

# Stress in sport situations experienced by people who practice karate

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- B** Data Collection
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## Abstract

### Background and Study Aim:

Sport situations can be difficult. Stress can be a factor which decreases the quality of sports performance, especially during competition. The aim of this study was to identify situations which generate the highest stress levels in karate contestants.

### Material/Methods:

Polish National Kyokushin team members (n=22) participated in the study. Questions concerning training and competitions were answered on a 10 – point scale. Cronbach alfa for questionnaire items were 0.84–0.97. Stress demand level was determined by sports motivation questionnaire. Mean values of males and females were compared by non-parametric tests ( $p \leq 0.05$ ).

### Results:

Competitions generated higher stress than training. Importance of competition and presence of audience increased stress intensity. Quality of fighting activities modified stress intensity. Stress intensity at the end of karate match remained lower in men than women. Stress during the first selection match and semi-final fight exceeded athletes' general demand for stress. Stress intensity was lower than the demand for stress during tactical and technical training, free of audience. The dissonance between stress intensity and demand for stress in women in final fights, against stronger opponent, exposed them to psychological discomfort.

### Conclusions:

Psychological and tactical preparations correlate. This manifests by development and realization of a fight plan and reaction to unexpected situation. Differences in reactions between men and women in stressful situations suggest the need for individual approach to training process and at each stage of competition.

### Key words:

competition • psychological preparation • stress modelling • strategy • algorithm • heuristics

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## BACKGROUND

Sport situation [1–3] is defined as a configuration of relationships between an athlete at a particular moment and the components of their specific environment (sport environment), with the athlete being a distinguished central component of this environment. This approach suggests the transactional character of athlete's behaviour. It seems legitimate for the purposes of the present study to view karate through a classification of combat sport which encompasses the three groups of disciplines

[4]: (a) using weapon (fencing, kendo); (b) using striking (karate, taekwondo, boxing), (c) using throws and grappling techniques (judo, sambo, wrestling). Such disciplines as ju-jitsu or hapkido martial art should be regarded as a mixed category. Mitchell's classification of sports [5] shows karate according to its static component. Karate has much higher power (maximal voluntary contraction) than in rhythmic gymnastics. In *Kyokushin* karate, developed by Masutatsu Oyama [6], fighting is broken up into the categories of men and women and weight categories. There are also competitions in open

**Competition** – A contest in which a winner is selected from among two or more participants. In sport, competition is socially regulated and is generally direct [40]. Fear of losing invites the greatest loss, but the loss of courage is tantamount to the loss of the self. Courage is actually greatly stimulated by the presence of a powerful rival [6].

**Psychological preparation** – mental preparation in which competitors learn how to deal with psychological stresses and achieve optimal of arousal so that they will be able to perform to the best of their ability.

**Psychological fitness** – mental fitness; such as the fitness of an athlete to cope with the stresses of competition [40].

**Stress modelling** – The inclusion in a training programme of stressors which an athlete is likely to encounter just before or during competition, so that the athlete can cope more easily with the stressors [40].

category. During tournaments at high sport level, a criterion of breaking standard boards with knife-hand, foot, fist or elbow is also used. In the case of a tie during a fight between the contestants with similar body mass, the result of this test determines the victory. The importance of the indexes of the course of fight which provide information about the level of technical and tactical preparation and sport achievements for a group of elite *Kyokushin* karate contestants have been widely discussed in the literature [7–9]. In combat sports such as karate or judo, assuming similar level of opponents in other aspects of training preparation, psychological preparation might determine the success during competitions [9–11]. The concept of stress, introduced to psychology by H. Selye, has been still waiting for a generally accepted definition [12]. Practitioners usually characterize stress reaction as a psychological mobilization of an organism in order to rise to a significant challenge. Lupien et al. [13] argue that:

*‘...In popular terms, stress is mainly defined as time pressure. We feel stressed when we do not have the time to perform the task we want to perform within a given period of time. This time pressure usually triggers a set of physiological reactions that give us the indication that we are stressed.... Stress is not equivalent to time pressure’....However we all know people that seek time pressure in order to perform adequately and others that are extremely stressed by time pressure...’* [13].

This is associated with the concept of temperament-related demand for stimulation [14].

Several authors have dealt with the problems of stress in sport activity [15–18]. Salvador [19] presented a review of the results of investigations in combat sports, with particular focus on higher testosterone levels in wrestlers after fights they won compared to lost fights [20]. Similar observations were reported during the study carried out among the members of Spain national judo team [21]. This problem is more complex if the factor of the level of tournament and gender is considered. Experts in this field agree that stress might modify emotional state or mental and physical fitness, which impacts on reduction in quality of optimal movements in a particular sport situation. Almost all fencers are frequently disturbed by so-called „acute stressors” during the long-winding, lonely, hard, and boring training procedures and even during an important competition. Acute stressors include the rebukes of the coach, the mistakes of their own; the trick/cheats of the opponent, the referee’s unfair decision [22]. ‘Choking is defined as performing more poorly than expected given one’s skill level and is thought to occur across many diverse task domains where incentives for optimal performance are at a maximum’ [23]. According to Hill et al. [24]:

*‘Choking in sport is a process whereby the individual perceives that their resources are insufficient to meet the demands of the situation, and concludes with a significant drop in performance ... a choke’.*

Similarly to stressful encounters such as public performances and academic and medical examinations [25], investigations in combat sports concerned the aspects of stress and coping before, during and after tournaments [13,21,26–29]. They are essentially important because recognition of strength and weaknesses in opponents is the basis for planning sport activities and the first step in algorithm of effective fight [8,30]. Proper evaluation of the chances helps prepare tactics of the fight. During tournaments, reactions which are used to relieve tension are observed under conditions of not following the assumed algorithm, when heuristics must be used. Emotional agitation and experiencing stress changes the effectiveness of intellectual processes and may be the cause of psychical and physical problems [13]. It happens under condition of stress connected with sport situations that competitors get angry, express their emotions verbally and using body language [29]. Matsumoto & Willingham [31] analysed facial expressions in winners and losers directly after the announcement of the verdict by the referee. Undoubtedly, this reflects experiencing stress and emotion-oriented coping strategy. Choice of a coping strategy depends on interpretation of a difficult situation, which is specific for a particular sport. Strategy can be task-oriented or emotion-oriented. The competitions may also adopt avoidance-oriented strategies [25,32,33].

