

Stress and coping during the COVID-19 pandemic among martial arts athletes – a cross-cultural study

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
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- E Funds Collection

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Abstract

Background and Study Aims:

Success in sports among athletes on a similar level of skill can depend on individual differences in experienced stress and coping strategies. The COVID-19 pandemic has affected many areas of life, including sports. The aim of the current study was to verify two hypotheses: (H1) emotional tension, external stress, and intrapsychic stress among martial arts athletes will be significantly higher during the height of the pandemic than in the pre-pandemic period; (H2) martial arts athletes will less frequently use problem-focused strategies of coping with stress, such as active coping and planning, during the height of the pandemic.

Materials and Methods:

The study used the Perception of Stress Questionnaire measuring the following dimensions of stress: emotional tension, external stress, and intrapsychic stress. Coping strategies were measured with the Brief COPE questionnaire distinguishing 14 coping strategies. Seven hundred and eighty-one athletes (including 116 martial arts athletes) from Poland, Romania, and Slovakia took part in the study in the pre-pandemic period. During the height of the pandemic, athletes from Hungary, Indonesia, Iran, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Spain took part in the study (n = 1,032, including 396 martial arts athletes).

Results: Higher levels of emotional tension, external stress, and intrapsychic stress were observed among Polish and Romanian martial arts athletes in the pre-pandemic period. Stress levels were higher before the pandemic than during its peak, when the lowest levels of emotional tension and external stress were reported by martial arts athletes in Romania, and the highest – in Lithuania and Spain. On the other hand, the lowest levels of intrapsychic stress were reported by martial arts athletes in Poland, and the highest – in Lithuania. Key gender-dependent strategies of coping with stress were identified. Male and female martial arts athletes used denial, focus on and venting of emotions, substance use, and acceptance. Additionally, men used self-blame and women used behavioural disengagement.

Conclusions: The effects of the pandemic do not involve an increase in subjectively perceived psychological stress among martial arts athletes from countries variously affected by the pandemic. The use of maladaptive coping strategies – denial, substance use, venting negative emotion etc. – allows for lowering the subjectively experienced stress (the emotional tension, external stress and intrapsychic stress) of martial arts athletes. It was the use of these strategies which facilitated lower stress levels. The second hypothesis, that martial arts athletes will less frequently use problem-focused strategies of coping with stress, such as active coping and planning, during the height of the pandemic, was confirmed.

Keywords: anxiety • chronic stress • depression • pre-pandemic period • preventive strategies

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NCAA – The National Collegiate Athletic Association.

MMA – mix martial arts (authors of this work join the opinion that MAMA is a form of neo-gladiatory and support **Częstochowa declaration 2015: HMA against MMA & Gdansk 2nd HMA World Congress Resolution** – see glossary).

Częstochowa declaration 2015: HMA against MMA – "continuous improvement of health through martial arts as one of the most attractive form of physical activity for a human, accessible during entire life should constantly exist in public space, especially in electronic media, to balance permanent degradation of mental and social health by enhancing the promotion of mixed martial arts – contemporary, bloody gladiatorship, significant tool of education to aggression in a macro scale".

Gdansk 2nd HMA World Congress Resolution – Article 1 The white flag with five interlocking "Olympic rings" is the most recognizable symbol in the global public space. Neither did the resurrected idea of Olympia, "Citius, Altius,

INTRODUCTION

In March 2020, the World Health Organization (WHO) has declared COVID-19 a global pandemic [1]. Together with the governments around the world, the WHO has decided that coordinated preventive strategies are required in order to halt its spread. However, these strategies are not identical across countries. Regardless of the implemented strategies, COVID-19 has impacted nearly every sector of global society to an unprecedented degree. In particular, sports and physical activity were affected adversely due to the restrictions imposed on social contacts. Representatives of the sports community did not participate in the decision-making processes regarding the social distancing rules during the pandemic [2]. Sports events and even regular training has been suspended or severely restricted in most countries. The Olympic Games and the UEFA Champions League have also been postponed to 2021. However, this still does not guarantee that they will take place then. Many athletes have engaged in very rigorous training for competitions, which, if cancelled, might mean the end of their professional careers. This has also impacted their income. Three main sources of income for athletes – media transmissions, advertisements, and earnings from games – have dropped to almost zero [3]. The

sports industry, which has been valued at over 470 billion US dollars in 2018, has lost billions during the pandemic [4]. The athletes' material situation naturally affects their functioning. A global sense of threat, social isolation, and uncertainty about the future can cause anxiety, depression, and chronic stress, which, being a moderator of immune system functioning, influences the risk of infection [5].

