useful in diagnosing CMA of wrestlers. According to specialists who deal with an issue of CMA diagnosis, the value of 0.50 in the case of reliability and 0.30 in the case of accuracy can be treated as sufficient. The indispensability of lowering the criteria is connected with considerable lability of the nervous system and its sensitivity to diverse internal stimuli (motivation) and external stimuli (e.g. the weather) [26-28].

As for the assessment of diagnostic informativeness of the applied tests, there occurred no substantial differences concerning the assumed criterion. Accuracy coefficients ranged from 0.27 to 0.54. Such similar results most probably stemmed from the same testing procedures, uniformity of the group regarding their coordination preparation, performance levels, etc.

The testing procedure employed in the study helped to reveal CMA which may be assessed in wrestlers with the use of Batak Lite tests. These include quick reaction, spatio-temporal orientation and movement coupling. The findings are in line with the observations of other authors regarding predominant coordination abilities in wrestling [2, 4, 13, 29].

The obtained research results prove the usefulness of Batak Lite tests in controlling the training process in wrestling as well as in other similar combat sports e.g. judo or Brazilian ju-jitsu. They can be implemented in recruitment, at various stages of selection and during operational and periodical controls in order to predict sports results and to monitor changes in the levels of predominant CMA resulting from training loads applied at all stages of training. They may also be used to define correlations between CMA and conditioning abilities, technical mastery, somatic indices, psychological functions as well as the influence of oriented coordination training on the efficacy indices of technical and tactical activities and on the speed and quality of acquiring new motor skills. Determining the factors that exert major influence on sports results is the basic problem whose solution increases the effectiveness of the training process [30].

Apart from its usefulness in diagnosing wrestlers' CMA, the device may also be used as a training machine that helps to improve CMA or coordination endurance. Batak Lite training may enhance perceptual abilities including perception and concentration. It can also serve as a supplement to physical training in the area of CMA improvement (reaction time in particular) and overall physical fitness.

Although it is reported that Batak proved advantageous in the training and selection of English policemen and that it led to the improvement of reaction time in young team-game players by 25% [17], it still requires further research and elaboration of proper training programmes. A more thorough analysis of the remaining criteria that research tools have to meet will be a valuable course of action. It is worth preparing adequate standards of operating the device as well as defining research procedures, instructions and norms precisely. Taking into account the aforementioned advantages of the device and its positive influence on various aspects of an athlete's functioning, it is also worth forming interdisciplinary teams of researchers (sports theoreticians, physiologists, psychologists, experts of biomechanics and others). An in-depth and multi-sided analysis of the available data and results will help to create a fuller image of a competitor's functioning and will make it possible to prepare more detailed hints for further coaching.

We ought to emphasise the fact that the issue of complex control of predominant CMA by means of proper tests in different sports still remains one of the least investigated and described aspects of sports theory and sports metrology [3, 5, 12, 31, 32, 33]. This problem particularly concerns sports with a complex structure of movement, including combat sports.

## Conclusions

Research results and their analysis made it possible to draw the following conclusions:

1. Four Batak Lite tests (I, II, IV and V) displayed sufficient reliability and diagnostic accuracy and may be used in the training process of wrestlers.
2. The highest accuracy coefficients of particular Batak Lite tests were observed in the case of the rank assessment taking into account sports achievements.
3. The strongest correlation was noted between Batak Lite tests and motor tests that assessed quick reaction, spatio-temporal orientation and movement coupling.

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