






Relationship of stress coping style to aerobic capacity and post-workout restitution efficiency during the direct preparation plan period for the European Women's Cadet Wrestling Championships

Authors' Contribution:

-  **A** Study Design
-  **B** Data Collection
-  **C** Statistical Analysis
-  **D** Manuscript Preparation
-  **E** Funds Collection

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Abstract

Background & Study Aim:

Achieving sports success at the international level, regardless of the age group represented, requires proper preparation for competition both psychologically and physiologically. Therefore, it is necessary to monitor how stress responses affect test scores in athletes who are in direct preparation for international championship competitions. The cognitive goal of this work is to know the correlation of the aerobic capacity test score and the level of post-workout restitution with the style of stress coping in female athletes at the training camp preceding the European Cadet Championships.

Material & Methods:

Two hypotheses are verified: H1: there is a significant relationship between the stress coping style and the result of the performance test; H2: there is a significant relationship between the changes in the 2nd and 1st terms of the performance test and restitution indices and the stress coping style of the subjects.

Female athletes of the National Team of Poland in wrestling ($n = 6$) were studied during a training camp located in the immediate starting period, before leaving for the European Cadet Championships. Stress coping style was examined using the Coping Inventory of Stressful Situation (CISS). Aerobic capacity was estimated using the Maximal Multistage 20-m Shuttle Run Test ('Beep-Test'). Post-workout restitution levels were performed using the Klonowicz coefficient of restitution at 3 minutes (COR3') and 5 minutes (COR5').

Results:

There was a significant correlation between the variables studied in the study terms, between 'Beep-Test' distance and task-based stress coping style ($r = 0.87$, $p = 0.025$), between emotional coping style and HR 5 min post-test ($r = 0.86$, $p = 0.029$), and between avoidant coping style and resting HR ($r = 0.87$, $p = 0.026$) and COR3' ($r = 0.88$, $p = 0.019$).

Conclusions:

Female athletes with a stress management style other than task-based were shown not to significantly improve their aerobic capacity levels between study dates. In addition, getting a better COR3' may be due to having a significantly higher resting heart rate.

Keywords:

combat sports • contact sport • psychological preparation

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Authors have declared that no competing interest exists

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Aerobic capacity – *noun* same as **VO2Max** [46].

VO2Max – *noun* the maximum possible intake of oxygen for aerobic metabolism during exercise [46].

Aerobic power – *noun* same as **VO2Max** [46].

Anaerobic capacity – *noun* the maximum amount of energy that can be produced by anaerobic metabolism [46].

Anaerobic metabolism – *noun* the breakdown of carbon and fats into energy without the presence of oxygen [46].

Combat sport – *noun* a sport in which one person fights another, e.g. wrestling, boxing and the martial arts [46].

Contact sport – *noun* any sport in which physical contact between players is an integral part of the game, e.g. boxing, rugby or taekwondo [46].

INTRODUCTION

Proper preparation in wrestling for championship-level athletic competition, regardless of the age group in which one competes, involves appropriate psychological and physiological preparation [1, 2]. In order for a female wrestler, including those in adolescence, to compete for the highest sporting goals, she must manifest certain personality traits and master related key skills – proper stress response, coping and recovery from stressful situations [3, 4]. They must also possess an adequate level of fitness to sustain the workload of a given bout and as high a level of post-workout restitution as possible to give them the opportunity to prepare for subsequent bouts in a given championship tournament.

The time of a single fight in classical style wrestling in the cadet age group (U17) includes 2 rounds of 2 minutes each with a 30 second break. On one day, a given athlete, in order to achieve success, must fight several bouts, which give her the next day a final bout or repechage bouts (with the possibility of fighting for the bronze medal). In addition, in the next age group, junior (U20) athletes fight 2 rounds of 3 minutes each with a 30 second break [5]. Despite the fact that the direct wrestling bout is dominated by work in the anaerobic energy zone [6, 7] appropriate level of aerobic capacity preparation for competition is necessary [8]. Adequate aerobic-anaerobic preparation of wrestlers is one of the determinants of the rate of post-workout recovery [9].

