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The use of functional tests to assess risk of injuries in judokas

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B Data Collection
C Statistical Analysis
D Manuscript Preparation
E Funds Collection

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Abstract

Background & Study Aim: High physical fitness requirements towards judokas, as well as the combat specificity may foster bodily injuries. The research objective was to identify the spinal joints, hip joints and shoulder joints mobility in relation to bodily injuries sustained by men practising judo (as professional or amateur sportsmen).

Material & Methods. Forty one men practising judo divided into two groups according to the level of sport advancement were considered for participation in this study. Group 1 (G1 – the study group) were 15 professional sportsmen. Group 2 (G2 – the control group) were recreational, amateur sportsmen (n = 26). The research tool consisted of a series of functional tests: (the Dega wall test, Thomas test, Thomayer test and Zipper – Back Scratch Test), as well as a custom survey on training methods, the number, type and circumstances of contracted injuries, as well as their treatment methods.

Results: Iliopsoas contracture was observed in 14 judokas (93%) in G1 and 15 judokas (58%) in G2. Thirteen practitioners in G1 and 11 in G2 scored negative in the Dega test, compared to 14 judokas in G1 and 7 judokas in G2 scored negative in the Back Scratch Test. Significant asymmetry was also observed in both groups: the discrepancy between the left and the right side amounted to $p = 0.002$ for G1 and $p<0.001$ for G2. A notably higher number of bodily injuries ($p = 0.022$) was noted among professional judo athletes.

Conclusions: The degree of functional limitations may be the effect, yet also the cause of bodily injuries. The majority of professional practitioners had limited joint flexibility (which may increase the risk of injury to this body part). This demonstrates an insufficient amount of stretching exercises during training.

Key words: Back Scratch Test • Dega test • Thomas test • Thomayer test

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Functional assessment – measures a person's level of function and ability to perform functional movement. Movement quality is an essential component to reducing the risk of injury and reaching optimal levels of performance.

Injury or trauma – damaged tissue, organ or larger body parts. Injury may be caused by action of many factors, mechanical, chemical, thermal, electrical, acoustic, light.

Introduction

Bodily injuries are an undesirable effect of sports or health training, may be a result of immediate sports combat (e.g. blows and throws in combat sports), excessive bodily effort, improperly performed training or the lack of optimal post-exertional recovery [1-3]. Bodily injuries may therefore be due to excessive strain (with improperly led training), willingness to obtain the best results, mismatch between training intensity and age and health status of players or a too early return to training after a contracted injury. Bodily injury renewal is fostered by the use of steroid preparates with analgesic and anti-inflammatory functions. These substances improve the functioning of the locomotor system, and as a result, the player seems healthy and ready to take on the training load. Another factors influencing bodily injuries include inaccurate warm-up (or the lack thereof), incorrect performance of exercises or their excessive difficulty, lack of protection, faulty sports equipment, facilities inaccurate to the exigencies of training performed, atmospheric conditions or behaviour of supporters [4-7].

In judo, as in other sport disciplines, bodily injuries are often a result of upper limb, lower limb and upper body overload, often related to the necessary adaptations of the musculoskeletal system. The repetitive block motions of uke (the opponent or fellow practitioner) cause overload in the same structures, creating muscular imbalance. It might cause a decrease in strength and flexibility and biochemical disorders in the locomotor system [8]. An early diagnosis of the asymmetry and muscular imbalance may be an effective means of bodily injury prevention.

The research objective was to identify the spinal joints, hip joints and shoulder joints mobility and to describe bodily injuries sustained by men practising judo (as professional or amateur sportsmen).

Material and methods

Participants

The study included 41 persons practising judo, aged 18 to 30. Group 1 (G1) were 15 athletes training judo for at least ten years, who have obtained at least one kyu and won at least one medal in the Polish National Championships. Students training judo as amateurs (n = 26) for at least a year were qualified to Group 2 (G2). The biometric characteristics of the sample persons are listed in Table 1. Local bioethics committee has given consent to the study.

Methods and protocols

All sample subjects were subjected to a series of functional tests assessing the range of joint motion in the spine, hip joints and glenohumeral joints [9].

Dega test enables detection of muscle contractures within the glenohumeral joints. The tested person lifts arms in standing posture or sitting back to the wall. The angle between outstretched arms and the wall defines the degree of contracture.