A study published on July 18, 2020 in *The Lancet Diabetes & Endocrinology* showed that those people infected with COVID-19 who have high levels of cortisol – the classic stress hormone – in their blood are at risk for a rapid decline in health and death [6]. This is the first study proving that cortisol levels might be an index of the severity of the COVID-19 infection. The authors state that measuring cortisol levels might thus be used to rapidly screen for those who require urgent care. They have tested 535 patients with a suspected COVID-19 infection, admitted into three hospitals in London in the period between March 9 and April 22, 2020.

Analysing articles in such databases as BASE, EBSCO, PubMed Central, Medline, Web of Science, or DOAJ, it can be observed that over

150 studies related to the pandemic are published daily. The most useful ones are almost exclusively medical studies. Publications on stress among athletes in the pandemic period are based on subjective observations and opinions rather than empirical research. Publications on COVID-19 and sports are mainly theoretical [7].

Researchers suggest that COVID-19 might impact mental health and mood [8]. Fédération Internationale des Associations de Footballeurs Professionnels and national football associations carried out a survey on a sample on 1602 professional football players from countries which have implemented drastic measures to limit the spread of COVID-19. Twenty-two percent of female footballers and 13% of male footballers have reported symptoms consistent with a diagnosis of depression, while 18% of women and 16% of men reported symptoms consistent with a diagnosis of generalized anxiety disorder [9]. A study carried out in the period between March 22 and April 14 2020 revealed that the percentage of professional football players reporting symptoms of depression has doubled [10]. The fact that many athletes, from various sports branches (athletics, hockey, karate, cricket, rugby, basketball etc.) felt depressed was confirmed by the researchers [11]. Authors emphasized, also, that in the case of a significant number of athletes sleep patterns changed, they preferred sedentary over active behaviour and consumed excessive amounts of carbohydrates. Most of the athletes had access to healthcare during the coronavirus disease (the lockdown period) and needed a proper motivation to keep active. Last but not least, we underline the effects of the Covid-19 pandemic on student athletes – over 37,000 students answered to a survey opened by NCAA (collaborating with the national Division I, II and III Student-Athlete Advisory Committees and with the NCAA Sport Science Institute) between April 10 – May 1 2020. The results showed that most of the students' athletes experienced mental distress, over a quarter felt very lonely, sad, mentally exhausted and reported a sense of loss [12].

Being able to identify patients at risk for a rapid decline in health would help provide the best medical care as efficiently as possible. A physiological marker of this sort could be cortisol levels, measured in laboratory studies, while a psychological marker could be the level of experienced stress, measured during psychological assessment.

The aim of the current study was to verify two hypotheses: (H1) emotional tension, external stress, and intrapsychic stress among martial arts athletes will be significantly higher during the height of the pandemic than in the pre-pandemic period; (H2) martial arts athletes will less frequently use problem-focused strategies of coping with stress, such as active coping and planning, during the height of the pandemic.

The main premises for the formulation of these hypotheses were the results of previous research; respectively: (H1) that athletes exhibited higher emotional tension and stress during the height of the pandemic due to Covid-19-related stressors [8, 10]; (H2) which authors [5] reported that during the circular interaction of stress-full pandemic-related conditions with stress triggered impairment of positive coping strategies.

MATERIAL AND METHODS

Participants and study design

The sample included athletes who have trained in a given sports discipline in a sports club, under the supervision of a coach, for at least two years.

Study 1 was carried out in the pre-pandemic period (November 2019) in Poland, Romania, and Slovakia. In total, 781 athletes took part in the study. Table 1 shows the descriptive statistics of the sample, divided by country, gender, and sports discipline (martial arts vs. other sports). Within the sample, 116 participants were martial arts athletes.

Slovak martial arts athletes were not included in the analysis due to an insufficient sample size (10 individuals).