Previous studies have determined the psychological profile of elite female wrestlers and champions of individual and combat sports [10-14]. Physical fitness, developmental age and somatic development of adolescent wrestlers were subjected to analysis. Physiological criteria of functional fitness of athletes of national wrestling teams were characterized [15]. The levels of physical fitness, aerobic capacity, body composition, eating habits developmental age, and somatic development of young wrestlers were

studied [16-18]. It has also been proven that the level of aerobic capacity, together with the rate of post-workout restitution, are among the controlling tools in the training process of highly skilled athletes in grappler combat sports, in different age groups [19-21]. So far, the associations of stress coping style with the level of aerobic capacity and the level of post-workout restitution and their changes during training camp in the period of direct competitive preparation for championship competitions have not been analysed.

Taking the above into account, the authors decided to analyse the results of the performance test and the index of post-workout restitution in relation to the style of coping with stress in female athletes who are in the immediate preparation period for the European Cadet Wrestling Championships.

The cognitive goal of this work is to know the correlation of the aerobic capacity test score and the level of post-workout restitution with the style of stress coping in female athletes at the training camp preceding the European Cadet Championships.

Two hypotheses are verified: H1: there is a significant relationship between the stress coping style and the result of the performance test; H2: there is a significant relationship between the changes in the 2nd and 1st terms of the performance test and restitution indices and the stress coping style of the subjects.

MATERIAL AND METHODS

Participants

The study included a group of 6 national team athletes in the cadet age group with an average age of 16.3 ± 0.54 years), in classical style wrestling. The subjects were at a training camp immediately preceding their departure for the European Cadet Women's Championships.

Ethical issues

The authors have obtained the consent of the Bioethics Committee at the Medical University of Poznań, issued on April 14, 2022 with the number 294/22.

Research tools

The Coping Inventory of Stressful Situation (CISS) questionnaire, by Ender and Parker [22], was used to assess coping styles. The questionnaire consists of questions about behaviour in stressful situations and allows us to determine the respondent's propensity to use particular coping styles – task (SST), emotion (SSE) and avoidance (SSA). In addition, the questionnaire details 2 subcategories of avoidant style – engaging in substitute activities (ESA) and looking for social contacts (LSC). When filling out the questionnaire, in individual questions the respondent specifies how much she engages in the given activities when in a stressful situation. She answers each question using a 5-point scale (from 1 to 5). Individual ratings mean: 1 never; 2 very rarely; 3 sometimes; 4 often; 5 very often. The study used the CISS questionnaire adapted by Strelau et al. [23] for use in Polish settings.

Aerobic capacity was examined using the Maximal Multistage 20-m Shuttle Run Test (the 'Beep-Test'). This test involves walking a designated 20-meter distance between 'beep signals at increasing speed and frequency of each level. The teste must cross the designated line before the next signal ('beep'), otherwise he receives a warning. Receiving a second warning marks the end of the test [24]. To calculate the estimated aerobic capacity, a modified formula was used for subjects aged 6-18:

$VO_2\max$ [ml/kg/min] = $-31.025 + 3.328X_1 - 3.248X_2 + 0.1536X_{12}$, where:

X_1 maximum aerobic speed of the last level of 'Beep-Test' [km/h];
 X_2 age (as a rounded down integer) [25].

To calculate the level of post-workout restitution, Klonowicz coefficient of restitution calculations were performed at 3 minutes (COR_3) and 5 minutes (COR_5) after the end of the performance test, according to the formulas:

$COR_3 =$; $COR_5 =$, where:

Hr_1 resting HR [bpm]

Hr_2 HR after the 'Beep-Test' [bpm]

Hr_3 HR 3' after the 'Beep-Test' [bpm]

Hr_5 HR 5' after the 'Beep-Test' [bpm] [26].

The subjects completed the CISS questionnaire once, at the beginning of the grouping. The performance test along with the analysis of post-workout restitution was carried out twice – at the beginning of the training camp (term I) and at the end of the training camp (term II), without prior training, so that the athletes were rested while performing the capacity test.

