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KINESIOLOGY & PSYCHOMOTOR SKILLS

Marta Niewczas[1(ABCDEFG)], Tadeusz Ambrozy[6(BDE)], Zbigniew Obminski[3(CDE)], Wojciech Wasacz[4(BCDEF)], Krzysztof Kasicki[5(EF)], Lukasz Rydzik[6(ACDEF)]
1 ORCID: 0000-0002-2687-3243
College of Medical Sciences, Institute of Physical Culture Studies, University of Rzeszow, Rzeszow (Poland)
2 ORCID: 0000-0001-7956-7488
Institute of Sport Science, University of Physical Education in Krakow, Krakow (Poland)
3 ORCID: 0000-0002-3754-9748
Research Institute, Institute of Sport-National Research Institute Warsaw, Warsaw (Poland)
4 ORCID: 0000-0002-7392-5229
Institute of Sport Science, University of Physical Education in Krakow, Krakow (Poland)
5 ORCID: 0009-0008-9231-8353
Faculty of Medicine and Health Sciences, University Andrzej Frycz-Modrzejewski Krakow, Krakow (Poland)
6 ORCID: 0000-0001-7361-9478
Institute of Sport Science, University of Physical Education in Krakow, Krakow (Poland)
Corresponding author: Lukasz Rydzik, Institute of Sport Science, University of Physical Education in Krakow, Krakow (Poland), al. Jana Pawla II 78, 31-571 Krakow
e-mail: lukas.rydzik@awf.krakow.pl, Tel. +48 12 683 15 46

Psychomotor skills of Kickboxing athletes and their correlation with training experience, body mass, and technical-tactical skill levels

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Key words: combat sports, psychomotor skills, training experience, body mass, Kickboxing, technical-tactical level

Abstract

Introduction. Contemporary Kickboxing is a discipline with a complex combat structure and demanding sports competition. One of the key areas determining the effectiveness of athletes is psychomotor potential. The aim of the study was to assess the psychomotor skills of Kickboxing athletes and identify their correlation with body mass and training experience. The aim of this study was to assess selected areas of psychomotor abilities in high-performance Kickboxing athletes using psychometric computer tests in the TEST2DRIVE system. A further aim was to diagnose their relationship with body mass, the training experience of the subjects and technical-tactical indicators

Materials and Methods. The study consisted of a group of 44 active Kickboxing athletes. Basic anthropometric procedures were applied (body height: 176.83 cm ± 4.33; body mass: $\tilde{x}$ =77.18 kg ± 9.93), and a direct interview was conducted (age: $\tilde{x}$ =22.60±2.72; training experience: $\tilde{x}$ =8.98±2.64). Psychomotor skill assessments were carried out using psychometric computer tests in the TEST2DRIVE system. Four thematic tests were applied: SIRT-simple reaction time, CHORT-choice reaction time, HECOR-hand--eye coordination, and SPANT-spatial prediction. Three components were used to assess the level of technical and tactical training

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(effectiveness, activity and effectiveness of the attack), recorded during a 3-round fight. Statistical analyses were performed using the Statistica 13.3 package to process the results.

Results. Comparative analysis revealed significant differentiation in the level of results for a given test ($p<0.001$). Within the Kickboxers group, very low intragroup variability was observed (CV%=9.1-15.8). Significant multiple associations were noted between training experience, body mass, and SIRT with moderate strength ($R= -0.437$; $p<0.05$) and SPANT with strong dependence ($R= -0.644$; $p<0.05$). Furthermore, during the analyses, significant strong partial correlations were demonstrated for the combination of training experience with SPANT ($r= -0.644$; $p<0.05$) and body mass with SIRT with moderate strength ($r= -0.417$; $p<0.05$). Components determining the level of training, i.e. special skills, were negatively correlated with reaction times in each test. The strongest associations were recorded for the SIRT test.

Conclusions. The research indicates that in kickboxers, reaction time is associated with lower body weight, and longer training experience significantly correlates with better visual-motor skills (SPANT test). Regular kickboxing training positively impacts the development of psychomotor abilities. The specificity of movements in kickboxing justifies the use of psychometric diagnostic tests to assess motor preparedness, with higher technical-tactical skills leading to shorter reaction times.

