

Experienced stress among martial arts athletes from selected European Union countries during the 4th wave of the covid-19 pandemic and the frequency of using coping strategies

Authors' Contribution:

- A Study Design
- B Data Collection
- C Statistical Analysis
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Abstract

- Background and Study Aims:** In sports, coronavirus disease 2019 (COVID-19) affected variables such as training, recovery or athletes' sleep quality, uncertainty about the future generating distress and anxiety in athletes. There are two cognitive purpose of the current study: knowledge about the subjectively experienced stress in martial arts athletes from selected Europe Union countries during the 4th wave of the pandemic; and knowledge of the likely of using coping strategies, and if so, with what frequency.
- Materials and Methods:** Three hundred and forty-one competitive martial arts athletes from Hungary, Italy, Latvia, Lithuania Poland, Romania, Slovakia, and Spain were investigated (female $n = 129$, male $n = 212$). The athletes represented (according to division of the combat sports under forms of the direct confrontation): workings of weapons (fencing); hits (boxing, karate, kickboxing, Muay Thai, taekwondo); throws and grips of immobilisation of opponent's body (Brazilian jiu-jitsu, freestyle wrestling, judo) were investigated. In this paper we analyse workings of weapons and hits as conventional "striking combat sports" SCS (in consequence FSCS or MSCS – for female and male respectively), while throws and grips of immobilization of opponent's body as "grappling combat sports" GCS (FGCS and MGCS respectively). The Perception of Stress Questionnaire was used to measure intrapsychic stress, external stress and emotional tension in athletes, while through the Brief COPE questionnaire the frequency of use of 14 coping strategies was examined.
- Results:** The highest intrapsychic stress levels, during the 4th wave of the pandemic, were registered by Slovak athletes, external stress was the highest among Italian martial arts athletes, while the highest emotional tension levels were reported by Latvian athletes. The lowest values were observed in Lithuanian martial arts athletes, in all three stress dimensions. Also, martial arts athletes who have tested positive for COVID-19 reported significantly higher levels of stress and used (during the 4th wave) more frequent denial, behavioural disengagement and less frequent positive reframing (as coping strategies). Gender and type of sport-dependent strategies to deal with stress were discussed: FSCS group used less frequently emotion-focused coping strategies than male athletes from both MSCS and MGCS (apparently a surprising result), and with a higher frequency dysfunctional coping strategies. No important differences were found between the four investigated groups of athletes MGCS, MSCS, FGCS and FSCS) with respect to the problem-focused coping strategies.
- Conclusions:** Martial arts (combat sports) athletes who have tested positive for COVID-19 reported significantly higher levels of intrapsychic stress, emotional tension and external stress, compared to athletes which reported that they have not suffered from COVID-19. Denial and behavioural disengagement (as dysfunctional coping strategies) were more frequent among athletes which reported that they were sick with COVID-19, while positive reframing was significantly less used. The research can be of interest for martial arts athletes, coaches, parents and sports psychologists seeking to promote the most effective strategies to deal with negative stress, if the pandemic will have long-term consequences for athletes' mental health and well-being.
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INTRODUCTION

The coronavirus disease 2019 (COVID-19) generated significant global challenges and the public health organizations, government agencies tried to minimize the peak infection rate. Social (physical) distancing seems to be the most effective recommendation known to postpone the spread of the SARS-COV-2 virus, most countries using this measure (isolation periods, the closing of public areas and mandatory lockdowns) [1]. COVID-19 has impacted every sector of global society and caused a worldwide increase in hospitalizations for pneumonia with multiorgan disease. In most cases, COVID-19 is asymptomatic or mild [2]. It seems that people infected with SARS-CoV-2 show high levels of cortisol (the stress hormone) in their blood. Thus, cortisol levels might be an index of the severity of the coronavirus infection 2019 [3].