Study 2 was carried out during the height of the pandemic (March 1, 2020 – July 12, 2020) in ten countries: Hungary, Indonesia, Iran, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Spain. Data collection was concluded at a different date in each country, this being the date at which sports training outside of one's home (i.e., in parks, forests, sports facilities) was made possible again. For example, in Poland, this date was June 1, 2020, while in Slovakia, it was May 15, 2020. One thousand and thirty-two athletes took part in Study 2. Table 2 shows the descriptive statistics of this sample, divided by country, gender, and sports discipline. Within the sample, 396

Fortius" save humanity from the horrors of two world wars, nor did the declared mission of the International Olympic Committee (IOC): "1. (...) the promotion of ethics and (...) ensuring that, in sport, the spirit of fair play prevails and violence is banned" (Olympic Charter, p. 18) stop the pathology of permanently educating contemporary man in aggression. **Article 2** Likewise, symbols (a sword pointed downwards surrounded by five rings) and motto ("Friendship through Sport") of Conseil International du Sport Militaire (CISM) did not stop soldiers from killing each other and murdering people after 1948 (the year of establishing CISM, the second largest multi-sport discipline organization after the IOC, and also the year of the Universal Declaration of Human Rights). **Article 3** Although there are five identical combat sports in the Olympic Games and the Military World Games, their potential is still not used to meet the second of the Fundamental Principles of Olympism: "(...) to place sport at the service of the harmonious development of humankind, with a view to promoting a peaceful society concerned with the preservation of human dignity" (Olympic Charter, p. 13). **Article 4** Boxing and wrestling cultivate the traditions of ancient Olympism. Judo and taekwondo have given martial arts humanistic and health attractiveness. Fencing combines this tradition with modernity in the spirit of chivalry. Aiming dynamic offensive and defensive actions directly at the opponent's body (irrespective of the protectors used) in such a way as not to hurt is a measure of respecting those knightly rules. This rule harmonizes with the principle of respect for the opponent's as well as one's own corporeality and dignity over the vain victory at all costs. **Article 5** For the civilized individual and the society for whom human health and dignity are the common good, participation, in any role, in brutal shows of people massacring each other cannot be a standard of the quality of life. Neo gladiatorship camouflaged under the banner of martial arts or combat sports is a slight to the Fundamental Principles of Olympism, but also to the Universal Declaration of Human Rights. Therefore, this Resolution should inspire as many actors of Knowledge Society as possible jointly to oppose any deformations of

the mission of Olympism and sport. The expansion of the pathology of unauthorized naming neo gladiators as combat sports athletes will soon turn the Fundamental Principles of Olympism into their own caricature – objective indicators are a testament to the devastation of all dimensions of health by the practice of legal bloody pageants [44].

Sten – A sten score indicates an individual's approximate position (as a range of values) with respect to the population of values and, therefore, to other people in that population. The individual sten scores are defined by reference to a standard normal distribution. Unlike stanine scores, which have a midpoint of five, sten scores have no midpoint (the midpoint is the value 5.5). Like stanines, individual sten scores are demarcated by half standard deviations. Thus, a sten score of 5 includes all standard scores from -0.5 to zero and is centred at -0.25 and a sten score of 4 includes all standard scores from -1.0 to -0.5 and is centred at -0.75. A sten score of 1 includes all standard scores below -2.0. Sten scores of 6-10 "mirror" scores 5-1. (Wikipedia).

Table 1. Number and age of female and male athletes from Poland, Romania, and Slovakia, divided into two subgroups, martial arts athletes and other athletes, in the pre-pandemic period.

Country	Martial arts athletes (n = 116)				Country	Other athletes (n = 665)			
	Women	Men	Age (years)			Women	Men	Age (years)	
	(n = 37)	(n = 79)	M	SD		(n = 225)	(n = 440)	M	SD
Poland (n = 46)	14	32	26.53	8.20	Poland (n = 333)	132	201	24.72	8.66
Romania (n = 60)	20	40	19.73	4.55	Romania (n = 226)	79	147	19.80	3.62
Slovakia (n = 10)	3	7	19.00	7.40	Slovakia (n = 106)	14	92	22.12	2.63

Table 2. Number and age of female and male athletes from ten countries, divided into two subgroups, martial arts athletes and other athletes, during the height of the pandemic.