Back Scratch Test (also referred to as Zipper Test or Shoulder Mobility Test) defines the functional mobility of the pectoral girdle during external rotation-abduction and internal rotation-adduction.

The Thomayer test (also referred to as finger tips-floor test) measures the spine and hip joints mobility. The tested person is asked to bend forward with straightened knee joints, and the distance is measured between the distal phalange of the third finger and the floor.

The Thomas test detects flexion contractures within the hip joint. The patient lies supine, the non-examined limb flexed to the maximum in the knee joint and the examined limb straightened. The examiner

Table 1. Characteristic of examined sportsmen

Groups	N	Age (years)	Body mass (kg)	Body height [cm]	Training experience (years)
G1 (professionals)	15	23.1 ±3.1	81.9 ±11.9	177.3 ±5.9	10.1 ±3.8
G2 (amateurs)	26	20.2 ±0.4	73.7 ±10.6	179.6 ±6.4	1.8 ±1.9

presses the thigh of the non-examined limb to the patient's chest. If a contracture is present, the tested limb rises off the floor. The angle between thigh axis and the surface on which the patient lies demonstrated the size of the contracture [9].

In tests for both sides, the general result was the score for the weaker side.

Furthermore, the researched persons filled in a custom survey which contained information concerning the contracted bodily injuries, their causes and treatment, as well as current health status.

Statistical analysis

Data were processed using standard methods of statistical analysis, arithmetical means and SD. The reliability of differences between particular groups was evaluated using Mann-Whitney U test, the differences between left and right side were compared by the Wilcoxon matched-pairs signed-ranks test. The minimal reliability level was adopted at $p \leq 0.05$.

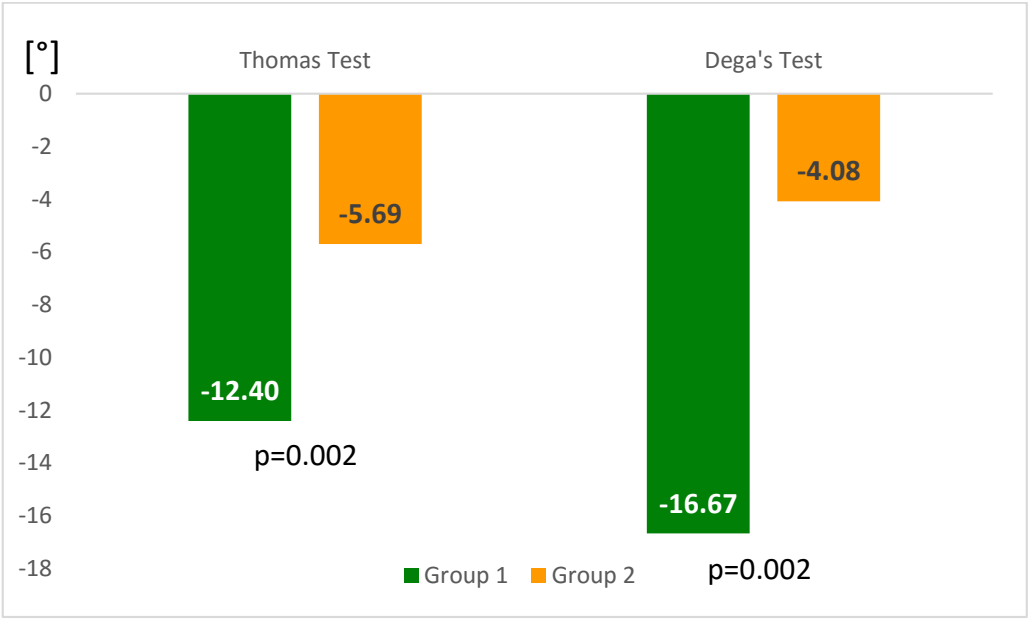

Figure 1. Results of Thomas and Dega tests (G1 n = 15, G2 n = 26).