Introduction

Currently, combat sports are experiencing significant popularity, and one of the directions of their development is Kickboxing [Di Marino 2018]. As a sports discipline, it demands high technical-tactical competence from athletes, above-average development of motor skills to execute quick, coordinated, powerful, and explosive kicks and punches [Ouergui *et al*. 2013; Ambrozy *et al*. 2021]. The psychological preparation is also crucial, with the emphasis on the control of emotions and stress, as well as the development of necessary self-confidence during a match [Rydzik *et al*. 2021a]. The athlete should also be characterized by well-developed endurance of strength and effort, in order to maintain a high level of intensity throughout the regulated time of the bout [Ambrozy *et al*. 2021]. This illustrates that modern Kickboxing is a discipline with a complex fighting structure and demanding sports competition.

One of the key areas influencing the effectiveness of a combat sports athlete is neuromuscular conductivity, as well as the dynamics and speed of muscle reactions in response to a given stimulus [Romanenko *et al*. 2022]. Proper neuromuscular stimulation ensures the effectiveness of such elements as evasions, blocks, rebounds, advances, as well as the execution of a single or combined offensive action. The speed at which an athlete can react is known as reaction time. This concept involves the complexity of psychophysiological processes, the integration of which occurs at multiple levels of the nervous system. In the psychomotor potential, one of the crucial elements is the cerebral cortex, which controls complex motor skills [Therrien, Bastian 2019]. Due to its function, the cerebral cortex can be divided into the motor cortex and the somatosensory cortex. Motor signals are transmitted directly from the cerebral cortex to the spinal cord through the corticospinal pathway and through additional communication pathways, including the basal nuclei, cerebellum, and brainstem nuclei [Buchanan, Tranel 2009; Beckinghausen, Sillitoe 2019]. The process of initiating movement in response to a visual stimulus occurs in a specific temporal sequence, meaning that each task can be assigned to specific time segments during which certain mental processes take place [Haith *et al*. 2016]. Reaction time is considered to be the moment between the appearance of the stimulus and the commencement of the organism's response to it. This sequence includes: stimulus processing by the sensory organ, differentiation of the impulse, decision-making by the integrating center, planning the response, and sending the impulse with feedback to the effector [Welford 1988]. Probably, a longer reaction time is associated with a greater demand for information processing, as well as the programming and organization of the organism's response [Carlton, Newell 1987]. Reaction time can serve to assess or index the speed of neuronal processes.

For effective professional actions, institutions from various sectors utilize advanced diagnostic methods. The TEST2DRIVE system has been applied in the psychology of road transport to assess the psychomotor and intellectual efficiency, as well as cognitive processes of drivers. The system comprises 10 tests covering cognitive, personality, and psychomotor efficiency areas [Tarnowski 2021]. Also, in the sports environment, the mentioned method of psychomotor assessment can be observed. Such actions have been conducted, for example, in the community of hand cyclists [Pasko *et al*. 2022a], female handball players of various ages and levels of expertise [Sliz *et al*. 2022; Sliz *et al*. 2023a]. An active athlete during training and tournament activities is exposed to stimuli constantly flowing into the visual analyzers. Thanks to the comprehensiveness of the system, a holistic assessment is possible in terms of indicators that play a crucial role in the performance of athletes.

In the Kickboxing environment, studies conducted so far report that full-contact formula fighters exhibit significantly faster reaction times than light-contact division fighters [Cetin *et al*. 2011]. In a group of Japanese Kickboxers (K1), post-fight reaction time results were notably less favorable than those recorded before the confrontation [Cimadoro 2017]. A comparative analysis

of Kickboxers and Taekwondo athletes showed a similar effect in reaction time to visual stimuli, with the latter demonstrating a significant advantage in auditory reaction time [Polat *et al*. 2018]. Conversely, when examining athletes in striking and grappling combat sports, comparative analyses by Mulhim and Akcan [2022] indicated that visual reaction time coexists with a higher level of sporting success. Furthermore, a more favorable result in the realm of both visual and auditory reaction times was demonstrated for representatives of striking combat sports. This was justified by the higher priority given to the speed, frequency, and timing of technical action movements in these professions. Similar conclusions are presented in the findings of Volodchenko and colleagues [2017], regarding the dominance of reactions to various stimuli in stand-up striking disciplines compared to wrestlers.