Country	N	Martial arts athletes (n = 396)				N	Other athletes (n = 636)				Study period
		Women	Men	Age (years)			Women	Men	Age (years)		
		(n = 105)	(n = 291)	M	SD		(n = 287)	(n = 349)	M	SD	
Hungary	50	19	31	34.58	11.11	33	15	18	32.00	10.75	21.06-07.07.2020
Indonesia	35	18	17	25.48	10.49	0	0	0	20.89	1.68	19.06-10.07.2020
Iran	7	2	5	34.42	7.71	22	6	16	36.09	6.90	21.06-14.07.2020
Latvia	31	12	19	26.16	8.80	73	41	32	23.21	4.30	26.05-30.06.2020
Lithuania	51	7	44	21.72	5.87	62	23	39	23.12	7.35	07.05-19.05.2020
Poland	52	4	48	30.46	10.18	86	46	40	30.07	10.20	25.04-15.05.2020
Romania	57	18	39	26.45	7.92	91	44	47	22.97	3.71	29.04-17.05.2020
Russia	59	9	50	21.08	3.01	129	60	69	22.08	6.74	18.05-02.06.2020
Slovakia	30	9	21	30.40	14.03	104	42	62	21.72	4.07	04.05-14.05.2020
Spain	24	7	17	28.87	10.87	36	10	26	27.66	7.42	01.06-01.07.2020

participants were martial arts athletes, training in, for example, Aikido, Brazilian Jiu Jitsu, boxing, laidō, Judo, Karate, Karate shōtōkan, Kenjutsu, kickboxing, Krav Maga, Kyokushin Karate, MMA (see glossary), Muay Thai, Pencak silat, Qwan ki do, Sambo, Shaolin Kung Fu, Shorinji Kempo, Taekwondo, Wing Chun Kung Fu, and Wrestling.

Instruments

In our research we used the *Perception of Stress Questionnaire* [13] and the *Brief COPE* questionnaire [14] which distinguishes 14 coping strategies.

The *Perception of Stress Questionnaire* consists of the following scales:

1. Emotional tension, which results from the sense of anxiety and excessive nervousness. It occurs when an individual finds it difficult to relax in various everyday situations. It is related to a lack of energy to act, the feeling of fatigue without any particular reason, as well as the tendency to resign from undertaking various tasks and fulfilling plans. High emotional tension triggers a tendency to be highly irritable in interpersonal relationships. Example items from this scale include: "I get nervous more often than I used to, and for no obvious reason", "Although I try to, I have difficulties relaxing".

2. External stress, which occurs when an individual is unjustly assessed by other people in various social contexts (at home, work) and when their sense of helplessness and exhaustion related to defending their point of view/position increases. External stress is experienced when an individual is used by others, becomes anxious, frustrated, or fatigued because expectations or tasks set by others exceed their own resources, skills, and coping abilities. Example items from this scale include: “I feel drained by constantly having to prove I am right”, “I am criticized too frequently”.

3. Intrapsychic stress is related to the inability to cope with one’s own feelings and anticipations. A mental system filled with tension and conflict does not require external pressure to experience stress. This kind of stress occurs when an individual has problems with themselves and their still vivid memories from the past, creating symptoms of loneliness and anxiety. Thoughts about the future evoke anxiety, tendencies to resign, pessimistic assessment of oneself and the world. Example items from this scale include: “I keep being bothered by things that have happened in the past”, “Thinking about my problems makes it hard for me to fall asleep”.

The generalized stress level is the sum of emotional tension, external stress, and intrapsychic stress scores. Each scale comprises seven items.

Through the *Brief COPE* questionnaire we measured the strategies of coping with stress. It comprises 28 statements covering 14 coping strategies: self-distraction, active coping, denial, substance use, use of emotional support, use of instrumental support, behavioural disengagement, venting, positive reframing, planning, humour, acceptance, religion, and self-blame (two statements for each strategy). The participant indicates their frequency of using each coping strategy on a four-point Likert-type scale, from 1 (*I haven’t been doing this at all*) to 4 (*I’ve been doing this a lot*).

Statistical analysis

This study used the STATISTICA 13.0 software for statistical analysis including analyses of variance (ANOVA with post-hoc Tukey’s HSD test), confirmatory factor analysis, and t-tests. Abbreviations: M arithmetic mean; SD standard deviation (others are explained in the tables).

To examine how coping strategies influenced the levels of experienced stress at the height of the

pandemic, a confirmatory analysis was carried out, separately for female and male martial arts athletes. The method of maximum likelihood estimation for the structural model was used. The model included all types of measured stress and selected, statistically significant coping strategies. When the root mean square error of approximation (RMSEA) value is less than 0.05, a model fits the data well [15, 16]. A model fits the data acceptably well if the RMSEA value is between 0.06 and 0.08 [15, 17]. If the value is greater than 0.08, a model poorly fits the data.