Statistical analysis

The estimation of the results is based on the following indicators: frequency (n); mean (M); minimum (Min); maximum (Max); standard deviation (SD or \pm); significance level, probability (p). Normality of the distribution was tested using the Shapiro-Wilk test. In order to analyse the significance of changes between the study in term I and term II, the t-test for dependent samples was used; in case the study variable in at least one of the terms did not have a normal distribution, the Wilcoxon paired rank-order test was applied. Cohen's d coefficient was used to estimate the size of the experimental effect [27], while in cases of heterogeneity of variance, the Rosnow & Rosenthal coefficient (d_{RR}) was used [28, p. 354].

Pearson's test and Spearman's rank correlation coefficients were used to determine the strength of relationships between variables in 2nd and 1st of investigation. When the test value was less than 0.2 the result was considered insignificant, between 0.2 and 0.49 as small, between 0.50 and 0.80 as medium, and when greater than 0.80 as strong [29].

RESULTS

In the stress coping style test, the athletes scored an average of 58.8 ± 6.85 points in task style, 48.8 ± 7.65 points in emotional style and 54.3 ± 7.39 points in avoidant style. In the subcategory of avoidant style – engaging in vicarious activities, the subjects scored an average of 23.5 ± 5.36 points and 20.8 ± 4.45 points in the social contact-seeking subcategory.

The tested female athletes between the 1st and 2nd test terms showed a significant, large

($d = 3.585$) increase in the level of aerobic capacity (VO_2 max [ml/kg/min]) by an average of 14.7 ml/kg/min, a large (Cohen's d size = 0.827) decrease in HR 5 min after the test by an average of 11.4 bpm. The other indicators tested showed no statistically significant ($p \geq 0.05$) difference between the tested terms (Table 1).

The study showed a strong significant negative association between SSE and distance in 'Beep-Test' ($r = -0.92$; $p < 0.01$), maximum aerobic speed of the last level of 'Beep-Test' ($r = -0.96$; $p < 0.005$), level in 'Beep-Test' ($r = -0.87$; $p < 0.05$) and HR 5' after the test ($r = -0.84$; $p < 0.05$). The study at term II showed a strong, significant

Table 1. Descriptive characteristics of performance and restitution variables in the 1st and 2nd terms of the study in the Polish National Cadet Wrestling Team women ($n = 6$).

Variable (indicators 'Beep-Test' and Klonowicz COR)	The study stage		The size of the experimental effect				
	term I	term II	$M_I - M_{II}$	d	d_{RR}	t	p
	M & SD						
distance [m]	1146.7 ± 270.01	1153.3 ± 293.30	6.6	0.024		1.00 ^a	0.364
maximum aerobic speed of the last level [km/h]	11.5 ± 0.71	11.7 ± 0.68	0.2	0.294		-1.00 ^a	0.363
VO_2 max [ml/kg/min]	44.8 ± 4.10	59.5 ± 4.46	14.7	3.585		-12.50^a	0.000
resting HR [bpm]	82.0 ± 19.56	78.7 ± 14.01	3.3	0.235		0.60 ^a	0.578
HR after the test [bpm]	174.7 ± 28.58	170.0 ± 31.77	4.7	0.164		0.25 ^a	0.801
HR 1' after the test [bpm]	138.0 ± 22.45	136.0 ± 25.04	2	0.089		0.26 ^a	0.806
HR 3' after the test [bpm]	113.3 ± 17.28	104.7 ± 14.40	8.6	0.597		2.48 ^a	0.056
HR 5' after the test [bpm]	104.7 ± 17.05	93.3 ± 13.78	11.4	0.827		3.11^a	0.026
Klonowicz COR 3' [%]	63.2 ± 15.83	71.2 ± 16.69	8		0.492	-0.97 ^b	0.375
Klonowicz COR 5' [%]	74.0 ± 8.63	83.9 ± 6.53	9.9		1.294	1.57 ^b	0.116

Note: ^at-test for dependent samples, ^bWilcoxon paired t-test, $p < 0.05$ values are in bold; d Cohen's coefficient; d_{RR} Rosnow & Rosenthal coefficient

Table 2. Correlations (Person test) between performance and restitution variables and stress coping style and self-efficacy in the 1st and 2nd terms of the Polish National Team study in cadet wrestling women ($n = 6$).