In the subject literature, little attention has been devoted to detailed analyses of the psychomotor skills of Kickboxers or other representatives of combat sports. There is a noticeable lack of studies presenting a broader range of variables describing this aspect. The aim of this study was to assess selected areas of psychomotor abilities in high-performance Kickboxing athletes using psychometric computer tests in the TEST2DRIVE system, and to diagnose their relationship with body mass, the training experience of the subjects, and technical-tactical indicators. The results of these activities, both in theoretical and practical terms, aim to supplement knowledge regarding methods for monitoring the comprehensive level of motor preparedness and its connections with somatic and environmental aspects. This will enable the optimization of training processes and contribute to further development of this sports discipline.

Based on existing scientific reports, in our research, we formulated the hypothesis that within the community of Kickboxers, due to the complexity of the test tasks, there will be a differentiation in the level of results in thematic diagnostic tests. Additionally, we hypothesized that lower body mass and longer training experience will be associated with more favorable test outcomes.

Materials and Methods

Participants

The study involved a group of 44 male competitive KICKBOXING athletes from various weight categories (body weight range: 67-90 kg, weight categories: n=1 to -63.5kg, n=2 to -67kg, n=3 to -71kg, n=4 to -75kg, n=18 to -81kg, n=12 to -86kg, n=2 to -91kg, n=2 to +91kg)) with diverse training experience (5-13 years). The age of the participants ranged from 20 to 28 years (mean age: 22.60±2.72). The average training experience (SE) was 8.98±2.64 years, with 4 to 6 training units per week, depending on the implemented training mesocycle. The sample size was calculated using the G*Power program (Confidence Level 95%, Margin of Error 5%). All participants were thoroughly informed about the measurement procedure and its purpose and provided written consent to participate in the study. The average body mass of the participants was 77.18 kg ± 9.93, while the average height was 176.83 cm ± 4.33. Basic somatic characteristics were assessed using the A213 anthropometer for height measurement and the certified electronic TANITA TBF-538 scale for body mass assessment, following anthropometric recommendations [Steward *et al*. 2011]. Inclusion criteria for the study were a minimum of 5 years of training experience, absence of current injuries, up-to-date medical examinations, positive medical recommendations, and active, systematic participation in training activities. Exclusion criteria were training experience of less than 5 years, the presence of injuries, lack of systematic participation in training, or a negative medical recommendation. The study was conducted during the preparatory period, and athletes were not on a restrictive diet. During his career all participants competed in elite-class competitions – international, national, and local – and some achieved significant sports results. Information regarding chronological age, activity, and competitive experience was obtained through a diagnostic survey method, employing direct interviews with athletes and coaching staff. The overview is presented in Table 1.

Table 1. General characteristics of studied Kickboxers

	x̃	SD	min	max	CV%
Age	22.60	2.72	17.80	28.00	12.03
Height	176.83	4.33	169.20	185.50	2.45
Body mass (BM)	77.18	9.93	60.20	93.20	12.86
Training experience (SE)	8.98	2.64	5.00	13.00	29.37

x̃ - arithmetic mean; sd - standard deviation; min – minimum value; max – maximum value; CV% - coefficient of variation

Research Design

The studies were conducted in the morning hours according to the schedule presented in Figure 1.

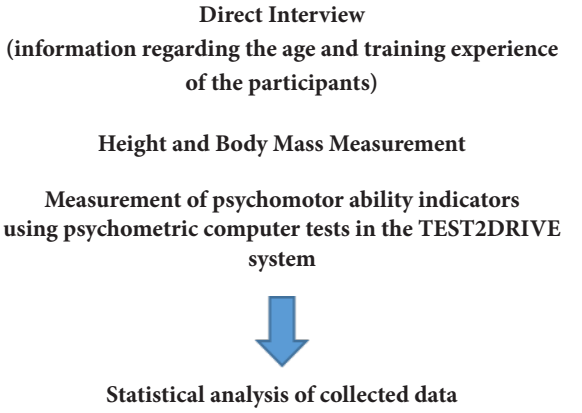


Figure 1. Study Procedure

The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Bioethics Committee at the Regional Medical Chamber (No. 287/KBL/OIL/2020).