The goal of the present study is to identify: (1) situations which generate the highest stress levels in karate contestants, with consideration of both genders; (2) events which occur during fight and stress level in contestants; (3) possible relationships between stress level and increasing level of difficulty of tournaments and opponents; (4) stress intensity in sport situations with consideration of the level of demand for stress among those who practice karate.

## MATERIAL AND METHODS

### Subjects

The study was carried out among the male members M (n=15; age: 16 to 32 years; training experience: from 4 to 20 years; number of training sessions: 3 to 10 sessions a week) and female members W (n=7; age: 15 to 35 years; training experience: 7 to 19 years, number of training sessions: from 2 to 14 sessions per week) of Poland national *Kyokushin* team during a training camp in competitive season Olympic Training Center in Zakopane, Poland. The subjects exhibited high sport level. They included medal winners in international tournaments (n=6) and national

championships (n=15). One man and one woman did not supply this information. All the subjects and their coaches gave their consent for participation in the study. The respondents were ensured the anonymity of their responses to the questions concerning stress intensity in sport situations.

### Tools

A retrospective approach to the problem was employed. The authors' own questionnaire was used, termed Stress Inventory (please see an Appendix 1). The questionnaire contains the questions connected with training and karate competitions. The questions were answered using a numerical forced-choice scale of 0 ('I don't feel stressed') to 10 ('I am under very high stress'). The questions concerned: (a) situations during training (11 questions); (b) situations before and after competitions (12 questions); (c) situations during competitions and fighting, with consideration of the level of difficulty of opponents and events which affect the course of fights and the results (41). The structure of the questions allowed for identification of the dynamics of changes in stress level in individual stages of competitions, difficulty of a tournament (e.g. conditions of fighting in your own club or in front of a great number of spectators), difficulties with fights and opponents (e.g. from selection matches for finals). This version of the questionnaire obtained satisfactory psychometric parameters. Cronbach's alpha for items of the questionnaire were 0.92 (part a), 0.84 (part b) and 0.97 (part c), that is enough high for internal consistency of the scales.

The subjects were likely to include the people that seek time pressure in order to perform adequately and others that are extremely stressed by time pressure. Therefore, additional questions were added in the study: three questions from the Motivation Questionnaire [34]. According to the procedure, the subjects also answered using numerical forced-choice evaluation scales of 0 (the least important) to 10 (very important motivation for sport) (max. 30 points). For the purposes of the present study, the answers obtained with numerical scale of the Motivation Questionnaire were divided by three, thus obtaining the evaluation of the importance of stress comparable to the scale used in the Stress Inventory (these 3 questions were involved in part b).

### Statistics

Independent variables were groups selected according to gender (M, W). The answers to the question were dependent variables. The Statgraphics Centurion v. XVI.I software was used in order to verify the normality of distributions for the whole set of results using Shapiro-Wilk test (in Total, n=22). According to the assumptions concerning the normality of distribution in the case of the

answers in the Stress Inventory, the medians (Me) and min-max values were calculated. Median values were compared by means of Kruskal-Wallis test (W) and Friedman test. The level of statistical significance was set at  $p \leq 0.05$ .

## RESULTS

Table 1 presents the mean, maximal and minimal values of the answers to the questions contained in Stress Inventory given by all the respondents, divided into groups of men and women.

### Situations which generate the highest stress in karate practitioners

Comparison of the results in Table 1 shows that situations during training were less stressful (Me from 0 to 2.5 points) compared to sport competitions (0.5 to 6 points). The most stressful situation during competitions (Me=6) was the first selection match and fighting with stronger opponents. The stress was also intensified with several-hour period of waiting for competitions (Me=5), situation of losing all the fights (5.5), second selection match (5), disqualification (5), highly competitive tournaments (5), first seconds of fight (4.5 points) and national-level championships (4.5 points), expected interviews with journalists (4.5 points). Other stressful factors (Me=4 points) included: thinking about consequences of lost fight, fighting with similar-level opponent, macro-regional competitions, competitions with great number of fans, final match, semi-final match and injury during competitions. The lowest level of stress (3–3.5 points) was generated during: the process of body mass control before competitions, thinking about lost competitions and competitions in other clubs, thinking about consequences during lost fights, in final instants of fights, during passive fight, during active fight with the advantage in attack, point difference, mistakes made when having advantage of points, thinking about consequences during evenly matched fights, inaccurate and ill-considered attack or another inaccurate and ill-considered attack.

### Level of competition and participation of spectators

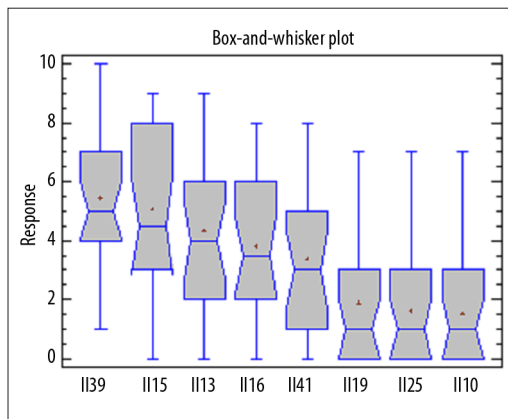
Generation of stress was favoured by highly competitive tournaments (Me=5), national-level championships (Me=4.5 points), macro-regional competitions and competitions with great number of supporters (4 points each), competitions in other clubs (3.5 points), fighting in front of the opponent's supporters (3.0), training with participation of spectators (2.5), little competitive tournaments (1.0), fighting in front of small number of spectators (1.0), fighting in front of a small number of supporters (1.0), training without audience (0 points).