The p-close test assesses the closeness of fit of the empirical data matrix to the theoretical model. Additionally, the p-close tests the null hypothesis that the RMSEA is not greater than 0.05. If the p-close is less than 0.05, the null hypothesis is rejected and the computed RMSEA is concluded to be greater than 0.05, which indicates a lack of a close fit. The goodness-of-fit index should exceed 0.90 [18]. This measure is not directly linked to sample size, but it provides information as to whether a tested model fits the data significantly better than no model at all [19].

Ethics

The research protocol was in accordance with the international ethical standards of the Helsinki Declaration. The anonymity of the participants was ensured and we obtained the informed consent of all the subjects.

RESULTS

The reliability of the scales of the stress in the current study was as follows: **emotional tension** Cronbach’s $\alpha = 0.811$; **external stress** Cronbach’s $\alpha = 0.726$; **intrapsychic stress** Cronbach’s $\alpha = 0.697$.

Table 3 shows the differences in stress levels experienced by Polish and Romanian martial arts athletes. As the distribution of the results did not differ from the normal (skewness and kurtosis < 1), the Student’s *t* test was employed in subsequent analyses.

Contrary to H1, higher levels of emotional tension, external stress, and intrapsychic stress were reported by Polish and Romanian martial arts athletes in the pre-pandemic period.

Stress levels (based on the generalized sten norms of the *Perception of Stress Questionnaire*) in the

Table 3. Differences in the levels of experienced stress between martial arts athletes from Poland and Romania, in the pre-pandemic period and during the height of the pandemic.

Poland						Romania					
Pre-pandemic period		Height of the pandemic				Pre-pandemic period		Height of the pandemic			
M	SD	M	SD	t	p	M	SD	M	SD	t	p
18.57	5.88	15.23	5.03	3.551	***	20.18	5.60	14.02	5.76	5.874	***
19.04	5.44	15.85	5.37	3.533	***	20.53	5.13	15.11	5.51	5.518	***
15.03	5.18	9.92	3.75	6.404	***	16.45	4.62	12.19	4.39	5.105	***

***p≤ 0.001

pre-pandemic period were medium (4-5 sten) in all the subsamples. At the height of the pandemic, stress levels in the subgroup of Polish and Romanian martial arts athletes were low to very low (1-3 sten).

Table 4 shows the results of a comparative analysis of non-martial arts athletes in the pre-pandemic period and during the height of the pandemic (here, the results of Polish, Romanian, and Slovakian athletes have been aggregated).

Statistically significant differences can be observed, along with the fact that the reported stress levels were slightly higher in the pre-pandemic period than during the height of the pandemic. High values ranged on the 4-5 sten, that is, medium level. The greatest drop in experienced stress has occurred on the scale of external stress. A comparative analysis of gender differences in stress experienced by non-martial arts athletes has been carried out, though no statistically significant differences have been observed.

Table 5 shows the results of an ANOVA including stress levels of martial arts athletes in nine countries: Hungary, Indonesia, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Spain. Tukey's HSD test was used.

Figure 1 displays the results of Table 5 in a format facilitating easier interpretation. However, Figure 1 also shows results of a subsample of martial arts athletes from Iran, even though this subsample was not included in Table 5 due to insufficient size.

The lowest level of emotional tension was reported by martial arts athletes in Romania, and the highest – in Lithuania and Spain (Table 5 and Figure 1). Similar results were reported for external stress (lowest level in Romania, and the highest in Lithuania). Finally, the lowest level of intrapsychic stress was reported by martial arts athletes in Poland, and the highest – in Lithuania. Statistically significant differences are presented in Table 5.

The method of maximum likelihood estimation for the structural model, presented in Figure 2. The model included all types of measured stress and selected, statistically significant coping strategies. For the subsample of male athletes, these were: denial, venting, substance use, acceptance, and self-blame. The Pearson's *r* correlation coefficient between coping strategies and stress levels among male martial arts athletes was 0.87.

Table 4. Differences in experienced stress levels among Polish, Romanian, and Slovak non-martial arts athletes during the pre-pandemic period and at the height of the pandemic.