Diagnosis of Psychomotor Abilities

The measurement of athletes' psychomotor abilities was performed using psychometric computer tests in the validated and standardized TEST2DRIVE system (ALTA, Siemianowice Slaskie, Poland), in online technology [Tarnowski 2016]. The system fulfills all requirements of the Regulation of the Minister of Health of 8 July 2014 regarding psychological tests of psychomotor abilities. To assess the level of psychomotor ability indicators, four thematic tests were applied [Przednowek *et al*. 2019; Pasko *et al*. 2021], executed by the participants in the following order:

1. SIRT – Simple Reaction Time: The test evaluated the speed and stability of simple reaction time. The signaling field of stimuli changed its color at specific time intervals. The reaction to stimuli involved quickly moving the finger from the *Start* field to the *Reaction time* field marked in blue.

2. CHORT – Choice Reaction Time: This test assessed the speed and adequacy of complex reaction time. In the upper signaling row, horizontal and vertical stimuli requiring a reaction were displayed, along with neutral stimuli (*diagonal benchmark*) that did not require a reaction. The activity involved moving the finger from the *Start* field to one of the two reaction fields (vertical or horizontal stimulus field). During the activity of the neutral stimulus, no action was taken, and the finger was kept on the *Start* field.

3. HECOR – Hand-Eye Coordination: This diagnostic trial assessed hand-eye coordination, requiring the participant to carefully observe the exposure panel and react quickly to the displayed red signaling field. The test participant's task was to move the finger from the *Start* field to the blue reaction field and then return the finger to the *Start* field.

4. SPANT – Spatial Anticipation: This trial evaluated hand-eye coordination with the aspect of complex spatial information. At the top, on the left and right sides of the test panel, signaling fields were located, of which two (highlighted in a row and one in a column) simultaneously changed color to red. In response to the stimulus, the participant had to point with the finger to the intersection of the highlighted row and column, and subsequently return the finger to the *Start* field.

After the familiarization procedure, the participants performed tasks in the morning in a random order. A participant was in a standing position, and tasks were carried out using the index finger of the dominant hand. The dominant hand was determined by *the pen test* making observations when signing the consent to research. For ambidextrous, an *indication test* was then performed. The measurement process took place in an isolated room to facilitate concentration. In each test (the break between tests was at least 20 minutes), stimuli appeared at different time intervals (1s, 1.5s, or 2s) and were exposed for 3 seconds. The number of stimuli was 20 for each test (the exception was CHORT – 24 stimuli). The temperature during the study was maintained at 20°C. Reaction time (RT, measured with an accuracy of 0.01 s) was the determinant in all tests. The total test time was 3 minutes. Each actual test was preceded by a practice test, allowing the participant to become familiar with the testing procedure [Przednowek *et al*. 2019; Pasko *et al*. 2021].

Measurement of technical and tactical training indicators

The analysis of the sports fight was made on the basis of a digital recording of the duel made using a camera. Based on the recording, indicators of technical and tactical training were determined according to established formulas [Rydzik *et al*. 2021b].

Attack effectiveness(Sa)

$$Sa = n / N$$

n – number of attacks rated in 1-points.

*In the K1 Rules formula, each clean hit of the opponent is worth 1 point

N – sum of observed fights

Attack Effectiveness(Ea)

Ea = (number of successful attacks)/(number of total attacks) x 100

*A successful attack is defined as a technical action for which a point was awarded

* The number of all attacks are all attempts at offensive techniques

Attack Activity (Aa)

Aa = (number of recorded attacks by the player)/(number of fights fought by the tested player)

Statistical Analysis

In the analysis of research results, basic statistical methods were applied for each of the four psychometric tests, determining the arithmetic mean, standard deviation, minimum and maximum values, and the coefficient of variation. The normality of data distribution was checked using the Shapiro-Wilk test. Non-parametric tests, Friedman's ANOVA, followed by multiple Wilcoxon comparison tests, were employed to compare the mean results of the four tests. To analyze the influence of two independent variables, i.e., body mass (BM) and training experience (SE) on the dependent variable, i.e., the

performance level in each of the four tests, multiple regression analysis was applied. Multiple correlation coefficients (R), partial correlation coefficients, and the proportion of the influence of each independent variable on the variance of the dependent variable (reaction time β) were calculated. The correlations of indicators of technical and tactical preparation with the results of reaction tests were verified using Sperman's rank correlation. The analysis of the collected data was conducted using Statistica software by Statsoft, version 13.3 (Statsoft, Krakow, Poland).