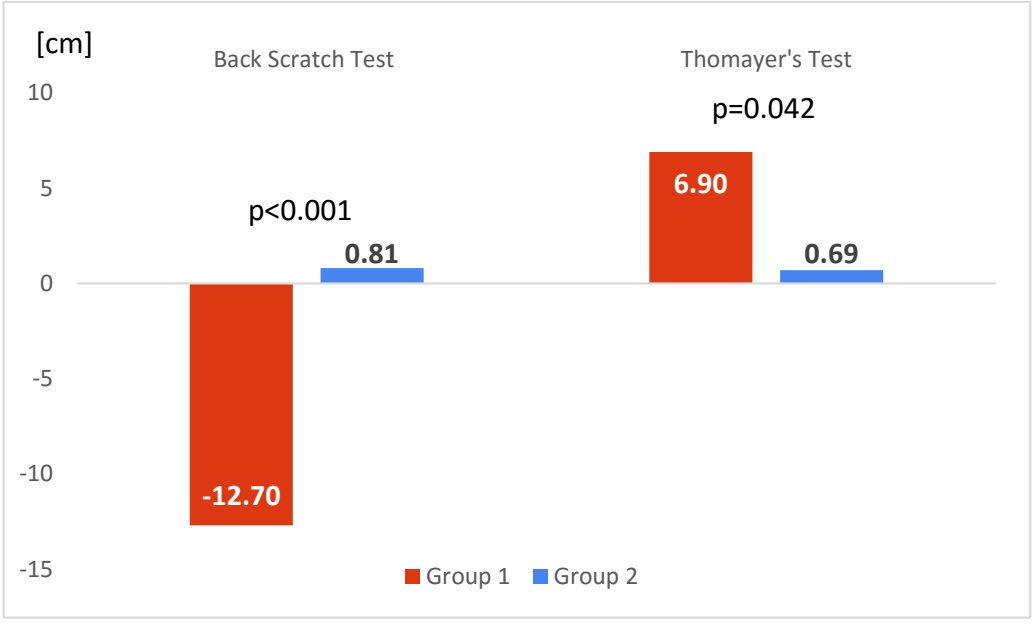

Figure 2. Results of Back Stratch and Thomayers tests (G1 n = 15, G2 n = 26).

The results were calculated in MS Excel 2013 and Statistica 10 computer packages.

Results

Bilateral iliopsoas contracture was observed in 14 out of 15 judokas in G1 (negative score in Thomas test). In G2, bilateral contracture was detected in 11 subjects, with unilateral contracture detected in 4. Negative result of Dega test (limited mobility in glenohumeral joints) was scored by 13 athletes in G1 (bilateral in 10 athletes, unilateral in 3) and 11 athletes in G2 (bilateral in 6 athletes, unilateral in 5). No significant differences were noted between results for left and right side in either group, both for Thomas and Dega tests (Table 2). The difference between both results in Thomas and Dega tests for judokas in G1 and G2 was statistically significant at p = 0.002 (Figure 1).

The negative score in Back Scratch Test, demonstrating the limited mobility of the pectoral girdle (during external rotation-abduction and internal rotation-adduction), was observed in 14 judokas in G1 (bilateral in 11 athletes, unilateral in three) and in 7 judokas in G2 (bilateral in 2 athletes, unilateral in 5). The differences between groups were significant, with p<0.001 (Figure 2). Significant asymmetry was also observed in both groups: the discrepancy between left and right side amounted to p = 0.002 in G1 and p<0.001 in G2 (Table 2).

Professional judo athletes earned better scores than amateurs in the Thomayer (spinal mobility) test (p = 0.042). Negative scores were observed for two subjects in G1 and eight in G2 (Figure 2).

A significantly higher number of bodily injuries (p = 0.022) was noted among professional practitioners. Taking account of the injury type, the one declared most often was contusion (2.4 cases per person in G1 and 0.12 in G2, p = 0.001), tendon or ligament strains and ruptures (1.13 in G1 and 0.12 in G2, p = 0.006) and joint sprains (1.07 in G1 and 0.58 in G2, p = 0.036). Joint dislocation and bone rupture were less common. Bodily injuries were most often related to upper extremities in G1 and lower extremities in G2. The quotient of bodily injuries and training experience (measured in years) amounted to, on average, to 0.56 in G1 and 0.91 in G2; the difference was not statistically significant (Table 3).

Discussion

Most athletes practising combat sports on a professional basis have contracted a bodily injury at

Table 2. Results of bilateral tests (G1 n = 15, G2 n = 26).