**Strategy** – The art of planning a campaign. It has been adopted in sport to describe the overall game plan of coaches and managers; Tactics is detailed directions and instructions which control movements or manoeuvres designed to achieve an aim [40].

### Algorithm of effective fight

– The tactical steps are: (a) making the reconnaissance of stronger and weaker points of the opponent; (b) concealing one's real intention (c) cutting down to the minimum the opponent's activity in attack and eliminating his possibilities in defence (d) conducting real attack techniques that give scores (e) keeping predominance, repeating effective actions and finishing the fight [8,30].

**Heuristics** – A method solving problems which cannot be solved in a finite number of steps. The method involves progressively limiting the field of search by inductive reasoning from past experience. In teaching students are allowed to learn things for themselves [40]. In practice during fight 'trial and error' method is used.



**Figure 1.** Mean stress level in male and female competitors from National Kyokushin Karate Team during different competitions. Box-and-whisker plot (points) shows quartiles 25 and 75 and covers 50% of observations. Central line corresponds to the median. Plus sign (+) localizes the mean. Competitions 39 – highly competitive; 15 – national level; 13 – with high number of supporters; 16 – in other club; 41 – in front of the opponent’s supporters; 19 – little competitive; 25 – with small number of spectators; 10 – with small number of supporters/spectators.

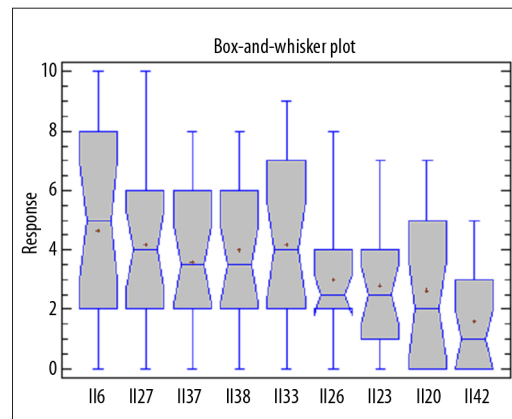
Participation in competitions generated stress with different intensity (Kruskal-Wallis test =54.96,  $p<0.001$ ).

Based on comparison of medians for stress intensity, the three uniform groups of competitions were found (Figure 1): (I) Highly competitive tournaments, national-level competitions, competitions with great number of spectators; (II) competitions with great number of supporters, in other club, in the presence of opponent’s supporters; (III) little-competitive tournaments, with low number of spectators and supporters.

**Events which affect the course of fight and stress intensity**

There are situations which affect the course of fight and the point scores. The strongest stressors included disqualification (Me=5 points) and injuries (4 points). Less effect was found for inaccurate and ill-considered attack and its renewal (3.5 points), mistakes made when the opponent had point advantage (2.5 points), penalty scored during fight (2.5 points), action which contributes to losing advantage (2 points), making technical mistakes (2 points), performing successful techniques (2 points), successful attack which gives advantage (1 point). Significant differences were found in stress reaction to the events which occur during fight (Kruskal-Wallis test =20.68,  $p<0.01$ ), presented in Figure 2.

Stress intensity caused by disqualification was significantly higher compared to the mistake made when opponent



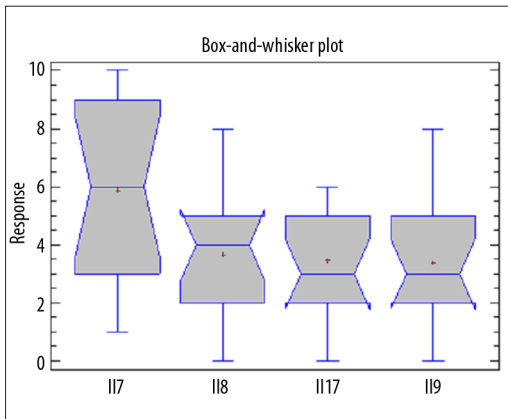
**Figure 2.** Mean stress level in male and female competitors from National Kyokushin Karate Team for different events during fight. Box-and-whisker plot (points) shows quartiles 25 and 75 and covers 50% of observations. Central line corresponds to the median. Plus sign (+) localizes the mean. Competitions: 6 – disqualification; 21 – injury; 37 – inaccurate, ill-considered attack; 38 – another inaccurate, ill-considered attack; 33 – action which causes loss of advantage; 26 – mistake made when the opponent has advantage; 23 – scoring penalty during fight; 20 – performing successful technique; 42 – successful attack which gives advantage

had advantage in points, scoring penalty during fight, performing successful techniques or successful attacks which give advantage. Inaccurate, ill-considered attacks resulted in considerably higher stress compared to successful attacks which gave advantage over the opponent. The actions which cause the loss in advantage were more stressful than performing successful techniques and effective attack.

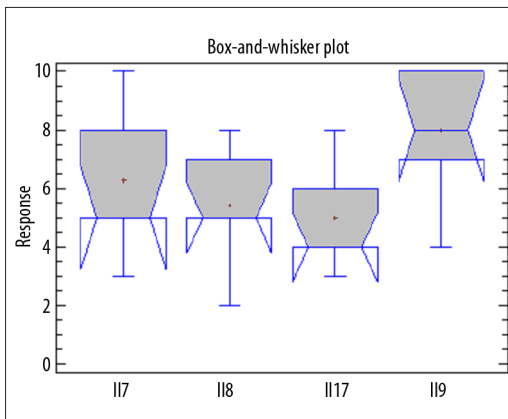
**Stress dynamics at individual stages of competition**

With regard to stages in competitions, it was found that the most stressful fights in general are the first (Me=6 points) and the second (Me=5 points) selection match. Semi-final and final matches exhibit lower stress level (Me=4 points). A significant difference in stress level during final match in men compared to women (M=3points vs. W=8 points, Kruskal-Wallis test=10.4,  $p<0.01$ , see Table 1) caused that this process should be analysed individually for groups M and W (Figures 3–5).

Significant differences were also demonstrated in the group M for the level of stress during fight (Friedman Test statistic =12.67; P-Value =0.005411). The most stressful situation was the first selection match (Me=6), whereas the second selection match, semi-finals and finals were less stressful (Me≤4 points). The group W showed the differences between medians which were close to statistical significance (Test statistic =7.313 P-Value =0.06258). The strongest stress was found for final matches.