Due to the restrictions imposed on social contacts, sports and physical activity were inevitably affected and various sports competitions have been suspended. Variables such as training, recovery, athletes' sleep quality were affected by COVID-19 isolation [4]. Generally, uncertainty about the future and social isolation can cause high anxiety, depression and distress in athletes. Being a moderator of immune system functioning, chronic stress influences the risk of infection [5]. Considering the impact of the COVID-19 pandemic on professional athletes, after conducting a scoping review, Haan et al. [6] captured the following: the health-related quality of life value was lowest (worst) in athletes coming from countries with the highest poverty levels; athletes (comparing to non-athletes) have a better mental health status; athletes from team sports were less anxious compared to individual athletes, while depression levels were similar in individual and team sports. However, other researchers found that team sports athletes reported less depression than individual athletes [7] (in this case, athletes were tested before the COVID-19 crisis). Also, an increase in body fat mass and worse results in jump and sprint performance were registered in soccer players [8]. Of course, there are differences between sports disciplines (for example runners were able to follow more easily the training plan during the waves of the pandemic). The fact that COVID-19 might impact mental health and mood, could cause symptoms consistent with a diagnosis of generalized anxiety disorder, distress (negative stress) or depression in athletes, has been confirmed by various authors [9-11].

Stress is conceptualized as a transaction between a person and the environment. Authors note that stress is generated by the discrepancy between the demands of a particular situation and the individual's ability to respond [12]. Stress can be seen as a stimulus (it has a triggering role, causing, for example, an anxiety reaction), as an intermediate variable (mediator), and as a response/ as a type of behaviour [13]. Analysing the publications on stress among athletes in time of COVID-19 it can be asserted that team athletes felt less negative stress (distress) when compared to athletes from individual sports [14], novice players experienced higher stress levels than top athletes [15], while athletes with high athletic identity: "tend to ruminate and catastrophize more" [16] and are less prone to higher levels of distress, compared to athletes with low athletic identity [14]. Also, between April 10 and May 1, 2020, over 37,000 students answered a survey opened by the National Collegiate Athletic Association (NCAA). The results emphasized that most of the student athletes experienced negative emotional states and distress – felt sad, very lonely, and reported a sense of loss [17].

Researchers also underlined that for most of the athletes (during the pandemic) sleep patterns changed, carbohydrate intake increased, they preferred sedentary over active behaviour and needed proper motivation to keep active [18]. Therefore, it is very important for athletes to use appropriate coping strategies that can reduce stress, increase well-being, and at the same time be beneficial in the long run (for example, substance abuse can be useful on a short-term, it can reduce distress, but we cannot recommend this coping strategy, taking into account the long-term effects).

Three stages in adapting a person to stress were identified [19]: the initial (primary) assessment, respectively the process of perceiving the danger; secondary assessment, in other words the process by which the plan of a potential response to danger appears; the coping mechanism, more precisely the implementation of a response. Researchers underline that coping skills and flexibility are positively associated with psychological adjustments [20] and are discussing about three indicators that influence coping [21]: control – if a person can avoid the stressor, there are fewer biological manifestations of stress; feedback – when a person is informed (for example, through a visual or auditory stimulus) about the

Martial arts – plural noun

any of various systems of combat and self-defence, e.g. judo or karate, developed especially in Japan and Korea and now usually practised as a sport [92] – "every combat sport is martial arts but not vice versa" [67, p. 18].

Division of the combat sports under forms of the direct confrontation

– workings of weapons; hits (strokes); throws and grips of immobilisation of opponent's body [67].

Brazilian Jiu Jitsu – is a type of fight in which a uniform or gi is used; its main purpose is to project or take your opponent down. Once on the ground, you must seek to control your adversary with different techniques (immobilizations, chokes, joints locks). In the absence of submission at the end of the fight, the winner is declared by the number of points won [98].

Muay thai – or thai boxing. originates from southern Asia (not only from Thailand, but also from Burma, Cambodia, Vietnam and Malaysia). It was inspired by fighting skills used on battle fields during wars conducted by the Thais in the twelfth and thirteenth century AD. Apart from a fight with use of various weapons, during hand-to-hand fighting warriors used *kaad chuek* (wrappings around hand and fore-arm) which were hardened and studded with gravel to cause the greatest damage possible martial art originally from Thailand characterized by the combined use of fists, elbows, knees, shins and feet [99].

Team sport – noun any sport that is played between two or more teams, e.g. football, tennis or hockey [92].

Psychological distress – noun is known as "bad" stress (unlike eustress – known as "good" stress) and normally viewed as threatening by persons, being detrimental to performance (is what we commonly known as stress) [93].