Variable	Pre-pandemic period		Height of the pandemic		t	p
	M	SD	M	SD		
Emotional tension	17.96	5.65	17.02	5.57	3.225	***
External stress	19.18	5.41	17.95	4.79	4.705	***
Intrapsychic stress	14.89	5.10	14.15	4.83	2.876	***

***p≤0.001

Table 5. Differences in stress levels among martial arts athletes from Spain, Indonesia, Lithuania, Latvia, Poland, Russia, Romania, Slovakia, and Hungary.

Country	Emotional tension		External stress		Intrapsychic stress	
	M	SD	M	SD	M	SD
1 Spain	19.08	4.61	17.38	3.46	13.75	3.85
2 Indonesia	17.54	4.79	17.83	4.84	13.11	3.59
3 Lithuania	18.25	4.47	19.92	3.93	15.49	4.22
4 Latvia	16.55	5.89	16.68	3.76	13.26	4.95
5 Poland	15.62	4.98	16.27	5.11	10.73	4.27
6 Russia	15.77	4.52	17.92	4.33	14.10	4.76
7 Romania	13.91	5.73	15.04	5.44	12.14	4.38
8 Slovakia	18.03	5.90	17.37	3.19	13.97	3.91
9 Hungary	16.78	5.64	16.08	4.86	14.27	5.84
Differences	1:7*, 3:7***		3:5**, 3:7***, 3:9***, 6:7*		3:5**, 3:7**, 5:6**, 5:9**	
F	4.105		4.873		4.639	
p	***		***		***	

*p≤0.05, ** p≤0.01, ***p≤0.001

Five statistically significant coping strategies were also identified in the subsample of female martial arts athletes. These were: denial, venting, substance use, acceptance, and behavioural disengagement. The Pearson’s *r* correlation coefficient between coping strategies and stress levels among female martial arts athletes was 0.77.

Only one statistically significant difference in coping strategy use between female and male martial arts athletes was observed: men used self-blame more often, while women engaged in behavioural disengagement more often.

Table 6 shows the fit indices of the models.

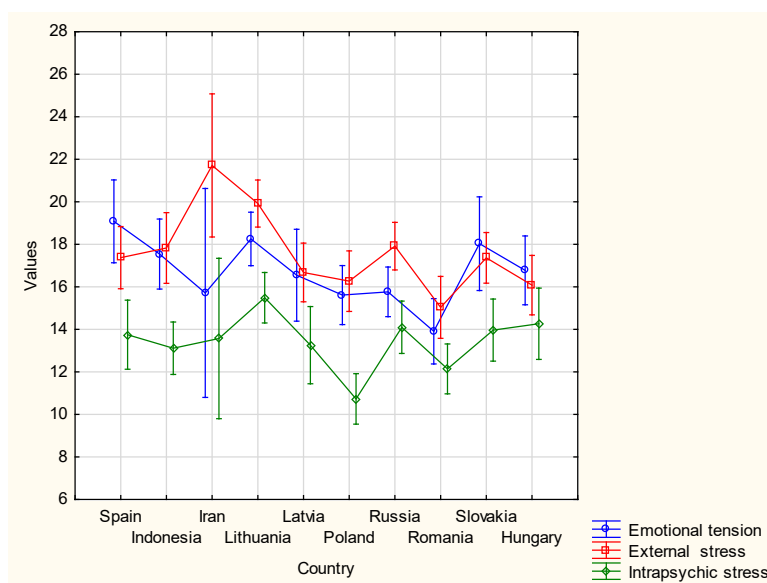


Figure 1. Stress levels among martial arts athletes from Hungary, Indonesia, Iran, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, and Spain during the height of the pandemic.