Variable (indicators 'Beep-Test' and Klonowicz COR)	SST		SSE		SSA		SSA - ESA		SSA - LSC	
	Term									
	I	II	I	II	I	II	I	II	I	II
level [in order of level]	-0.08	0.31	-0.96^{III}	-0.80	-0.46	-0.29	-0.40	-0.52	-0.13	0.21
distance [m]	-0.02	0.28	-0.92^{III}	-0.79	-0.42	-0.37	-0.41	-0.61	-0.09	0.19
maximum aerobic speed of the last level [km/h]	-0.08	0.31	-0.96^{III}	-0.80	-0.50	-0.29	-0.40	-0.52	-0.13	0.21
VO_2 max [ml/kg/min]	-0.01	0.24	-0.87^I	-0.70	-0.48	-0.29	-0.56	-0.47	0.01	0.12
resting HR [bpm]	0.39	0.34	-0.77	-0.36	-0.30	0.42	-0.62	-0.18	0.31	0.74
HR after the test [bpm]	0.53	0.01	-0.63	-0.22	-0.35	0.23	-0.59	-0.24	0.36	0.46
HR 1' after the test [bpm]	0.26	0.07	-0.74	-0.20	-0.02	0.22	-0.44	-0.16	0.46	0.33
HR 3' after the test [bpm]	0.15	-0.04	-0.74	-0.50	-0.10	-0.27	-0.30	-0.33	0.18	-0.10
HR 5' after the test [bpm]	0.19	0.33	-0.84^I	-0.48	-0.34	-0.04	-0.52	-0.54	0.14	0.51
COR Klonowicza 3' [%]	0.46	0.42	-0.31	0.13	-0.46	0.66	-0.60	-0.08	0.23	0.97^{III}
COR Klonowicza 5' [%]	0.67	0.02	-0.31	0.21	-0.18	0.96^{III}	-0.53	0.53	0.53	0.67

Note: ^I $p < 0.05$; ^{III} $p < 0.01$: this values are in bold

positive association of SSA with COR 5' ($r = -0.96$; $p < 0.005$) and a strong positive association of SSA-LSC with COR 3' ($r = 0.97$; $p < 0.002$) (Table 2).

Between the 2nd and 1st terms, there was a positive strong significant association between SST and distance achieved on the 'Beep-Test' ($r = 0.87$; $p < 0.05$), a positive strong significant association between SSE and HR 5 min after the 'Beep-Test' ($r = 0.86$; $p < 0.05$), and a positive strong significant association between SSA and resting HR ($r = 0.87$; $p < 0.05$) and COR 3' Klonowicz ($r = 0.88$; $p < 0.02$) (Table 3).

DISCUSSION

Both hypotheses were confirmed. Stress coping style is significantly related to the score obtained in the performance test and the post-workout restitution rate (H1), and changes in these variables between the beginning of the grouping (term I) and the end of the grouping (term II).

The study analysed showed that female athletes characterized by a higher score of emotional stress coping style obtained a lower score in the performance test in the 1st term of the study. Female athletes with an avoidant stress coping style obtained a higher restitution rate at 5 min post-workout in the 2nd term, but this

style had a significant effect on increasing resting heart rate compared to the 1st term of the study. Female athletes with a higher task-based stress coping style obtained a significantly higher score in the 2nd term of the study compared to the 1st term of the study.

