Adapting the motor behavior of the judoka in the formative stage of performance

Lucian Constantin Costache, Liliana Mihăilescu
Faculty of Sciences, Physical Education and Informatics, University of Pitești, Romania

Abstract
This study is a meta-analysis of the concept of motor behavior in judo, addressed during the formative stage of performance discussed in the international and Romanian literature: the components of motor behavior, the stimuli used during training regarding the possibilities of optimizing motor behavior in judo, regulation and self-regulation as factors for improving performance in judo.

The issue of the progressive optimization of training stimuli, which are represented by the factors of training (volume, intensity, complexity-density), as well as that of motor, medical and psychological criteria, applied during training by methods and procedures specific to judo, is addressed.

To obtain high performance, the coach together with the team of specialists should act on the mentioned levers, through specific training methods, as well as by investigating and monitoring their level. High-intensity effort is stress for the judoka, and athletes must continuously adapt by special and repeated training. In order for this adaptation to occur, during training, increasing intensity stimuli will be used, until stimuli close or identical to those used in competition are obtained.

Keywords: motor behavior, judo, training stimuli, adaptation.

Particularities of motor behavior in judo, in the formative stage of performance

We consider the formative stage of performance the post-puberty/adolescence age (15-18 years). At this age, the motor behavior of judoka is relatively little studied in the international and Romanian literature. The optimization of motor behavior refers to the following: the technical and physical training system for junior judoka IV, III and II (U-18, U-16 and U-15); the biomotor abilities required to obtain performance – strength and resistance of the trunk muscles, particularly lumbar, scapulohumeral girdle and forearm and palmar flexor strength, which would allow the judoka to increase their capacity to generate and maintain force during the fight; reaction and execution speed, explosive force, motor coordination resistance, focused attention.

Optimizing motor behavior involves improving the main requirements of judo: those of neuromuscular and neuropsychic nature such as kinesthesia (the capacity to sense the movement of various parts of the body), coordination/dexterity, attention focusing capacity, reaction speed, explosive force (push-ups and plyometric jumps, hitting the medicine ball with one hand, throwing the medicine ball from the chest, jump squats), requirements that currently have a relatively low level, which influences the competition results.

The high level of coordination, as a component of motor behavior, is the premise for effective learning of new technical elements, and abilities and coordination determine the way in which a judoka fights (Czajkowski, 2004).

Judo is a sport characterized by many specific technical procedures and a variety of exercises practiced under exceptional conditions. The movements of judoka should be rapid and sufficiently precise to ensure the effectiveness of the fighting technique used. Consequently, judo is considered as the sport with the highest level of coordination and complexity (Hirtz & Starosta, 1991; Starosta, 2003; Starosta, 2006).

Technical and tactical training in judo involves preparing all technical procedures and forming skills and abilities according to the athlete’s motor abilities (Hantău, 1996). At relatively early ages (14-15 years), when work for improving the technique intensifies, training should be largely aimed at developing the general and specific motor skills, so that the judoka can acquire a correct technique of the technical procedures, Nage-Waza components and Ne-Waza components (Vodă & Pop, 2008).
In studies conducted in groups of junior judoka (U 18), it was found that the activity of subjects during personal attack phases was correlated with their abilities to differentiate movements and speed, as well as with the accuracy and precision of movements, while the reaction time was correlated with the level of sports achievement (Lech et al., 2011; Lech et al., 2014). Other studies demonstrated that higher performance in cadet tournaments (juniors under 18 years of age) significantly depends on the strength and resistance of the cadet/junior (Krstulović et al., 2005).

Individual aspects of coordination might affect the course of the entire attack, as well as phase I and II; consequently, coordination can determine the level of performance of the competitors. Despite the importance of motor coordination, this determining component of success in judo has been little investigated in studies related to judo. The aspects of coordination as a result of fatigue (Lima et al., 2004) and its relationship with other sports abilities (Hrysomallis, 2011) are studied even less. In the literature on judo, a number of publications present data referring to the levels of aerobic and anaerobic capacity (Little, 1991; Borkowski et al., 2001; Thomas et al., 1989), resistance (Iwai et al., 2008) and the constitutional biotype (body type) (Franchini et al., 2007) of judoka, as well as their importance in obtaining success.