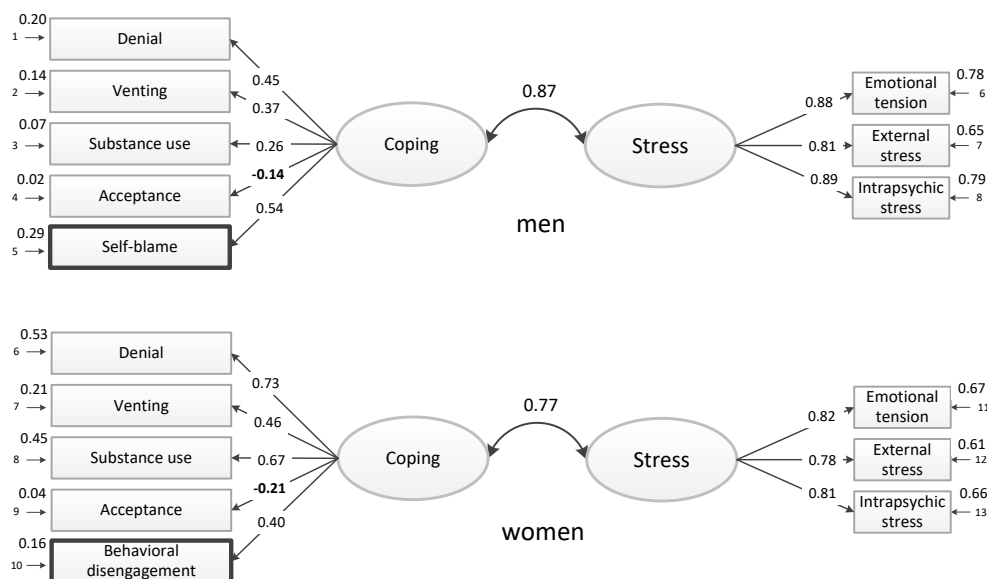


Figure 2. Confirmatory analysis model for female and male martial arts athletes.

DISCUSSION

The models in the current study can be confirmed to have been verified against the results distribution from the data matrix. In all three models, the RMSA was less than 0.08, the goodness of fit index (GFI) and the adjusted GFI (AGFI) were greater than 0.90, and the p-close test was greater than 0.05, which indicates a good fit to the data. The properties of the χ^2 distribution cause the test to easily reject the null hypothesis, and thus discredit the model, for larger samples, whereas the model could be very much acceptable.

In sum, it can be concluded that the goodness of fit tests presented above positively answer the question of whether the hypothetical models can be verified against the results distribution from the data matrix.

The first hypothesis in the current study stated that stress levels among martial arts athletes would increase during the height of the

pandemic. This hypothesis was not confirmed. In sum, stress levels among martial arts athletes were higher in the pre-pandemic period than during its height. How can these surprising results be interpreted? The first possible explanation involves the mechanism of habituation – the disappearance of a reaction to a repeated stimulus. As a result of long-term influence of a constant stimulus, the reaction decreases in strength and can, in time, disappear [20]. Habituation plays an adaptive role, as it allows for efficient use of an individual’s emotional and cognitive resources. Second, the athletes’ stress could have lowered due to the postponement or recalling of competitions [21]. Third, the athletes could have experienced a lower degree of stress due to less intensive training/work, and rest and social distancing could have allowed them to replenish their psychological resources [22]. Fourth, the degree of perceived competition could have become lower, as virtually all athletes found themselves in a similar situation [23]. Fifth – the

Table 6. Fit Indices of the models for female and male martial arts athletes.

Gender	χ^2	p	CMIN/df	RMSA	LO	HI	GFI	AGFI	p-close
Men (n = ??)	28.29	0.078	1.49	0.045	<0.001	0.078	0.972	0.946	0.561
Women (n = ??)	20.68	0.335	1.09	0.034	<0.001	0.109	0.935	0.877	0.564

Note: **p** significance level; **RMSEA** root mean square error of approximation; **LO** low RMSA; **HI** high RMSE; **GFI** goodness of fit index; **AGFI** adjusted goodness of fit index; **p-close** test of closeness of fit.

pandemic has caused a shift in personal priorities so that health and wellbeing became more important. The risk of infection with COVID-19 is minimal when rigorously following the rules of hygiene and social distancing. Additionally, other sources of stress do not adversely impact mood during a global pandemic. When health and even survival are threatened, individuals evaluate everyday problems differently. Sixth – athletes received less exposure in the media, which can be a strong source of pressure [24].

The stress levels reported by martial arts athletes in the current study differed significantly between the studied countries. This can be related to numerous factors: the intensity of the pandemic, the current economic and political situation of a given country, the athletes' stability of employment, and so forth. The *Human Development Index*, which rates the quality of life in a given country [25] is also a significant marker. Among the 14 strategies of coping with stress, only five significantly contributed to lower stress levels among martial arts athletes. Both male and female martial arts athletes reported using similar coping strategies: denial, focus on and venting of emotions, alcohol/drug abuse, and acceptance. Men additionally used self-blame and women – behavioural disengagement. Gender differences in coping with stress were also reported by the specialized literature [26, 27]. It is also worth noting that martial arts athletes did not engage frequently in active coping strategies, such as planning, active coping, or positive reframing. This is not surprising among groups characterized by chronic work-related stress [28]. Denial and venting of emotions are the so-called *avoidant* coping strategies. Athletes using these coping strategies display lower levels of self-control [29] and can also engage in unhealthy behaviours [30]. However, they do not necessarily have to display poorer mental health [31]. Substance abuse, self-blame, and behavioural disengagement are coping strategies which express *helplessness*. Denial and self-blame are contradictory strategies [14]. Substance abuse is an independent factor. Venting, behavioural disengagement, and substance use are considered less effective than active coping strategies, although they can be very useful in certain circumstances. However, it has to be pointed out that venting is a form of aggression. The participants in the current study practiced martial arts, where sports aggression is an inherent part. Thus, it would have been surprising if female and male martial athletes did not use this coping strategy.