Previous research has shown that the style of responding to stress can significantly affect the course of wrestling. It has been shown that the desired style of coping with difficult situations in sports is task-focused. Athletes who withdraw in difficult situations and who are emotionally oriented perform worse in crucial moments [30]. Elite senior wrestling competitors have been shown to have a more task-focused style of coping with stress than elite juniors [31]. Less-experienced wrestlers are more likely to base their reactions on emotions, which reduce emotional stability in competitive sports situations [10, 31, 32]. This indicates the need to introduce psychological preparation into sports training early enough, related to coping with difficult situations and recovering as quickly as possible from a stressful situation.

In wrestling (as in many contact sports or intervention activities, such as uniformed services work [33-41]), it is required to endure prolonged physical exertion and mental strain, as well as a high level of post-stress recovery appropriate

Table 3. Results of analysis of changes in the relationship between performance variables and stress coping style and self-efficacy between term II and term I in the Polish National Team group in cadet wrestling women ($n = 6$).

Variable (indicators 'Beep-Test' and Klonowicz COR)	SST		SSE		SSA		SSA – ESA		SSA – LSC	
	r	p	r	p	r	p	r	p	r	p
level in Beep-Test [in order of level] ^a	0.66	0.151	0.33	0.522	0.31	0.551	-0.18	0.729	0.57	0.238
distance [m] ^b	0.87^l	0.025	0.44	0.381	0.00	1.000	0.74	0.096	0.72	0.109
maximum aerobic speed of the last level [km/h] ^a	0.66	0.151	0.33	0.522	0.31	0.551	-0.18	0.729	0.57	0.238
VO2 max [ml/kg/min] ^a	0.38	0.458	0.16	0.768	0.24	0.652	0.06	0.912	0.17	0.744
resting HR [bpm] ^a	-0.21	0.691	0.73	0.103	0.87^l	0.026	0.69	0.128	0.32	0.541
HR after the test [bpm] ^a	-0.33	0.525	0.25	0.639	0.39	0.450	0.20	0.703	0.10	0.852
HR 1' after the test [bpm] ^a	-0.41	0.425	0.62	0.192	0.32	0.543	0.30	0.558	-0.11	0.836
HR 3' after the test [bpm] ^a	-0.37	0.469	0.65	0.166	-0.26	0.617	0.06	0.908	-0.53	0.280
HR 5' after the test [bpm] ^a	0.15	0.780	0.86^l	0.029	0.59	0.217	0.16	0.763	0.53	0.281
COR Klonowicz 3' [%] ^a	-0.02	0.970	0.36	0.490	0.88^{ll}	0.019	0.40	0.427	0.62	0.186
COR Klonowicz 5' [%] ^a	-0.52	0.291	0.37	0.466	0.73	0.101	0.74	0.091	-0.02	0.976

Note: ^a Pearson test; ^b Spearman's rank correlations; ^l $p < 0.05$; ^{ll} $p < 0.02$: this values are in bold

to the activity – in this case, wrestling bouts [4]. This makes it necessary for female wrestlers to be adequately prepared from an early age to endure situational stress with increased fatigue of the body, which is greater at subsequent stages of the tournament. The results of our own and other studies confirm that in order for effective competition in the sport of wrestling to be possible, it is necessary to conduct sports training based on the methodology of the sport along with parallel psychological preparation from an early age [42-44].

As experienced athletes were found to have weakened psychological resilience with age, compared to younger elite wrestlers, this indicates the need for regular psychological preparation control of athletes, conducted under similar conditions, along with analysis of their changes. Similar conclusions were drawn from an analysis of wrestlers from Ukraine and Croatia, where it was shown that periodic psychophysiological control is necessary [45].

This means that a continuous, individualized and uninterrupted process of psychological training for female athletes preparing for championship wrestling competitions is necessary, since, as it was shown in our own and other authors' studies, the style of coping with stress and the level of preparation for dealing with difficult situations directly affects their effectiveness during sports combat.

CONCLUSIONS

Significant correlations were found between the style of coping with stress and performance in performance tests and the level of post-workout restitution in female athletes in direct training before the European Championships in classical wrestling. Significant changes between the 1st and 2nd terms indicate this to the need for regular psychological training and periodic monitoring of psychological preparation.

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