Tests	Groups	Left	Right
Thomas Test	G1	**–10.07**** ±6.66	**–10.67**** ±5.17
	G2	–4.35 ±4.71	–4.81 ±5.24
Dega's Test	G1	**–15.47**** ±12.82	**–11.00**** ±8.48
	G2	–3.62 ±5.45	–2.92 ±4.89
Back Scratch Test	G1	**–11.97***** ±9.85	**–6.40***** ±10.05
	G2	1.00 ±7.69	5.85 ±6.31

**p<0.01; *** p<0.001: differences between groups

Table 3. Characteristic of injuries in judokas G1 (n = 15) and G2 (n = 25).

Number of injuries	Groups	Head and spine	Upper limb	Lower limb
[n/person]	G1	0.80 ±1.08	**3.60*** ±5.03	2.47 ±3.11
	G2	0.35 ±0.62	0.42 ±0.76	0.92 ±1.62
[n/person/training experience]	G1	0.04 ±0.07	0.30 ±0.44	0.20 ±0.29
	G2	0.10 ±0.41	0.28 ±0.61	0.54 ±0.97

*p<0.05: differences between groups

least once during their career [10-14]. However, the issue also concerns representatives of other disciplines. On the basis of studies among 157 athletes in six disciplines (football, handball, volleyball, basketball, athletics, judo), it was stated that 95% of them have contracted bodily injury at least once during their sports career [15]. During large sporting events, injuries prevent as many as one in eight athletes from competing or finishing the competition [16]. According to Engebretsen et al. [17], at the London Olympics, bodily injuries were noted in 12.9% participants, with the majority (54.9%) having contracted it during the competition. Among combat sports athletes, only in taekwondo was the percentage of the injured higher than the average for all disciplines (39.1%). Fewer bodily injuries were noted in judo than in football, handball, athletics, weightlifting, mountain biking, field hockey, sailing, triathlon, badminton, synchronised swimming, water polo or beach volleyball [17]. It can be said that bodily injuries are part of sports activity and constitute a serious problem in contemporary sport not only in its professional sphere, but also among amateurs, which is confirmed by studies from other authors [18-23] and own research.

The age of the athlete has an impact on the appearance of overload injuries. For young athletes, where rapid bone growth in length was observed, muscles and tendons did not have enough time to gain length and flexibility. This may lead to the development of contractures in lower extremities. Their consequences include avulsion fractures, muscle tear and sprain, as well as growth cartilage overuse injury [24]. Incorrectly managed strength and endurance training, along with rapid growth in pubertal age, may lead to muscle-tendon imbalance. The imbalance between the volume and strength of antagonist muscles may lead to tendinitis and tunnel syndromes [25].

Judo practitioners sampled for the present paper were most likely to contract bodily injuries within upper extremities (professionals) and lower extremities (amateurs). Injuries of the lower extremities were also dominant among men training combat sports studied by Radzioch et al. [26]. Young judo adepts studied by Pieter, in turn, were prone to upper extremity injuries [27].

The injury risk assessment is done by various methods, including Flamingo Test, Rotational Test, Test of Susceptibility to Injuries During Falls (TSIDF), Double Leg Lowering Manuvre (DLLM), Core Muscle Strength and Stability Test (CMS&ST) or Functional Movement Screen (FMS) [28-34]. The aforementioned tests assess balance, range of motion of particular joints or the quality of movement: reconstructing the complex movement patterns. After all, bodily injuries may have different causes. However, they are most often due to a cumulation of micro injuries, locomotor system stress or incorrect warm-up [35-37].

Paterno et al. [38] have demonstrated that 30-50% of bodily injuries in children practising athletics are stress injuries. Acute injuries only constitute 15% of all cases and are most often the result of contact against the opponent. Among children training running, knee joint pathologies are the most common [38]. A higher risk of acute injury may appear in team sports and combat sports. It is due to more frequent physical contact between athletes. Hence, this group of sports puts an impact of muscular tissue, high balance level and postural muscle efficiency, as well as specific coordination skills, such as the ability to fall safely [38-43].

Currently, in professional sport, the role of physiotherapists is indisputable [44]. Future research should determine the suitability of functional physiotherapist tests with regards to the work of sport physiotherapists. Moreover, the use other standardised tests and trials could be useful to gain full information on a particular athlete. Functional studies of the locomotor system may be used in the pre-season preparations of the athletes. This might make it possible to identify pains experienced by athletes or their movement limitations, which may influence their preparation process and them achieving better sport results.