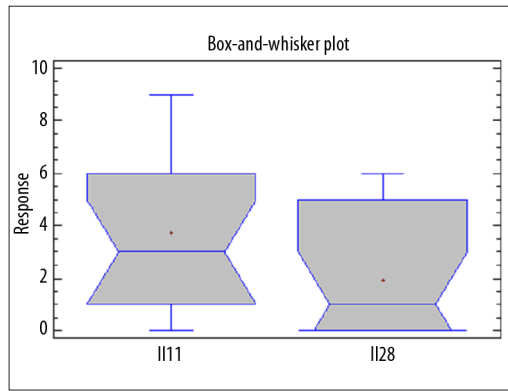
**Figure 3.** Mean stress level in male (M) competitors from National Kyokushin Karate Team for different stages of competitions. Box-and-whisker plot (points) in group M shows quartiles 25 and 75 and covers 50% of observations. Central line corresponds to the median. Plus sign (+) localizes the mean. Competitions: 7 – the first selection match; 8 – the second selection match; 17 – semi-final fight; 9 – final fight.



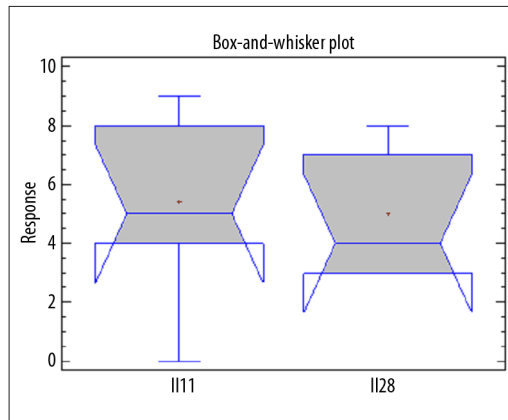
**Figure 4.** Mean stress level in female (W) competitors from National Kyokushin Karate Team for different stages of competitions. Box-and-whisker plot (points) in group W shows quartiles 25 and 75 and covers 50% of observations. Central line corresponds to the median. Plus sign (+) localizes the mean. Competitions: 7 – the first selection match; 8 – the second selection match; 17 – semi-final fight; 9 – final fight.

Stress generated in the beginning of the fight was higher in women, whereas the fight in final seconds caused lower stress in men ( $Me=1$ ) compared to women ( $Me=4$ ) (Kruskal-Wallis test =6.1,  $p<0.05$ ; see Table 1).

The next figure (Figure 5) presents significant differences in stress in the first and final seconds of fight in men (Friedman Test statistic =3.85,  $p=0.04986$ ). Median in final seconds of the fight had a statistically significantly higher value than in the beginning of the fight.



**Figure 5.** Mean stress level in male (M) competitors from National Kyokushin Karate Team in the beginning and at the end of the match. Box-and-whisker plot (points) in group M shows quartiles 25 and 75 and covers 50% of observations. Central line corresponds to the median. Plus sign (+) localizes the mean. Competitions: 11 – first seconds of the fight; 28 – last seconds of the match.



**Figure 6.** Mean stress level in female (W) competitors from National Kyokushin Karate Team in the beginning and at the end of the match. Box-and-whisker plot (points) in group W shows quartiles 25 and 75 and covers 50% of observations. Central line corresponds to the median. Plus sign (+) localizes the mean. Competitions: 11 – first seconds of the fight; 28 – last seconds of the match.

Figure 6 presents changes in stress intensity in group W, which, although not statistically significant (Test statistic =2.833; P-Value =0.09232), confirmed the tendency observed in group M.

**Stress intensity in sport situations vs. demand for stress in karate practitioners**

Individual assessment of stressors in the whole group ( $n=22$ ) ranged from 0 to 10 points,  $\bar{x}\pm 2.83$  points and met the criterion of normal distribution (Shapiro-Wilks test  $p=0.209$ ). Median for stress causes in the whole group amounted to 4 points. Medians for the demand for stress in men ( $n=15$ ) and women ( $n=7$ ) did