Competition judo is a high-intensity sport, in which athletes unbalance each other permanently, while executing different techniques (Yoshitomi et al., 2006; Perrot et al., 1998; Perrin et al., 2002). These continuous and dynamic changes in balance are part of a dynamic system in which two judoka, beneficiaries of a rich technical and tactical repertoire, having abilities specific to the age and weight category, use this repertoire and always create attacks, defensive actions and counterattacks (Sertić et al., 2009; Sterkowicz et al., 1997; Sterkowicz & Maslej, 1998; Franchini et al., 2008; Sertić, 2004).

In judo, the two fighters come close to each other, execute the holds, move on the tatami, and attack. The approaches and kumi-kata (hold technique) allow specific behaviors between the two competitors. The duration and capacity of simultaneous actions, the multitude of interactions and the final result lead to a complex system, which is most frequently established by the coach and the competitor. A computerized record can help to evidence actions associated with success in this complex system (Calmet et al., 2010).

During a judo fight, the athletes aim to throw their opponent to the ground or to obtain control during the ground fight. For example, technical and tactical behaviors are essential for attacks and combinations of tasks in different situations, required for the application of the techniques (Franchini et al., 2008). To project an opponent, a judoka must get close to him/her. Consequently, the attacker adopts various interactive behaviors, adapted to his/her opponent (Castralenas & Planas, 1997).

The muscular effort during a fight is combined, both dynamic and static, but the dynamic effort prevails over the static one, being represented by explosive executions and moves (Little, 1991; Kubo et al., 2006; Heitkamp et al., 2002; Sertić et al., 2007). Judo as a sport is a specific model of physical activity with high demands on the psychosomatic state of the athletes. During training and competition, almost all psychosomatic systems of the judoka function in the submaximal and maximal exercise areas (Sertić et al., 2009; Parmigiani et al., 2006).

Psychosomatic medicine is an interdisciplinary medical field that explores the relationships between the social, psychological and behavioral factors of the body processes and quality of life in humans and animals or, in other words, the relationship between the body and the mind.

Physical exercise, particularly maximal and submaximal exercise, performed during training and competition, represents stress that acts on the athlete’s mind during training as well as in competition.

Learning to manage this stress during competition or training, when maximal and submaximal exercise is performed, is extremely important for athletes. Otherwise, they are prone to become victims of these functions, with the diminution of performance, which will be negatively influenced by mental, psychosomatic factors such as stress and anxiety (Yoshihara & Kubo, 2009). Judo is a complex sport, with requirements comprising a number of specific characteristics, needed to reach a high level in competition. Upper and lower body strength and resistance, speed, anaerobic power and trunk muscle function were evidenced as important factors in obtaining success during judo competition (Iwai et al., 2008; Franchini š.c., 2011; Muraru, 2008).

In a classification of sports performed by Gandelsman and Smirnov in 1970, assigning sports to 7 groups, which is still valid today, judo is part of the fourth group that includes all team sports and individual sports with direct opponents – contact sports (boxing, wrestling, judo, fencing). The necessary skills are an excellent functioning of senses and the ability to perceive and act under continuously changing competition conditions. The decisions made in a complex fight situation depend on the athlete’s ability to sense the external stimuli, which allow the athlete to interact with the opponent at different levels. The rapidity and precision of the interpretation can prevent the opponent from executing a successful tactical move or can bring success (Bompa, 2002).

Regarding the trunk muscle function, the improvement of the strength and resistance of these muscles would allow the judoka to increase their capacity to generate and maintain force during a fight. Furthermore, basic stability can contribute to judo performance, because it would facilitate the transmission of the forces generated by the lower limbs to the trunk (and vice versa) (Kibler et al., 2006) during judo techniques and would improve balance control (van Dieen et al., 2012), a key factor in counteracting the unbalances caused by the opponent (Yoshitomi et al., 2006; Perrot et al., 1998; Perrin et al., 2002).