Emotion-oriented coping strategies – plural noun

represent "self-oriented efforts directed at reducing stress through emotional responses, self-preoccupation, and fantasizing" [94].

Problem/task-oriented coping strategies – plural noun are associated with problem

resolution, involving obtaining information about the stressor in order to decide priorities and to solve the stressful situation [95].

Dysfunctional-focused coping strategies (DCS) – plural noun refers to withdrawal and ruminating, playing games on the mobile phone or PC, surfing in the internet, drinking alcohol, eating more (or less), buying useless things, under stress conditions. The use of DCS is associated with a higher probability of being burnt out [96].

COVID-19 – noun "is a disease caused by a new strain of coronavirus. 'CO' stands for corona, 'VI' for virus, and 'D' for disease. Formerly, this disease was referred to as '2019 novel coronavirus' or '2019-nCoV'. The COVID-19 virus is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS) and some types of common cold" [97].

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development of the stressful situation, the intensity of stress decreases; prediction – if the occurrence of stress is predicted, less intense reactions associated with distress are observed. But these indicators cannot be valued during a pandemic, maybe just the control – a person can avoid the stressor avoiding human interactions.

Most research (considering the coping strategies) is based on the analysis of stress and ways of adapting to stress, developed by Lazarus in 1966 [22], Lazarus and Folkman in 1984 [23]. Coping denotes the conscious use of behavioural, affective and cognitive efforts to effectively deal with events, internal and external demands that the individual perceives as potentially harmful [24]. The person may resort to anxiolytic drugs, alcohol, deny the existence of any danger or resort to humour, adopting an optimistic attitude. Coping strategies help athletes when faced with disappointments, problems, and stresses of life [25], being influenced by the aims that a person pursues in achievement contexts [26]. Adaptive coping strategies, such as positive thinking, seeking social support, active stress coping, have a positive role for maintaining athletes' health, helping them to deal with distress and burnout [27]. But what is adaptive for an athlete in a specific situation may not be adaptive for another, individual and contextual differences being important to consider [28]. Regarding the coping structure, there is little agreement in the literature, being at least 100 coping taxonomies and, also, 400 lower-order categories proposed [29]. It is worth mentioning the Coping Circumplex Model (2019), as an integrative model of the structure of coping with stress, the basic assumptions being that coping refers to both volitional/ intentional and automatized, emotional, cognitive, and behavioural responses to stress [30].

Sport performance requires, from athletes, multiple mental skills, coping skills being among the most important. Athletes must cope with stressful situations such as recovery, failure or even trauma [31], and in the last years, with the COVID-19 pandemic (we can only think how athletes' income decreased and the training was carried out, for months, at home). It seems that the perceived level of anxiety influences the coping behaviour [32]. And it is known that anxiety and stress are connected, anxiety acting as a mediator between the stressful situation and the physiological reaction patterns [33]. Investigating

aerobic gymnastics and handball practitioners, researchers emphasized that if anxiety in potentially harmful situations (as COVID-19 is), socially-evaluative circumstances, new or ambiguous situations is maintained at a medium level/ slightly below the average level, this fact is linked with a better capacity of the athletes to eliminate competing activities, with a lower level of mental passivity and with better planning abilities – as coping strategies [34]. Also, studying senior male table tennis competitors, it was found that an approach (active) coping style has the capacity to predict sports performance on the first 20 trials (a ball was projected automatically by a machine), whereas for the next 30 trials – a combination of positive and negative affect and avoidance coping strategies best predicted sports performance [35] (avoidance coping includes, among others, psychological distancing, reducing the importance of the stressor and focusing immediately on the next task).

Effective coping strategies reduce perceived stress in athletes during the pandemic [36, 37] – positive reframing (as emotion-focused coping strategy) helps athletes to have a positive mood state and reduces negative stress, while self-blaming and behavioural disengagement (dysfunctional coping strategies) negatively influences athletes' mood.

In the COVID-19 pandemic context becomes very important for the specialists to find not only physiological markers (for example, the cortisol levels, as authors mentioned above), but also psychological markers which can identify patients at risk for a rapid decline in health. Such a psychological marker could be obtained during psychological assessment and can refer to the level of experienced stress.