**Table 1.** Stress intensity for a group of men (M) and women (W) who practice karate (median and min-max).

Items	Total (n=22)			M (n=15)			W (n=7)			Kruskal-Wallis test
	Me	Min	Max	Me	Min	Max	Me	Min	Max	
Training 1	1.0	0.0	4.0	1.0	0.0	4.0	1.0	0.0	2.0	NS
Training 2	1.0	0.0	5.0	1.0	0.0	5.0	1.0	0.0	2.0	NS
Training 3	1.0	0.0	5.0	1.0	0.0	5.0	1.0	0.0	5.0	NS
Training 4	2.0	0.0	7.0	2.0	0.0	4.0	2.0	0.0	7.0	NS
Training 5	1.0	0.0	7.0	1.0	0.0	5.0	1.0	0.0	2.0	NS
Training 6	2.5	0.0	10.0	2.0	0.0	5.0	3.0	0.0	10.0	NS
Training 7	2.0	0.0	8.0	2.0	0.0	8.0	2.0	0.0	4.0	NS
Training 8	1.0	0.0	8.0	0	0.0	8.0	1.0	0.0	2.0	NS
Training 9	2.0	0.0	6.0	2.0	0.0	6.0	2.0	0.0	5.0	NS
Training 10	2.5	0.0	8.0	2.0	0.0	8.0	3.0	0.0	8.0	NS
Training 11	0.0	0.0	6.0	0.0	0.0	6.0	0.0	0.0	4.0	NS
I1	2.0	0.0	5.0	2.0	0.0	5.0	0.0	0.0	5.0	NS
I2	0.5	0.0	5.0	0.0	0.0	5.0	1.0	0.0	5.0	NS
I3	0.5	0.0	5.0	0.0	0.0	3.0	1.0	0.0	5.0	NS
I4	5.0	0.0	10.0	5.0	3.0	7.0	5.0	0.0	10.0	NS
I5	3.0	0.0	10.0	3.0	0.0	8.0	3.0	0.0	10.0	NS
I6	3.0	0.0	9.0	3.0	0.0	8.0	1.0	0.0	9.0	NS
I7	2.0	0.0	9.0	2.0	0.0	8.0	1.0	0.0	9.0	NS
I8	3.0	0.0	10.0	3.0	0.0	10.0	3.0	1.0	9.0	NS
I9	4.0	0.0	10.0	4.0	0.0	6.0	5.0	0.0	10.0	NS
I10	2.0	0.0	9.0	2.0	0.0	8.0	1.0	0.0	9.0	NS
I11	3.0	0.0	8.0	3.0	0.0	7.0	3.0	0.0	8.0	NS
I13	4.0	0.0	9.0	4.0	0.0	9.0	3.0	2.0	9.0	NS
I14	6.0	0.0	10.0	6.0	0.0	10.0	7.0	0.0	10.0	NS
I15	4.5	0.0	9.0	4.0	0.0	9.0	8.0	3.0	9.0	NS
I16	2.0	0.0	10.0	2.0	0.0	10.0	3.0	0.0	7.0	NS
II1	2.0	0.0	9.0	2.0	0.0	9.0	1.0	0.0	5.0	NS
II2	4.0	1.0	8.0	4.0	1.0	8.0	5.0	3.0	8.0	NS
II3	4.0	0.0	9.0	4.0	0.0	7.0	4.0	0.0	9.0	NS
II4	3.5	0.0	10.0	3.0	0.0	10.0	5.0	0.0	10.0	NS
II5	4.0	0.0	9.0	4.0	0.0	8.0	4.0	0.0	9.0	NS
II6	5.0	0.0	10.0	5.0	0.0	10.0	5.0	0.0	9.0	NS
II7	6.0	1.0	10.0	6.0	1.0	10.0	5.0	3.0	10.0	NS
II8	5.0	0.0	8.0	4.0	0.0	8.0	5.0	2.0	8.0	NS
II9	4.0	0.0	10.0	3.0	0.0	8.0	8.0	4.0	10.0	10.4, p<0.01
II10	1.0	0.0	7.0	1.0	0.0	4.0	0.0	0.0	7.0	NS

**Table 1 continued.** Stress intensity for a group of men (M) and women (W) who practice karate (median and min-max).

Items	Total (n=22)			M (n=15)			W (n=7)			Kruskal-Wallis test
	Me	Min	Max	Me	Min	Max	Me	Min	Max	
II11	4.5	0.0	9.0	3.0	0.0	9.0	5.0	0.0	9.0	NS
II12	5.5	0.0	10.0	6.0	0.0	8.0	5.0	0.0	10.0	NS
II13	4.0	0.0	9.0	4.0	0.0	9.0	3.0	2.0	9.0	NS
II15	4.5	0.0	9.0	4.0	0.0	9.0	8.0	3.0	9.0	NS
II16	3.5	0.0	8.0	3.0	0.0	8.0	5.0	3.0	8.0	NS
II17	4.0	0.0	8.0	3.0	0.0	6.0	4.0	3.0	8.0	NS
II18	6.0	1.0	10.0	6.0	1.0	10.0	9.0	3.0	10.0	NS
II19	1.0	0.0	7.0	1.0	0.0	5.0	1.0	0.0	7.0	NS
II 20	2.0	0.0	7.0	2.0	0.0	6.0	1.0	0.0	7.0	NS
II21	4.0	0.0	10.0	3.0	0.0	10.0	4.0	2.0	9.0	NS
II22	1.5	0.0	8.0	1.0	0.0	7.0	2.0	0.0	8.0	NS
II23	2.5	0.0	7.0	2.0	0.0	7.0	3.0	0.0	7.0	NS
II24	3.5	0.0	9.0	3.0	0.0	8.0	4.0	0.0	9.0	NS
II25	1.0	0.0	7.0	2.0	0.0	5.0	0.0	0.0	7.0	NS
II26	2.5	0.0	8.0	2.0	0.0	6.0	3.0	2.0	8.0	NS
II27	1.0	0.0	7.0	1.0	0.0	7.0	1.0	0.0	7.0	NS
II28	3.0	0.0	8.0	1.0	0.0	6.0	4.0	3.0	8.0	6.1. p<0.05
II29	3.0	0.0	9.0	3.0	0.0	6.0	3.0	1.0	9.0	NS
II30	3.0	0.0	9.0	3.0	0.0	6.0	3.0	1.0	9.0	NS
II31	1.0	0.0	6.0	1.0	0.0	5.0	1.0	0.0	6.0	NS
II32	0.0	0.0	6.0	0.0	0.0	5.0	0.0	0.0	6.0	NS
II33	2.0	0.0	7.0	2.0	0.0	5.0	3.0	1.0	7.0	NS
II34	3.5	0.0	9.0	3.0	0.0	8.0	5.0	1.0	9.0	NS
II35	3.0	0.0	9.0	3.0	0.0	8.0	3.0	0.0	9.0	NS
II36	3.5	0.0	8.0	3.0	0.0	7.0	5.0	0.0	8.0	NS
II37	3.5	0.0	8.0	4.0	0.0	7.0	3.0	1.0	8.0	NS
II38	3.5	0.0	8.0	3.0	0.0	8.0	5.0	1.0	8.0	NS
II39	5.0	1.0	10.0	5.0	1.0	8.0	6.0	4.0	10.0	3.82. p=0.05
II40	2.0	0.0	6.0	2.0	0.0	6.0	2.0	0.0	6.0	NS
II41	3.0	0.0	8.0	3.0	0.0	6.0	4.0	2.0	8.0	NS
II42	1.0	0.0	5.0	1.0	0.0	4.0	1.0	0.0	5.0	NS

not differ statistically ( $W=57.5$   $p=0.749$ ,  $Me_{men}=3$  vs.  $Me_{women}=4$  points).