The requirements in judo (neuromuscular and neuropsychic) are the following: kinesthesia (the ability to sense the movement of various parts of the body), native intelligence, dexterity, attention focusing capacity, reaction speed, explosive force (hitting the medicine ball with one hand, throwing the medicine ball from the chest, jump squats, “frog leaps”, lateral jumps over hurdles) (Toačă, 2002).
According to Ioan-Enne (1), competitive judo has the following characteristics: it is a confrontation of two personalities, with different skills, temperaments and fighting styles; the opponents change frequently, in a relatively short time; a direct dispute takes place, at a relatively small distance, in which the two opponents study their intentions and moves, trying to counter them using a wide range of technical and tactical means; rapid and unpredictable changes occur in the technical actions and in the tactical thinking of both opponents during a match or an action.

The factors of performance in judo according to Ioan-Enne (1), reflected in the current scientific and methodical literature, taken into consideration when drawing up the descriptive chart to establish the psychological profile of the judoka, and the selected mental qualities pertaining to these factors are shown in Table I.

<table>
<thead>
<tr>
<th>Motor ability</th>
<th>Mental ability</th>
<th>Somatic type</th>
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</thead>
<tbody>
<tr>
<td>43%</td>
<td>40%</td>
<td>15%</td>
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<tr>
<td>Mental qualities</td>
<td>- Intellectual factor</td>
<td></td>
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<tr>
<td></td>
<td>- attention</td>
<td></td>
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<tr>
<td>Dexterity</td>
<td>- creativity (operational thinking)</td>
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<td></td>
<td>- rapid decision (anticipation-intuition)</td>
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<tr>
<td></td>
<td>- memory</td>
<td></td>
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<td></td>
<td>- imagination</td>
<td></td>
</tr>
<tr>
<td>40%</td>
<td>45%</td>
<td>40%</td>
</tr>
<tr>
<td>Strength-Speed</td>
<td>- Volitional factor</td>
<td></td>
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<td></td>
<td>- courage (boldness)</td>
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<td></td>
<td>- determination (activism)</td>
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<td></td>
<td>- initiative</td>
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<td></td>
<td>- perseverance</td>
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<tr>
<td>Resistance</td>
<td>Mental qualities</td>
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<td></td>
<td>- Emotional factor</td>
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<td></td>
<td>- emotional stability</td>
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<td></td>
<td>- vigilance (responsibility)</td>
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<td></td>
<td>- commitment</td>
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<td>20%</td>
<td>25%</td>
<td>25%</td>
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</table>

The psychological profile of a successful judoka is a projection of the human psyche, a complex, difficult to verify process, which should however be included in the sphere of the perspective plan (Table I).

Studies in the field of motor behavior in judo

Research in judo dates back to the beginning of the past century, the trends in judo being expressed by J Kano’s slogan: Maximum efficiency with minimum effort (2).

Over the last 30 years, researchers in different countries have demonstrated that one of the most important factors for the development of technique and tactical excellence in judo as well as in other wrestling or team sports is coordination (Blume, 1978; Starosta, 2003). Coordination and its role in motor behavior were also studied by Czajkowski (2004), Hirtz & Starosta (1991), Starosta (2006). Some studies focused on the importance and role of strength and resistance in juniors (Krstulović et al., 2005), Lima et al. (2004) and Hrysomallis (2011) studied aspects of coordination under fatigue conditions.

Some other studies published abroad focused on aerobic and anaerobic exercise capacity (Little, 1991; Borkowski et al., 2001; Thomas et al., 1989), resistance (Iwai et al., 2008) and the constitutional biotype (body type) (Franchini et al., 2007).

Some authors took scientific interest in the procedures and their technique for improving balance control, a key factor in fighting the unbalances caused by the opponent: Perrot et al.,1998; Perrin et al., 2002; Yoshitomi et al., 2006.

In Romania, reference fundamental or applicative scientific studies related to sport in general, motor behavior and human performance, neuromuscular and neuropsychic aspects or judo were conducted by: Epuran, 2001; Bompa, 2002; Dragnea & Teodorescu, 2002; Epuran, 2005; Hillerin et al., 2015; Marin et al., 2015; Botezatu et al., 2015.