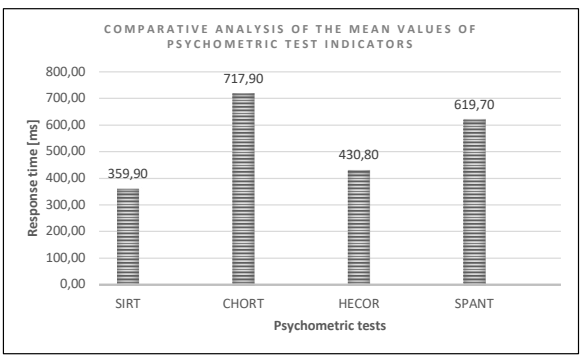
Results

Table 2 presents descriptive results of the four conducted specialized psychometric tests. Comparative analysis of the mean values from all tests revealed statistically significant differences in the level of results for each test. The highest mean value was observed for CHORT, while the lowest was in relation to SIRT. Additionally, significantly higher mean values were noted for SPANT compared to HECOR.

Table 2. Statistical Characteristics of Psychometric Test Results and Comparative Analysis of Average Reaction Times of Studied Kickboxing Athletes

Test	x̃±sd	CV%	min-max	Mean comparisons
SIRT - RT[ms]	359.9 ±36.5	10.1	294-422	*CHORT* > *SPANT* > > *HECOR* > *SIRT* Z > 5.000, p < 0.001
CHORT - RT[ms]	717.9 ±66.5	9.3	629-824	
HECOR – RT[ms]	430.8 ±39.3	9.1	353-488	
SPANT – RT[ms]	619.7 ±97.2	15.8	483-807	

x˜ - Mean; sd – Standard Deviation; CV% - Coefficient of Variation; min - Minimum Value; max - Maximum Value; RT – Reaction Time; Z – Rank Sum Test Value; p - Significance Level



ms – millisecond

Figure 2. Comparative analysis of the mean values of psychometric test indicators

The coefficient of variation results indicate that within the studied population, intragroup variation was very low in each test. The highest level of dispersion was observed for SPANT, while the lowest was for HECOR (Table 2).

The results of observations of the presented technical and tactical skills are included in Table 3.

Table 3. Descriptive statistics of technical-tactical components

Variable	x̃±sd	CV%	min-max	-95%CI-+95%CI
Efficiency	33.4±7.2	21.6	20-50.5	31.0- 35.4
Activity	124.1± 31.7	25.8	75-196	115.6-134.9
Effectiveness	49.8 ±14,5	28.7	32-82	36.1-54.9

%CI confidence interval

There were significant correlations between the components of technical and tactical skills expressed by correlation coefficients: effectiveness · activity = 0.151, effectiveness · effectiveness = 0.560 and effectiveness · activity = 0.873. There were also significant negative correlations between technical and tactical features and the results of psychometric tests (Table 4). The strongest correlation was noted for simple reaction time (SIRT) with the components of technical and tactical training. This suggests that the shorter the reaction time, the stronger it may be a determinant of success. The results in Table 4 also show differences in the diagnostic power of psychometric tests for kickboxing.

Tables 4. Rho correlations between the components of the level of technical and tactical training and psychometric parameters

Variable	SIRT	CHORT	CHECO	SPANT
Efficiency	**-0.564**	-0.215	**-0.402**	-0.162
Activity	**-0.376**	-0.177	-0.264	-0.115
Effectiveness	**-0.611**	**-0.305**	**-0.450**	-0.193

The results of the linear multiple regression analysis conducted for independent variables (SE, BM) relative to the dependent variable (test score) in the group of studied Kickboxers are presented in Table 3. Regarding the global relationship (R) between variables, a significant, moderate multiple correlation with a negative direction was demonstrated for SIRT. A similar correlation trend, though stronger, was observed for SPANT. For the CHORT and HECOR tests, a non-significant, negative correlation with a very weak relationship was found.

The parameter β revealed the quantitative contribution of SE and BM to the variance of reaction time for each test. It was shown that these contributions are different for each test. Regarding regression coefficients for SE, their negative directions were observed in all tests. In comparison with SPANT, a unitary influence was noted, explaining 66.6% of the variance, with characteristics of a significant, negative, and strong partial correlation. For BM, an impact on SIRT was recorded, explaining 42.7% of the variance, with features of a significant, moderate partial correlation (Table 5).