In general, among eleven situations considered in the training, stress intensity in nine of them were significantly lower than the demand for experiencing stress in karate

practitioners ( $p<0.05$ ). Only endurance training ( $W=171.5$ ,  $p=0.098$ ) and training with participation of spectators ( $W=182$ ,  $p=0.159$ ) met the stress intensity expectations of respondents in terms of demand for stress. 54 situations were analysed under conditions of competitions. The need for experiencing stress was satisfied in the majority of situations

connected with participation in tournaments ( $n=42$ , 77.8%). Stress which was significantly lower than its demand was found in 10 situations (18.5%): during tournaments in respondents' own club ( $W=127$ ,  $p<0.01$ ), competitions with small number of supporters ( $W=101$ ,  $p<0.001$ ), little-competitive tournaments ( $W=141.5$ ,  $p<0.01$ ), with small number of spectators ( $105.5$ ,  $p<0.01$ ), fighting with similar-level opponents ( $W=87$ ,  $p<0.001$ ), with weaker opponent ( $130.0$ ,  $p<0.01$ ), active fight with advantage in attack ( $W=157$ ,  $p<0.05$ ), successful attack which gives advantage ( $W=108.5$ ,  $p<0.01$ ), performing effective techniques ( $92.0$ ,  $p<0.001$ ), thinking about consequences when winning the fight ( $W=147$ ,  $p<0.05$ ), breaks and discussions about the fight with coaches ( $W=141.5$ ,  $p<0.05$ ). Stress exceeded the expectations in these terms only in two situations (3.7%) as statistically significant differences observed between medians for stress intensity and demand for stress were found in the first selection match ( $Me=6>Me=4$ ,  $W=332.5$ ,  $p<0.05$ ) and semi-finals ( $Me=6>Me=4$ ,  $W=340.0$ ,  $p<0.05$ ).

During karate training, stress intensity in men and women corresponded to the need for experiencing stress in the following situations: training of parts of fight ( $W=71$ ,  $p=0.086$  vs.  $W=17.5$ ,  $p=0.401$ ), endurance training ( $W=73.5$ ,  $p=0.107$  vs.  $W=19.5$ ,  $p=0.561$ ), speed training using karate techniques ( $W=75.5$ ,  $p=0.125$  vs.  $W=9.5$ ,  $p=0.06$ ), training in front of spectators ( $W=87.5$ ,  $p=0.310$  vs.  $W=17.5$ ,  $p=0.403$ ). Moreover, specific pressure was observed in men when they made technical mistakes, ( $W=74$ ,  $p=0.111$ ) and in women during special strength training using special equipment and devices ( $W=13$ ,  $p=0.155$ ) and training in general ( $W=11$ ,  $p=0.093$ ). In both groups stress assessment was essentially lower than the demand for stress in situations of technical and tactical training and without participation of the spectators ( $p<0.05$ ).

Fifty four situations were considered under competitive conditions. According to men, demand for stress connected with practicing karate was satisfied in 41 situations (76.6%) (test  $W$ ,  $p>0.05$ ). Stress lower than the level of demand in this area was caused by the following situations ( $n=11$ , 20.4%): competitions with low number of supporters ( $W=55$ ,  $p<0.05$ ), little competitive tournaments ( $W=64$ ,  $p<0.05$ ), fighting in front of small number of spectators ( $W=57.5$ ,  $p<0.05$ ), fighting with weaker opponent ( $W=57.5$ ,  $p<0.05$ ), final seconds of the fight ( $W=61$ ,  $p<0.05$ ), performing the successful attack which gives advantage ( $W=55$ ,  $p<0.05$ ), performing successful techniques ( $W=42$ ,  $p<0.05$ ), successful attack which gives advantage in fight ( $W=56.5$ ,  $p<0.05$ ) and break and discussion of the fight by the coach ( $W=62.5$ ,  $p<0.05$ ). Significantly lower stress intensity (compared to the demand for stress) was found in both men and women as a result of thinking after competitions they won ( $W=39$ ,  $p<0.01$  vs.  $W=7.5$ ,  $P<0.05$ ) and thinking about

the consequences of competitions they won ( $W=43$ ,  $p<0.05$  vs.  $W=7.5$ ,  $P<0.05$ ). Moreover, the results of test in  $W$  group demonstrated that the warm-up before competitions in the group of women was characterized by lower stress level compared to the demand ( $W=7.0$ ,  $p<0.05$ ). In women, stress was lower than the demand for stress only in three situations (5.6%). A particularly difficult situation, with stress assessment substantially exceeding its demand was found in female karateists twice (3.7%): during final matches ( $W=44.5$ ,  $p<0.05$ ) and fighting with stronger opponents ( $W=41$ ,  $p<0.05$ ).

## DISCUSSION

Sport situations the competitors face generates tension connected with participation in training process and competitions. Sport competitions require that elite athletes must exhibit high level of technical, tactical, fitness and psychological preparation [33]. In order to meet such a comprehensive demands, it is necessary to implement adequate training schemes. We found that the majority of situations which can be used for developing and maintaining the level of technical, tactical or fitness preparation do not suffice to meet the psychological conditions of competitions. This concerns the situations which generate stress. If we adopt the well-known maxim which says 'You compete like you train', we can argue that training practice provides in general good preparation for participation in competitions. However, some competitors may find it difficult to face new difficult situations, which may make them develop choking condition which negatively affects the quality of task performance. The people who participated in the present study had many-year training experience, which corresponds to a great deal of experience connected with participation in competitions and development of individual coping strategies used during competitions [35]. As emphasized by Lupien et al. [13], there are the people who perform better at higher stress intensity. The demand for stress in these people may be better satisfied through taking risky actions and experimenting by means of trial-and-error methods (heuristics), which are not necessarily effective in judges' opinion. Sport competitions are conducive to generating stress in contact fight of karate. The karate fighting is characterized by powerful strikes with upper and lower extremities in sensitive areas of the body. The timing and method of attack is essential. Preparation of the plan of tactical actions according to five-step algorithm of effective fight [8, 30] might help competitors recognize strengths and weaknesses of the opponents and choose a moment convenient for attack, which obviously does not exclude the effectiveness of heuristic approach. It is fight when the biggest stress occurs, which can be additionally magnified by the level of competitions, participation of spectators