In our country, in the area of judo - motor behavior, research was carried out on the following subjects specific to judo, focusing on the following topics referring to the forms of training and functions specific to this sport: technical and methodical training (Hantău, 1996; Hantău & Bocioacă, 1998; Bocioacă, 2007; Vodă & Pop, 2008; Pop, 2010; Robolu, 2014b); technical training (Hantău & Bocioacă, 1998; Bordea, 2000; Pop, 2010; Frazzei, 2014); methodical training (Muraru, 1975; Stefañuț, 1983; Hantău, 2000; Pălărie, 2003; Chelaru, 2010; Răchiță, 2011; Robolu, 2014a; Robolu, 2014c); physical training, development of motor skills (Hantău & Bocioacă, 1998; Bocioacă, 2003; Pop & Pop, 2007; Giurgiuveanu, 2014; Robolu, 2014a) and improvement of balance function (Răchiță, 2011); psychological training (Rosu et al., 2006; Sava, 2014); biomechanics of procedures in judo (Răchiță, 2011; Pop, 2012); selection in judo (Steñañuț, 1983; Chelaru, 2010; Robolu, 2014b).

Analysis of motor behavior specific to judo

The components of human motor behavior are: movements (change of the body position in time and space), acts, actions, activities, movement, which are considered as an organization of behavior depending on certain purposes and are supported by motivation (Epuran, 2005, 266).

When analyzing behavior in high performance sport, the accuracy of a technical gesture or element, the problem of correctly training specific skills, as well as the possibility of improving their efficacy emerges (Epuran, 2005). Hence, the need for correct acquisition of the basic technique of technical procedures in judo in order to avoid subsequent time allocation during training to correct the technical errors.

Motricity and movement are basic terms in the theory of body activities (Table II).

The psychological profile of a successful judoka is a projection of the human psyche, a complex, difficult to verify process, which should however be included in the sphere of the perspective plan (Table I).

Studies in the field of motor behavior in judo

Classification of fundamental movements (Dauer et al., 1986; Gallahue, 1993; Siedentop et al., 1984, quoted by Epuran, 2005).
It is the teacher (coach) who monitors the achievement of motor acts, builds them and evaluates them based on a number of criteria (Epuran, 2005, 273).

According to some researchers, behaviors fit into two categories: adaptive behaviors, which are those observable and measurable reactions/responses learned during ontogenetic development that are useful to a person and help that person efficiently adapt to the environment; disadaptive behaviors, which are those observable and measurable reactions/responses learned during ontogenetic development that are detrimental to a person and prevent that person from efficiently adapting to the environment. A behavior is not adaptive or disadaptive per se; it becomes adaptive or disadaptive only in relation to a certain context (David, 2016).

Mental processes such as imagination, thinking and memory significantly contribute to the training and improvement of an athlete, forming and changing the behavior of the athlete (judoka in our case).

The behavior of a high performance athlete also varies depending on the personality of the coach and on the objectives set by him/her in the training plan. Stimuli also play an extremely important role in the behavioral-sporting manifestation and significantly influence the athlete’s behavior. The rules of sports are other factors that contribute to the behavioral development of athletes. Technique and tactics are elements that define the individual behavior of athletes. Stimuli (requests during training) are muscular, cardiorespiratory, neuroendocrine-metabolic, psychic, physical exercise with its parameters, motor (technical) actions, etc.

At the opposite pole are non-sporting, deviant behaviors, which also contribute to the behavioral portrait of a high performance athlete. The practiced sport influences both the athlete’s character and behavior. For example, athletes having practiced a team sport more easily integrate in the social environment, are more flexible and open to collaboration and successfully work in larger groups of people. There are individuals who have a harder, firmer behavior, in which a slightly excessive attitudinal rigor can be seen in relation to the rest of the surrounding persons, who did not practice high performance sport. This type of behavior is influenced by the rules and the particularity of individual sport, especially in those sports where there is direct contact with the opponent (e.g. judo) (Ciurea, 2017).

Motor behavior in judo is directly influenced by the program attended during training: inclusion of adequately dosed and individualized exercises for the development of strength in the extensor muscles of the knee joints, trunk flexors and rotators. As a result of using the selected specific and non-specific means, aimed at the acquisition of throwing over the hip procedures, good results were obtained regarding: the optimization of motor skills and abilities; the development of specific muscle groups, which shortly contributed to the correct acquisition of the procedures (Sava & Panatrescu, 2016).