Table 5. Results of Multiple Regression Analysis for Variables in the Kickboxer Group

Test	Regression components		t-value	p-value	β -value	R	partial r
SIRT	Intercept	**541.8**	**9.064**	**<0.001**	-	**-0.437 p<0.05**	-
	SE	-0.341	-0.231	0.819	-0.034		-0.036
	BM	**-2.267**	**-2.939**	**0.005**	**-0.427**		**-0.417**
CHORT	Intercept	**730.9**	**6.182**	**<0.001**	-	-0.150 p>0.05	-
	SE	-1.747	-0.927	0.359	-0.148		-0.143
	BM	-0.070	-0.045	0.964	-0.007		-0.007
HECOR	Intercept	484.7	**6.826**	**<0.001**	-	-0.127 p>0.05	-
	SE	-0.361	-0.205	0.838	-0.033		-0.032
	BM	-0.653	-0.712	0.481	0.114		-0.111
SPANT	Intercept	516.1	3.811	**<0.001**	-	**-0.644 p<0.05**	-
	SE	**-18.06**	**-5.389**	**<0.001**	**-0.666**		**-0.644**
	BM	2.666	1.526	0.135	0.189		0.232

Test: SIRT, CHORT, HECOR, SPANT – dependent variable; Intercept – intercept; SE - training experience (independent variable); BM - body mass (independent variable); t-value - significance level; p-value - significance level; β - regression coefficient; R - multiple correlation coefficient; partial r - partial correlation coefficient

Discussion

The aim of our research was to identify the profile of psychomotor abilities in the group of elite kickboxers and diagnose its relationship with body mass and training experience. The results of the present study suggest that higher psychomotor skills competence in competitive kickboxing, co-occurs with longer training experience, higher technical and tactical efficiency and lower body weight of players.

In our own studies, significant variability in motor effects was demonstrated for individual tests. The most favorable results were noted for SIRT, followed by HECOR, SPANT, and CHORT (Table 2, Figure 2). These conclusions align with earlier reports where assessments were made using the same method, conducted in groups such as professional handball players [Przednowek *et al.* 2019], young soccer players [Pasko *et al.* 2021], candidates for special forces [Pasko *et al.* 2022b], and professional rugby players [Sliz *et al.* 2023b]. It can be assumed with high probability that the revealed differences between the means correspond to the difficulty scale of each test task. This difficulty is related to the necessary total time for the components of tasks: visual perception, information processing, decision-making, and limb movement toward the correct target. In terms of comparative correspondence, kickboxers from our study presented less favorable test results compared to professional handball players [Przednowek *et al.* 2019] and professional rugby players [Sliz *et al.* 2023b]. Compared to candidates for special forces [Pasko *et al.* 2022b], they excelled only in the SPANT trial. They achieved higher overall test effectiveness compared to young soccer players [Pasko *et al.* 2021]. Analyzing the mean values of the variation coefficients, it was observed that kickboxers exhibited high homogeneity in terms of obtained results (Table 2). Low intragroup variation occurred in each diagnostic test. Similar conclusions regarding low intragroup variation in simple reaction time were found for BJJ, Thai boxing, and MMA athletes [Wasacz, Pociecha 2021; Wasacz *et al.* 2022], using the computerized tests of coordination abilities method [Klocek *et al.* 2002]. It is noteworthy that, similar to the studies mentioned in the introduction section as well as in our studies, athletes specializing in the stand-up-striking plane of combat achieved more favorable simple reaction time results compared to athletes originating from or practicing grappling combat sports (Wrestling, Grappling, BJJ) [Wasacz, Pociecha 2021; Wasacz *et al.* 2022; Adamczyk *et al.* 2013]. It seems highly probable that the influence of targeted and specialized training contributes to low variation in results within the examined group. This suggests that the specificity of this discipline favors athletes with precisely these predispositions. In the context of kickboxing and other combat sports, labeling motor coordination as merely useful does not fully capture the picture. Athletes in these disciplines perform offensive-defensive actions, reacting in both simple and complex ways. All of this is based on an open habit, which requires the athlete to selectively adapt to the situation, unlike a closed habit found, for example, in gymnastics, shot put, or sprinting. Proper neuromuscular stimulation allows for so-called quicker perception of strikes, information processing, and consequently, faster decision-making and reaction. Examples of this include quick evasion, blocking, delivering a strike or performing combinations.