and unpredictable events in the course of fight. We realize that the athletes included in our study are the elite competitors with long training experience, which is conducive to development of individual competencies of coping with stress. In other study, the authors concluded that, independently of gender and whether combat sports are practiced at a competitive level, a typical personality disposition aimed at alleviating stress is task-oriented strategy. Emotion-oriented strategy is a women's domain, particularly in those who practice combat sports at a competitive level. Comparing to untrained subjects, people who practice combat sports at a competitive level (both male and female) reveal tendencies to use avoidance and distraction strategies to a lesser extent [35]. Moreover, these subjects might have exhibited the intensified demand for stress, which they wanted to satisfy through participation in fight during competition. Different factors can be modifiers of reaction to stress. They include gender, temperament and other characteristics. The effect of stressors was observed mainly during sport competitions. Although we demonstrated an interesting relationship for stress level in sport situation among men and women, a limitation of the present study was not taking into consideration the other factors such as e.g. temperament. Analysis of stress level compared to the demand for stress and relieving stress produced the results which showed that karate practitioners in general cope with these problems very well. In the present study, identification of the specific conditions and stress reaction in athletes is the basis for taking into account the individual coping strategies. This concerns development of pre-start routines or psycho-regulatory techniques included in the warm-up, which ensure reaching the zone of optimal function [16]. Individual variation should also be considered during mental preparation. Coaches should know which focus styles are optimal for their athletes. J. Taylor [36] distinguishes between internal and external focus styles. Those who use internal focus styles need longer time for concentration and thinking about tactics. The athletes of this type should be immediately informed about the results of the draw for the first fight and characteristics of the opponent's abilities. If their attention is disturbed by the stimuli not connected with their sport, the problems with returning to the desired level of concentration might arise. The athletes with external focus style do not need much time for concentration before training or competitions. They like to be busy with other things e.g. joking. If they think too much, some negative thoughts, losing faith in their own strength or excessive excitation might arise. Therefore, coaches should not force their own focus styles on athletes but, based on observation and interview, they should take into account the focus style which is the best for a particular athlete [36].

None of the aspects of preparation (physical, technical, tactical and psychological) should be neglected over the period of general and special preparation, because in practice they are interrelated with each other and affect performance during competitions. There is a need for adopting special training methodology. For example, psychological training allows athletes to acquire skills which help them cope with such problems as: being afraid of making mistakes, high level of fear, lack of confidence, lost attention. Basic elements of mental training include relaxation, activation, concentration (focus, switching attention), imagination, internal speech and pre-start routines [37]. In some situations, imagery training might be very helpful. If used in sport, it has the features of relaxation, anticipation and suggestion. Paivio distinguished between imagery with cognitive and motivational functions. Cognitive imagery concerns strategies, pre-start routines or particular skills of an athlete, whereas motivational imagery focuses on the level of excitement and emotions and achievement of individual goals [38]. On the one hand, it seems helpful to identify demand for stress, but, on the other hand, coping strategies and the resources the athletes have are also important. This makes it easier to select the means of comprehensive preparation and development of adequate pre-start routines.

The ways of helping the sportsmen in building stress coping strategies, especially before the fight, which are recommended in this article are just couple of practical solutions. However, the problem is far more complex. Editorial limitations do not allow us to further discuss other aspects of (these) issues such as sportsman stress identification indexes. Sometimes the situations might be embarrassing for the sportsman – e.g. uncontrolled urination [39] – and coach might not be aware of them it. The trust in the relation “sportsman – coach – psychologist – physiotherapist” is at the basis of developing successful stress coping strategies.

## CONCLUSIONS

Competitions generated higher stress compared to training. Importance of competition and participation of spectators magnified stress intensity. Quality of activities performed during fighting modified stress intensity. Stress intensity at the end of karate match remains lower in men compared to women. Predominantly, stress intensity in training situations does not correspond to demand for stress among karate practitioners in general (without taking gender into account). Satisfying this demand occurs mainly through endurance training with participation of spectators. Stress which occurs during the first selection match and semi-final fight exceeds the needs of the athletes in these terms. Stress intensity in both groups of men and women, which were considered separately, is significantly lower than the demand for stress



under conditions of tactical and technical training and training without participation of spectators. This might have negative implications for the course and effectiveness of technical and tactical actions during competitions at high level. The dissonance between stress intensity and demand for stress observed in women during final matches and when fighting with stronger opponents puts them at risk of feeling psychological discomfort during fight.

### Practical applications

Psychological preparation is an integral part of preparation of an athlete for participating in competitions.

Evaluation of individual demand for stress and focus styles allows for choosing adequate means of preparation for an athlete to be competitive. Psychological preparation and tactical preparation are correlated with each other, which manifests in particular in development and realization of a fight plan (an algorithm of effective fight) and reaction to unexpected situations (using heuristics). Both tactics should be incorporated in training schedules. Differences in reactions demonstrated between men and women in stressful situations suggest the necessity of individual approach during training process and at individual stages of sport competitions.

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**APPENDIX**

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STRESS INVENTORY for situations experienced in KARATE

Which of the training and competition-related situations listed below make you feel stressed? Please evaluate according to the scale of 0 (not stressed) to 10 (stressed very much). Circle the number on the right.