An important role in the acquisition and development of skills by training is played by the coach or instructor starting from young ages, up to older ages. The way in which the intervention is performed during training by introducing the new techniques and procedures in order to acquire new skills is by focusing on the individual characteristics taking into account the existing knowledge in the field, which provides a new approach to training (DeMars & Pedro, 2013). Thus, a new training program is created, which is based on the current requirements and trends in the development of wrestling sports, and in this way, the degree of adaptability to physical and mental exercise, the level of personal safety and self-confidence increase (Pop & Pop, 2007).

The theoretical basis of behavioral change by the system of reinforcements and punishments represents the mechanism of operant conditioning, studied by some outstanding representatives of the behavioral school (Thomndike, Tolman, Guthrie, quoted by Dafinoiu, 1999). They discovered that if a certain behavior is consistently followed by reward, the behavior is more likely to reoccur.

The most accessible, easy to observe and identify personality traits are the temperamental ones. They refer to the energy level of action. Descriptive adjectives: energetic, explosive, resistant, expansive, rapid, slow, and their antonyms (Dafinoiu, 1999). Temperament refers to the energetic-dynamic dimension of personality and is expressed both by particularities of intellectual activity and affectivity and by external behavior (motricity and speech).

Cosmovici (1999) mentions attention as an orientation and concentration of mental and cognitive activity on an object or process, in agreement with Toacă (2002), which mentions the importance of attention, particularly its focusing capacity, among the requirements of judo. This mental process is strongly influenced by motivation, emotional states, being accompanied by well-known characteristics of posture and mimics.

In motor learning, memory has a determining role. Memory is the basis of both cognitive and motor learning. Motor learning is aimed at the acquisition of motor abilities and behaviors. It requires the control of energy sources and the specific use of analyzers. For the training of motor abilities, the acquisition of knowledge is not the purpose, but the means by which training is achieved, cognitive learning being a functional process for the motor solution, and not its objective (Schmidt 1982, Weineck 1982, quoted by Hanțiu, 1993).

The specific movements of sports or sport branches are part of their technique. Learning them, consequently learning the technique, obeys the rules of motor learning.

An extremely important principle that should be taken into consideration during training is the correct acquisition of the technical procedures of judo, which represents a fundamental task of the coach during the first stage of training, with major repercussions in the subsequent training stages. The technical procedures are special motor skills, by means of which the judoka performs judo specific actions with maximum efficiency (Dragnea et al., 2006).

Continuing the ideas above, we consider that paying greater attention to correct learning of the basic judo technique is required from the teachers-coaches who initiate athletes to the practice of judo, even if this involves delaying the participation of these categories of juniors in multiple competitions in order to win medals at any cost. New technical procedures (skills and abilities) should be trained, with emphasis on a correct basic technique and
then the formation of a personal style depending on the athlete’s biopsychomotor particularities, especially the temperamental predominance of each athlete. Technical errors should be avoided, because a lot of training is required subsequently for their correction.

Motor competences involve the fluency and control of the body muscle movements. This includes gross or basic motricity, exerted by the muscle groups (e.g.: “to start”, “to stop”, “to turn around”, “to climb”) and fine motricity (e.g.: “facial expressions”, “finger dexterity”, etc.). Motor competences are extremely important for the investigation of the environment and the acquisition of new knowledge (Miclea et al., 2010).

An emotionally balanced athlete contributes to the control of his/her own behavior in limit situations (high-level competitions, tense training sessions, disturbing administrative, financial, health-related factors, etc.). Emotional balance depends on emotional maturity, which in turns depends on the heredity of the person concerned and on the environment in which that person develops (the family in particular). Emotional balance also manifests by mobility/dynamics depending on the situation, therefore moderate mobility, while emotional imbalance appears as both too great mobility (fluctuation, transition from one mood to another without any reason) and too reduced mobility (emotional perseverance).

The result of an important competition can be decisively influenced by emotional moods generated by various factors, some of which can frequently be not attributed to the coach (transport/meal/accommodation conditions, tension in the relationship with the friends/family, etc.). Training can be affected by such causes, for which the coach should find solutions (identification-recognition-solution) through sincere, well-balanced communication with the entire group or only with those concerned. The coach has the task to keep informed about everything that is important in the life of the athletes with whom he/she works (family, school, hobbies, favorite movie characters, etc.) in order to act, adjusting his/her own behavior, using all his/her skills (authority and professional competence, personal charm, humor, etc.) when needed and then, to induce by contagion the optimal emotional state for training and competition.