Evaluation of the group of athletes from our own research in terms of the relationship between thematic variables allows us to observe that with prolonged training experience and lower body mass, the average reaction time of the subjects decreases in psychometric diagnostics. This is indicated by the negative directions of multiple correlation coefficients for each trial. The highest significant associations were found for SPANT at a strong correlation level and for SIRT, showing moderate relationships. Examining a group of ground combat sport athletes in Brazilian Jiu-Jitsu (BJJ), similar information was presented regarding simple reaction time to visual stimuli, demonstrating a significant negative correlation with training experience [Wasacz *et al.* 2022]. Interestingly, de Brito and Silva [2011], studying a group of Shotokan Karate practitioners, found that older athletes with longer practice and advanced degrees required more time to respond in reaction time and decision-making trials compared to other study participants, although they made significantly fewer errors in their choices. Delving into the thematic area of the identified dependencies, in the context of the individual variable of training experience, negative partial correlation links

were demonstrated in comparison with each trial. The association with SPANT exhibited the highest effect of significant strength. This means that kickboxers with higher training levels showed a higher level of coordination abilities development, involving elements such as complex reaction time, movement planning, spatial orientation, or multidimensional perception. Again, this phenomenon appears to be influenced by specialized, focused training and competitive activities that extend over time. Body mass also had an impact on the test effect level. A significant link of this variable occurred only for the simple reaction time test (SIRT), suggesting that athletes in lower weight categories react faster to simple visual stimuli. In other words, our own research unequivocally demonstrated an inverse proportion: the lower the body mass of the subjects, the higher the efficiency in the discussed test. According to the existing reports, heavier athletes exhibit highly developed strength capabilities, employ fewer techniques and demonstrate lower technical-tactical efficiency compared to lighter athletes characterized by greater dynamics in their match conduct, with higher diversity and frequency of offensive techniques [Ambrozy *et al.* 2023; Rydzik *et al.* 2021b]. In a qualitative conclusion, the mentioned components can coexist with the demonstrated level of simple reaction time in our own research.

The results of our own research confirm the diagnostic value of the applied battery of psychometric tests for assessing selected areas of general motor coordination in kickboxers and their relationships with body weight and training experience. This tool is selective, precise, and reliable, facilitating comprehensive coaching control and optimizing the training process. The likely influence on the obtained research results was the recruitment and systematically conducted selection in the kickboxing section, which favors athletes with such a level of psychomotor skills and demonstrated relationships. Another extremely important factor appears to be the specialized and focused training process to which the researched athletes were subjected in their life history.

Limitations of the Study

Our research was subject to certain limitations. One of them was the inability to access a representative sample of players from particular weight categories and training experience ranges. In future research activities, it is recommended to perform a comparative analysis taking into account the above-mentioned variables. To capture the multidimensional clinical context, future studies should include the diagnosis of comparisons with other populations, such as representatives of other combat sports, non-athletes, as well as groups of female athletes. It is also recommended to diagnose the co-occurrence of optimal psychomotor skills with areas such as technical-tactical performance, sports levels and results. Future explorations should also identify the best way to apply these findings in optimizing training programs.

Conclusions

The research results enable the diagnosis and interpretation of the psychomotor profile of kickboxers, along with key relationships that may determine motor effects. The diverse cascade of test tasks influences the motor effect exhibited in the kickboxer community for each specific trial. Optimal simple reaction time in kickboxing can be associated with lower body weight for athletes in this specialization. In kickboxing, longer training experience significantly and strongly correlates with a higher level of visual-motor coordination (tasks in the SPANT test). The obtained results confirm that regular kickboxing training, to which the participants had been subjected, positively influences the shaping and improvement of the revealed level of psychomotor abilities. The specificity of movements typical for kickboxing, where open habits are prevalent, justifies the introduction of psychometric diagnostic tests to assess the level of motor preparedness. The higher the technical-tactical abilities the shorter the time response.