Conclusions

The degree of functional limitations may be the effect, yet also the cause of bodily injuries. The majority of professional practitioners had limited joint flexibility (which may increase the risk of injury to this body part). This demonstrates an insufficient amount of stretching exercises during training.

Overall, the results obtained call for a greater impact on supplementary exercises (compensatory exercises and stretching) in the training process for judokas.

Conflict of interest

The author declares that has no conflict of interest.

References

1. Bulzacchelli MT, Sulsky SI, Rodriguez-Monguio R et al. Injury during U.S. Army basic combat training: a systematic review of risk factor studies. Am J Prev Med 2014; 47(6): 813-822
2. Gray SE, Finch CF. Epidemiology of hospital-treated injuries sustained by fitness participants. Res Q Exerc Sport 2015; 86(1): 81-87
3. Kim KS, Park KJ, Lee J et al. Injuries in national Olympic level judo athletes: an epidemiological study. Br J Sports Med 2015; 49(17): 1144-1150
4. Kazemi M, Shearer H, Choung YS. Pre-competition habits and injuries in Taekwondo athletes. BMC Musculoskel Dis 2005; 6: 26
5. Yamaner F, Gumusdag H, Kartal A et al. The prevalence of injuries in professional Turkish soccer players. Biomed Hum Kinet 2011; 3: 6-9
6. Feddermann-Demont N, Junge A, Edouard P et al. Injuries in 13 international Athletics championships between 2007-2012. Br J Sports Med 2014; 48(7): 513-522
7. Gallant JL, Pierynowski MR. A theoretical perspective on running-related injuries. J Am Podiat Med Assn 2014; 104(2): 211-220
8. Hjelm N, Werner S, Renstrom P. Injury risk factors in junior tennis players: a prospective 2-year study, Scand J Med Sci Spor 2012; 22 (1): 40-48
9. Buckup K. Testy kliniczne w badaniu kości, stawów i mięśni. Warszawa: PZWL; 2007 [in Polish]
10. Sterkowicz S, Rukasz W. Typowe urazowe uszkodzenie ciała i ogólne wskazania w rehabilitacji ruchowej judoków. Medycyna Sportowa 1996; 11-12: 12-17 [in Polish]
11. Kuźma D, Pacek J, Sieroń D. Urazowe obrażenia w boksie amatorskim. Medicina Sportiva Practica 2010; 11(4): 64-69 [in Polish]
12. Pocecco E, Ruedl G, Stankovic N et al. Injuries in judo: a systematic literature review including suggestions for prevention. Br J Sports Med 2013; 47: 1139-1143
13. Prill R, Coriolano HJA, Michel S et al. The Influence of the Special Throwing Technique on the Prevalence of Knee Joint Injuries in Judo. Arch Budo 2014; 10: 211-216
14. Bolach B, Witkowski K, Zerzut M et al. Injuries and overloads in thai boxing (muay thai). Arch Budo 2015; 11: 339-349
15. Walentukiewicz A. Epidemilogia urazów sportowych. Rocznik Naukowy AWFiS w Gdańsku, 2002; 13: 19-35 [in Polish]
16. Green CM, Petrou MJ, Fogarty-Hover MLS et al. Injuries among judokas during competition. Scand J Med Sci Spor 2007; 17: 205-210
17. Engebretsen L, Soligard T, Steffen K, et al. Sports injuries and illnesses during the London Summer Olympic Games 2012. Br J Sport Med 2013; 47: 407-414
18. Pérez-Turpín JA, Penichet-Tomás A, Suárez-Llorca C et al. Injury incidence in judokas at the Spanish National University Championship. Arch Budo 2013; 3: 211-218
19. Feddermann-Demont N, Junge A, Edouard P et al. Injuries in 13 international Athletics championships between 2007-2012. Br J Sport Med 2014; 48(7): 513-522
20. Gray SE, Finch CF. Epidemiology of hospital-treated injuries sustained by fitness participants. Res Q Exerc Sport 2015; 86(1): 81-87
21. Kim KS, Park KJ, Lee J et al. Injuries in national Olympic level judo athletes: an epidemiological study. Br J Sport Med 2015; 49(17): 1144-1150
22. Lystad RP, Graham PL, Poulos RG. Epidemiology of training injuries in amateur taekwondo athletes: a retrospective cohort study. Biol Sport 2015; 32(3): 213-218