**Biomedical particularities of judo depending on the training stimuli applied**

The factors of training in general, and in judo in particular, are the following: volume, intensity and complexity (density), which are the levers used in the regulation of the parameters of exercise, for the development of specific motor skills. We also mention that a complete training process is based on three main criteria: motor, biomedical and psychological. To obtain high performance, the coach together with the team of specialists must act on the mentioned levers, by methods and means specific to judo. Intense and high-intensity exercise, as previously mentioned, is stress for the athlete, for the judoka, respectively. The judoka must adapt to this inevitable high-intensity stress and cope with it by special and repeated training. For this, as part of training, increasingly intense motor, biomedical and psychological stimuli will be used, until stimuli close or identical to those of competitive activity, including stress factors, are obtained. It is known that judo is a sport of explosive force, of strength-speed, muscle resistance, combined with an apparently latent phase of unbalancing the opponent and avoiding to be unbalanced by the opponent.

According to some authors, sports can be classified into 9 categories, according to the type of physical exercise performed (Tache & Staicu, 2010). Judo fits in three of these categories (types), alongside other sports, in which the same type of effort occurs.

- Sports with special cardiac demand and apnea: swimming, athletics – sprint running, fencing, gymnastics, weightlifting, judo, wrestling, alpine skiing, tennis and table tennis, underwater sports, yachting (Talbot 1975, quoted by Epuran et al. 2001).
- Mixed-effort sports: games; boxing; tennis and table tennis; Greco-Roman and free wrestling; judo; handball; biathlon; motoring; badminton; horse riding; rowing; sports gymnastics; ice hockey; motorcycling; speed skating; rugby (Tache & Galea, 2003).
- Acyclic sports - jumps (long jump, high jump, triple jump, pole jump), motoring, badminton, hockey, judo, Greco-Roman and free wrestling, motorcycling, fencing, tennis (Tache & Galea, 2003).

Bompa (2002) mentions the same thing but focusing on judo, namely that in this sport, the following aerobic and anaerobic energy systems should be developed during a long training period:

- the dominant energy systems: the types of anaerobic alactacid exercise and aerobic lactacid exercise;
- the limiting factors: start power, power-resistance (P-R), reactive power, muscle resistance (M-R);
- the objectives of training: start power, reactive power, power-resistance (P-R), muscle resistance (M-R)

It can be seen that the objectives of training, according to Bompa (2002), are precisely the training or development of the limiting factors of exercise.

Due to the fact that according to the rules, judo competitions take place by age and weight categories (Table III), the indicators related to the height-weight ratio, i.e. the body mass index (BMI) and body composition, are extremely important. Determining weight and BMI allows to assign a subject to a certain weight category. However, based on this measurement, no information about the amount of adipose tissue is obtained. BMI can be increased in the absence of excessive fat tissue in relation to the age and height of the subject.

In athletes, the values of indicators should be interpreted based on the requirements of the different sports. Thus, in strength sports, the indicators will be much higher compared to sports games or other sports. In judo, like in other sports related to weight categories, forced weight loss in juniors is forbidden (until the end of growth and development processes); they will periodically change the weight category, because forced weight loss by only 2% of the body weight reduces muscle efficiency by 20%. Optimal weight will be regulated based on the nutritional state (Cordun, 2009).

In athletes, the body composition differs depending on the constitutional biotype (characteristic of different sports
Judo competitions take place by age and weight categories. For each age category, there are at least 8 weight categories. Nevertheless, very many athletes reduce their body weight in several days, before competition, in order to obtain a competitive advantage over their lighter opponents. To obtain a rapid weight loss, athletes use a number of aggressive nutritive strategies, so that many of them place themselves at a high health risk. Rapid weight loss has proven to affect health negatively. In short, it can lead to acute cardiovascular dysfunction, a decrease in bone density, affecting thermoregulation, cognitive function, it can induce hormonal imbalance, growth deficiency, etc. In 1997, three judoka died as a result of using such rapid weight loss diets. Following these deaths, the International Judo Federation implemented a weight management program, which was effective in improving this harmful behavior (Artioli, 2010).

### Conflicts of interests

No conflicts of interests.

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### References


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Websites