Practical Applications

An objective analysis of the demonstrated levels and relationships, along with the provision of individual research protocols, can individualize and enhance the training process for kickboxers and coaching control. Due to the proven utility of assessing kickboxers using a battery of psychometric tests, it is recommended to utilize this method in other combat sports disciplines (striking, grappling, and those involving both stand-up and ground planes). The recommended tool can be safely applied in training facilities. The presented research results can serve researchers for comparative analyses and interpretation of indicators based on the mean values identified in this study. Finally, the conducted actions prompt further observations regarding the comparison of psychomotor levels and relationships with other populations and variables.

Conflict of Interest

The authors declare no conflict of interest.

Ethical considerations

The study was conducted according to the Declaration of Helsinki and approved by the Ethics Committee of the University of Rzeszow (protocol code 8/12/2021).

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Zdolności psychomotoryczne zawodników Kickboxingu oraz ich związek z poziomem wyszkolenia techniczno-taktycznego oraz stażem treningowym i masą ciała

Słowa kluczowe: sporty walki, zdolności psychomotoryczne, staż treningowy, masa ciała, Kickboxing

Streszczenie

Wprowadzenie. Współczesny Kickboxing jest dyscypliną o złożonej strukturze walki oraz wymagającej rywalizacji sportowej. Jednym z kluczowych obszarów, który determinuje skuteczność zawodnika jest potencjał psychomotoryczny. Celem pracy była ocena wybranych obszarów zdolności psychomotorycznych u wyczynowych zawodników kickboxingu za pomocą psychometrycznych testów komputerowych w systemie TEST2DRIVE oraz zdiagnozowanie ich związku z masą ciała, doświadczeniem treningowym osób badanych oraz wskaźnikami techniczno-taktycznymi.

Materiał i metoda. Badaniami objęto grupę 44 wyczynowych zawodników Kickboxingu. Zastosowano podstawową procedurę antropometrii (wysokość ciała: 176,83 cm ± 4,33; masa ciała: $\tilde{x}$ =77,18 kg ± 9,93), oraz przeprowadzono wywiad bezpośredni (wiek: $\tilde{x}$ =22,60±2,72; staż treningowy: $\tilde{x}$ =8,98±2,64). Oceny zdolności psychomotorycznych dokonano za pomocą psychometrycznych testów komputerowych, w systemie *TEST2DRIVE*. Zastosowano cztery tematyczne testy: *SIRT*-czas reakcji prostej, *CHORT*-czas reakcji wyboru, *HECOR*- koordynacja ręka-oko *i SPANT*- przewidywanie przestrzenne. Do opracowania wyników przeprowadzono analizy statystyczne z wykorzystaniem pakietu Statistica 13.3.

Wyniki. Analiza porównawcza wykazała istotne zróżnicowanie, w poziomie wyniku dla danego testu ($p<0,001$). W grupie kickboxerów stwierdzono bardzo niskie zróżnicowanie wewnątrzgrupowe (CV%=9.1-15.8) . Odnotowano znaczące związki wielokrotne miedzy stażem treningowym, masą ciała a *SIRT* o umiarkowanej sile ($R= -0.437;p<0.05$) i *SPANT* o silnej zależności ($R= -0.644;p<0.05$). Ponadto w toku analiz wykazano znamienne, silne korelacje cząstkowe dla zestawienia stażu treningowego ze *SPANT* ($r= -0.644;p<0.05$), oraz masy ciała ze *SIRT* o umiarkowanej sile ($r= -0.417;p<0.05$). Odnotowano zależności pomiędzy trzema komponentami wyszkolenia techniczno-taktycznego, zdefiniowanymi jako efektywność, aktywność, skuteczność a wynikami testów psychometrycznymi. Generalnie, im wyższy poziom wyszkolenia tym krótszy czas reakcji, szczególnie dla testu SIRT.

Wnioski. Badania wskazują, że u kickboxerów czas reakcji wiąże się z niższą masą ciała, a dłuższy staż treningowy istotnie koreluje z lepszymi umiejętnościami wzrokowo-motorycznymi (test SPANT). Regularny trening kickboxingu pozytywnie wpływa na rozwój zdolności psychomotorycznych. Specyfika ruchów w kickboxingu uzasadnia stosowanie psychometrycznych testów diagnostycznych do oceny gotowości motorycznej, przy czym wyższe umiejętności techniczno-taktyczne prowadzą do krótszych czasów reakcji.