23. Noh JW, Park BS, Kim MY et al. Analysis of combat sports players' injuries according to playing style for sports physiotherapy research. J Phys Ther Sci 2015; 27(8): 2425-2430
24. Kriz P. Overuse injuries in the young athlete. Medicine and Health Rhode Island 2011; 94(7): 203-208
25. Outerbridge AR, Micheli LJ. Overuse injuries in the young athlete. Clin Sport Med 1995; 14(3): 503-516
26. Radzioch W, Grzybowski A, Łęgosz P et al. Analiza obrażeń w sportach walki w materiale Poradni Medycyny Sportowej w Częstochowie. Medycyna Sportowa 2000; 110: 24-27 [in Polish]
27. Pieter W. Martial Arts. In: Caine D, Maffulli N, editors. Epidemiology of pediatric sports injuries. Basel: Karger; 2005: 59-73
28. Ladeira CE, Hess L, Galin B et al. Validation of an abdominal muscle strength test with dynamometry. J Strength Cond Res 2005; 19(4): 925-930
29. Kalina RM, Barczyński B, Klukowski K et al. The method to evaluate the susceptibility of injuries during the fall – validation procedure of the specific motor test. Arch Budo 2011; 7(4): 201-215
30. Kalina RM, Jagiełło W, Barczyński BJ. The method to evaluate the body balance disturbation tolerance skills – validation procedure of the Rotational Test. Arch Budo 2013; 1: 59-80
31. Cook G, Burton L, Hoogenboom BJ et al. Functional Movement Screening: the use of fundamental movements as an assessments of function – part 1. Int J Sports Phys Ther 2014; 3: 396-409
32. Cook G, Burton L, Hoogenboom BJ et al. Functional Movement Screening: the use of fundamental movements as an assessments of function – part 2. Int J Sports Phys Ther 2014; 4: 549-563
33. Mosler D. Validity and reliability of non-apparatus and quasi apparatus flexibility tests – verification during health-related training based on judo. Arch Budo Sci Martial Art Extreme Sport 2015; 11: 123-133
34. Mosler D. Usability of non-apparatus and quasi apparatus flexibility tests based on self-perception participants in health-related judo training. Arch Budo Sci Martial Art Extreme Sport 2015; 11: 189-197
35. Hosseini SG, Hosseini S. The prevalence and causes of bodily injuries in martial art kung-fu. Biomed Hum Kinet 2010; 2: 34-37
36. Witkowski K, Maśliński J, Szałek M et al. Risk related to passion – comparative analysis of traumas on the example of judo and wrestling. Arch Budo 2015; 11: 413-417
37. Dossa K, Cashman G, Howitt S, et al. Can injury in major junior hockey players be predicted by a preseason functional movement screen – a prospective cohort study. J Can Chiropr Assoc 2014: 58-62
38. Paterno MV, Taylor-Haas JA, Myer GD et al. Prevention of Overuse Sports Injuries in the Young Athlete, Orthop Clin North Am 2013, 44(4): 553-564
39. Chorba RS, Chorba DJ, Bouillon LE et al. Use of a functional movement screening tool to determine injury risk in female collegiate athletes. N Am J Sports Phys Ther 2010; 5: 47-54
40. Letafatkar A, Hadadnezhad M, Shojaedin S et al. Relationship between Functional Movement Screening score and history of injury. Int J Sports Phys Ther 2014; 1: 21-27
41. Boguszewski D, Adamczyk JG, Kerbaum K et al. Susceptibility to injury during falls in women practicing combat sports and martial arts. Pol J Sport Tourism 2015; 22: 15-24
42. Boguszewski D, Jakubowska KJ, Adamczyk JG et al. The assessment of movements patterns of children practicing karate using the Functional Movement Screen test. J Combat Sports Martial Arts 2015; 6(1): 21-26
43. Mroczkowski A, Sikorski MM. The susceptibility to body injuries during a fall and abilities related to motor coordination of children aged 10 to 12. Arch Budo Sci Martial Art Extreme Sport 2015; 11: 65-71
44. Boguszewski D. Application of physiotherapeutic methods to support training and post-exercise recovery of combat sports and martial arts contestants. J Combat Sports Martial Arts 2015; 6(2): 85-90

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