There are two cognitive purpose of the current study: knowledge about the subjectively experienced stress in martial arts athletes from selected Europe Union countries during the 4th wave of the pandemic; and knowledge of the likely of using coping strategies, and if so, with what frequency.

The following research questions were put forward in the current study:

1. Whether there are statistically significant differences in the level of stress between athletes practicing martial arts (combat sports) in

selected countries of the European Union during the 4th wave of the COVID-19 pandemic?

2. Whether there are statistically significant differences in stress dimensions (external stress, intrapsychic stress, emotional tension) and in the frequency of using coping strategies, between martial arts athletes who have been diagnosed with SARS-COV-2 (until the 4th wave of the pandemic) and martial arts athletes which reported that they were not ill with COVID-19?

3. Are there significant differences in perceived external stress, intrapsychic stress, emotional tension and considering emotion-focused, problem-focused and dysfunctional coping strategies (used during the 4th wave of the pandemic), between martial arts athletes from “striking combat sports” (SCS) and “grappling combat sports” (GCS) groups?

non inclusion criterion for the study was at least two years of training in a sports club and the minimum age was 18 years old (Table 1).

Athletes have been practicing martial arts (in the entire sample) for an average of 6.3 years, at different levels (84.75% achieved local/regional level performances, and 15.25% registered national/international results). In each country, athletes from both categories (considering the obtained sports performances) were investigated.

In this paper we analyse workings of weapons (SCS, $n = 215$) and throws and grips of immobilization of opponent's body as “grappling combat sports” (GCS, $n = 126$) athletes. In consequence F_{SCS} (female, $n = 77$) and M_{SCS} (male, $n = 138$), while F_{GCS} ($n = 52$) and M_{GCS} ($n = 74$) respectively.

Measures

Using an ad hoc questionnaire comprised of six items, sociodemographic and personal data were collected (athletes' age, gender, type of sport practised, years of training, competitive level, and if they have been diagnosed with SARS-COV-2 virus by the time of testing).

Perceived stress was measured using the Perception of Stress Questionnaire [38], having three scales: *intrapsychic stress*, *external stress* and *emotional tension*. There are 7 items for each scale, e.g. “Thinking about my problems makes it hard for me to fall asleep” (*intrapsychic stress*), “I feel drained by constantly having to prove I am right” (*external stress*), “Although I try to, I have

MATERIALS AND METHODS

Participants

Three hundred and forty-one competitive martial arts athletes from Hungary, Italy, Latvia, Lithuania Poland, Romania, Slovakia, and Spain were investigated (female $n = 129$, male 212). The athletes represented (according to division of the combat sports under forms of the direct confrontation – see glossary): workings of weapons (fencing); hits (boxing, karate, kickboxing, Muay Thai, taekwondo); throws and grips of immobilisation of opponent's body (Brazilian jiu-jitsu, freestyle wrestling, judo) were investigated. The *sine qua*

Table 1. Number, age and gender distribution of the martial arts athletes from eight Europe Union countries – investigated during the 4th wave of the pandemic.

Country	Women			Men		
	N	M _{age}	SD	N	M _{age}	SD
Hungary	10	28.87	10.13	14	29.15	9.10
Italy	10	21.10	5.72	20	30.8	10.25
Latvia	11	24.34	7.36	15	24.64	7.17
Lithuania	31	23.76	7.58	53	24.13	6.44
Poland	19	26.47	9.03	29	25.53	8.68
Romania	28	22.18	5.37	48	22.85	6.04
Slovakia	12	23.56	6.70	20	24.38	8.46
Spain	8	28.09	10.20	13	27.60	9.11
Total	129			212		

difficulties relaxing" (*emotional tension*). In the case of intrapsychic stress, the person has problems with himself/ herself, has difficulty coping with stress generated by various memories from the past and shows a pessimistic view (generally). Also, anticipatory thoughts generate anxiety and stress, the mental system being filled with tension. Considering external stress, the person feels that is treated/ assessed unfairly by others (at work, at home etc.). Fatigue and a sense of helplessness is felt, because the tasks and the expectations set by others exceed the resources and possibilities of the person. Referring to emotional tension, the individual feels nervous, irritable in interpersonal relationships and lacking energy. Also, the person has difficulty relaxing in everyday life and a tendency to resign from undertaking various activities in which he/ she is involved.