**TRAINING**

1	Technical	0 1 2 3 4 5 6 7 8 9 10
2	Tactical	0 1 2 3 4 5 6 7 8 9 10
3	General	0 1 2 3 4 5 6 7 8 9 10
4	Training of parts of fights	0 1 2 3 4 5 6 7 8 9 10
5	Special strength training (using weights and equipment)	0 1 2 3 4 5 6 7 8 9 10
6	Endurance training	0 1 2 3 4 5 6 7 8 9 10
7	Speed training using karate techniques	0 1 2 3 4 5 6 7 8 9 10
8	General preparation training	0 1 2 3 4 5 6 7 8 9 10
9	Technical mistakes made during training	0 1 2 3 4 5 6 7 8 9 10
10	Training in front of spectators	0 1 2 3 4 5 6 7 8 9 10
11	Training without spectators	0 1 2 3 4 5 6 7 8 9 10
	Other (please specify):	0 1 2 3 4 5 6 7 8 9 10

**COMPETITIONS**

I

1	Warm-up	0 1 2 3 4 5 6 7 8 9 10
2	Thinking about the consequences after competitions you win	0 1 2 3 4 5 6 7 8 9 10
3	Thinking after competitions you win	0 1 2 3 4 5 6 7 8 9 10
4	Several hours before competitions	0 1 2 3 4 5 6 7 8 9 10
5	During the process of body mass control before competitions	0 1 2 3 4 5 6 7 8 9 10
6	Official weighing before competition	0 1 2 3 4 5 6 7 8 9 10
7	Before competitions, being watched by the spectators	0 1 2 3 4 5 6 7 8 9 10
8	Waiting for the results of the draw before competitions	0 1 2 3 4 5 6 7 8 9 10
9	Thinking about consequences after competitions you lose	0 1 2 3 4 5 6 7 8 9 10
10	Thinking before competitions and sparring matches	0 1 2 3 4 5 6 7 8 9 10
11	Thinking after competitions you lost	0 1 2 3 4 5 6 7 8 9 10
12	Other (please specify):	0 1 2 3 4 5 6 7 8 9 10
13	I like the tension and pressure during fighting	0 1 2 3 4 5 6 7 8 9 10
14	I like the excitement triggered by fighting	0 1 2 3 4 5 6 7 8 9 10
15	Expected contacts with journalists	0 1 2 3 4 5 6 7 8 9 10
16	I practice karate because it relieves stress and anxiety	0 1 2 3 4 5 6 7 8 9 10
	Other (please specify):	0 1 2 3 4 5 6 7 8 9 10



## II

1	Competitions in your own club	0 1 2 3 4 5 6 7 8 9 10
2	Fighting with similar-level competitor	0 1 2 3 4 5 6 7 8 9 10
3	Macro-regional competitions	0 1 2 3 4 5 6 7 8 9 10
4	Leaving the mat because of disqualification	0 1 2 3 4 5 6 7 8 9 10
5	Fighting in front of your own fans	0 1 2 3 4 5 6 7 8 9 10
6	Disqualification during competition	0 1 2 3 4 5 6 7 8 9 10
7	The first selection match	0 1 2 3 4 5 6 7 8 9 10
8	The second selection match	0 1 2 3 4 5 6 7 8 9 10
9	Final match	0 1 2 3 4 5 6 7 8 9 10
10	Competitions with small number of supporters	0 1 2 3 4 5 6 7 8 9 10
11	First seconds of the fight	0 1 2 3 4 5 6 7 8 9 10
12	All fights lost during competitions	0 1 2 3 4 5 6 7 8 9 10
13	Competitions with high number of fans	0 1 2 3 4 5 6 7 8 9 10
14	Participation in last chance competitions	0 1 2 3 4 5 6 7 8 9 10
15	National-level competitions	0 1 2 3 4 5 6 7 8 9 10
16	Competitions in other clubs	0 1 2 3 4 5 6 7 8 9 10
17	The first fight of semi-final	0 1 2 3 4 5 6 7 8 9 10
18	Fighting with stronger opponents	0 1 2 3 4 5 6 7 8 9 10
19	Little competitive tournaments	0 1 2 3 4 5 6 7 8 9 10
20	Making technical mistake during competitions	0 1 2 3 4 5 6 7 8 9 10
21	Injury during competitions	0 1 2 3 4 5 6 7 8 9 10
22	Breaks and discussing fights with coaches	0 1 2 3 4 5 6 7 8 9 10
23	Scoring penalty	0 1 2 3 4 5 6 7 8 9 10
24	Thinking about consequences when losing fights	0 1 2 3 4 5 6 7 8 9 10
25	Fighting in front of small number of spectators	0 1 2 3 4 5 6 7 8 9 10
26	Mistake made when the opponents has advantage of points	0 1 2 3 4 5 6 7 8 9 10
27	Fighting with weaker opponents	0 1 2 3 4 5 6 7 8 9 10
28	Final seconds of the fight	0 1 2 3 4 5 6 7 8 9 10
29	Passive fight (less attack and more defence)	0 1 2 3 4 5 6 7 8 9 10
30	Active fight (more attack)	0 1 2 3 4 5 6 7 8 9 10
31	Successful attack which gives advantage	0 1 2 3 4 5 6 7 8 9 10
32	Performing successful techniques	0 1 2 3 4 5 6 7 8 9 10
33	Action with losing advantage	0 1 2 3 4 5 6 7 8 9 10
34	Point disadvantage	0 1 2 3 4 5 6 7 8 9 10
35	Making mistakes when having advantage	0 1 2 3 4 5 6 7 8 9 10
36	Thinking about consequences during evenly-matched fights	0 1 2 3 4 5 6 7 8 9 10
37	Inaccurate and ill-considered attack	0 1 2 3 4 5 6 7 8 9 10
38	Another inaccurate and ill-considered attack	0 1 2 3 4 5 6 7 8 9 10
39	Highly competitive tournaments	0 1 2 3 4 5 6 7 8 9 10
40	Thinking about the consequences during fight when winning the fight	0 1 2 3 4 5 6 7 8 9 10
41	Fighting in front of opponent's fans	0 1 2 3 4 5 6 7 8 9 10
42	Successful attack which gives advantage	0 1 2 3 4 5 6 7 8 9 10
	Other (please specify):	0 1 2 3 4 5 6 7 8 9 10

Respondent Data: Frequency of training session a week.....; Favourite competition (please underline): Kumite, Kata, Tameshiwari; achievements during competitions in last year: (name, place, year).....  
.....  
..... Place where you train in.....  
; Age..... years; Sex: M, F; Education level/school.....; Karate training experience.....  
years; Level (Kyu, Dan).....

Please check whether you have answered all the questions.....**Thank you.**