Accepting one's situation might be linked to stress-related growth among the athletes [32]. This is particularly important in a situation of a global pandemic, as individuals have only a limited influence over its course. Also importantly, the coping strategies preferred by elite athletes do not adversely impact their goal orientation [33]. Although they are not the most effective coping strategies, low levels of stress experienced by martial arts athletes during the pandemic prove that they serve their function, that is, they effectively lower stress. Higher stress levels would most likely be counteracted by active coping strategies. An interesting fact is also that researchers reported similar coping strategies during the pandemic among people with disabilities (e.g., denial, substance use, behavioural disengagement, venting, and self-blame) [34]. These results are notable in the following context - coping skills are not related to the intensity of traumatic symptoms among athletes [35].

It was found that female and male martial arts athletes differed with respect to the frequency of using denial as a coping strategy [36]. Women and men use similar coping strategies, but they prefer some more strongly than others, and they variously impact their perceived stress levels [37]. Thus, close cooperation with a coach and/or a sports psychologist is important in order to identify and promote the most effective strategies of coping with stress for a given person [38]. Athletes, coaches, and medical practitioners should work towards minimizing daily stressors so as to minimize the strain experienced by the athletes [39].

Denial as a coping strategy was used by both women and men. This strategy engages the defence mechanisms of the Ego. During the height of the pandemic, denial, that is, rejecting the facts about the current situation, can facilitate the decision to, for example, travel to a place not as severely affected by COVID-19, such as the countryside, mountains, or other low-population areas. The risk of infection is lower there, and so the individual "denies" the reality of the pandemic. According to the availability heuristic, denial among athletes might mean that the risk of a severe course of the COVID-19 infection is very low. Athletes might not be convinced of the reality of the risk due to not having met or known an infected or dying person.

Finally, it is interesting to consider the reasons for the emergence of self-blame as a significant coping strategy among male martial arts athletes. Authors showed that individuals suffering from cancer attempted to find the answer to the question of why they became ill [40]. This could have been due to external factors, such as stress and environmental pollution, or internal ones, for example, genetic vulnerability, lack of physical activity, or improper diet. The latter answer contributed to self-blame. These individuals used the strategy of comparing down, which has a protective character and does not facilitate development and changes. This was partially confirmed by the current research. Perhaps the pandemic situation led the athletes to consider their position as relatively better than that of many others, resulting in low stress levels.

CONCLUSIONS

The effects of the pandemic do not involve an increase in subjectively perceived psychological stress among martial arts athletes from countries variously affected by the pandemic. The use of maladaptive coping strategies – denial, substance use, venting negative emotion, self-blame and behavioural disengagement (at a low level) and acceptance as an adaptive strategy (at a moderate or high level) allows for lowering the

subjectively experienced stress (the emotional tension, external stress and intrapsychic stress) of martial arts athletes. It was the use of these strategies which facilitated lower stress levels. To sum up, the second hypothesis, that martial arts athletes will less frequently use problem-focused strategies of coping with stress, such as active coping and planning, during the height of the pandemic, was confirmed.

The majority of the athletes experienced low stress levels during the pandemic. It can be expected that they are at a low risk of infection with COVID-19 [6].

The strengths of this study are the cross-cultural design and relatively large sample. This study has some limitations. The first limitation of the present research is that we relied on the self-report measures. Second, subsample of martial arts athletes from Iran was not included in the analysis due to insufficient sample size.

Because the pandemic can have long-term effects, further research needs to be conducted to monitor athletes' stress levels after it subsides. The results of the current study can be of interest not only to athletes, but also coaches and sports psychologists seeking to promote optimal strategies of coping with stress.

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