The athletes indicated their answers on a five-point Likert-type scale, from 1 (Not true) to 5 (True). There are no reverse items. The reliability of the three scales in the current study (in each country) was verified using the McDonald's omega coefficient (ω). In the case of the eight countries included in the research, considering the Emotional tension, ω ranged from 0.58 to 0.85, for External stress, ω ranged from 0.61 to 0.82, and for Intrapsychic stress, ω ranged from 0.59 to 0.81.

The Perception of Stress Questionnaire has been used in previous studies of athletes from various countries [39] or in the study of paramedics' stress levels [40].

The strategies of coping with stress were measured through the Brief COPE questionnaire, containing 28 items and covering 14 coping strategies: active coping, self-distraction, denial, venting, substance use, positive reframing, use of emotional support, use of instrumental support, planning, humour, acceptance, self-blame, behavioural disengagement, and religion (two statements for each coping strategy) [41]. Athletes expressed their frequency of using each strategy for coping with stress 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".

Procedure

The study was carried out during the fourth wave of the COVID-19 pandemic (starting from October 2021). At the beginning of 2022 data collection (which took place in Hungary, Italy, Latvia, Lithuania, Poland, Romania, Slovakia, and

Spain) was concluded. The snowball sampling technique was used in order to investigate the participants (senior martial arts practitioners, not easy-to-reach population). For collecting the data, the questionnaires were applied through Google forms (Google LLC, Mountain View, CA, United States), as in previous studies [42, 40].

Considering The Perception of Stress Questionnaire, the translation in Hungarian, Italian, Latvian, Lithuanian, Romanian, Slovak, and Spanish language (from the original Polish version) was carried out with the consent of the author (Ryszard Makarowski). The questionnaire was initially translated into English (from Polish) and then translated again into Polish by translators with psychological experience. The final versions of the questionnaires (in each language) were created through retroversion – a procedure which has been used in previous studies [43]. All authors have equally contributed to the study and questionnaire versions.

Statistical analysis

The STATISTICA 13.0 software for statistical analysis was used, including a single-factor multivariate analysis of variance – the Box M test was calculated and according to the Levene's test results (equality of variance) [44], Tamhane post-hoc test was interpreted [45]. Also, analyses of variance (ANOVA) with Hochberg GT2 post-hoc test (for equal variances [46]), and independent t-tests were used.

Regarding the effect size for ANOVA, eta square (η^2) range intervals are: 0.01, small; 0.06, medium effect; 0.14, large [46]. When talking about Cohen's d, it was interpreted as follows: ≤ 0.2 , trivial; > 0.2 , small; > 0.6 , moderate; > 1.2 , large; > 2.0 , very large; > 4.0 , nearly perfect [47]. The normality of the distribution was verified through the skewness coefficients, which in absolute value were less than 1 [48]. In a first phase, collected data were screened for outliers and missing values [49].

Ethics

The research was conducted with respect to the recommendations of the Declaration of Helsinki. Informed consent was obtained from all participants. Athletes were informed about the study purpose, while the anonymity and confidentiality of collected data was ensured. Also, the study was approved by the local Ethics Committee – National University of Physical Education and Sports, Bucharest, Romania (No 1185).

RESULTS

Answer the first question

All variables had a normal distribution (skewness values were less than 1.00). The results highlight that the highest emotional tension levels, during the fourth wave of the pandemic, were registered by Latvian athletes, external stress was the highest among Italian athletes, and for intrapsychic stress Slovak athletes reported the highest scores. The lowest values were observed in Lithuanian martial arts athletes, in all three stress dimensions (Table 2).

Answer the second question

All dependent variables (DVs) were normally distributed – skewness values <1. Martial arts athletes who have been diagnosed with SARS-COV-2 until wave 4 of the pandemic (the moment they completed the questionnaires) reported significantly higher levels of emotional tension, intrapsychic stress and external stress, compared to martial arts athletes which reported that they have not suffered from COVID-19. Significant differences were found, also, when investigating the frequency of using different strategies to deal with stress. Denial and behavioural disengagement were more frequent among martial arts athletes which reported that they were sick (at some

point) with COVID-19, while positive reframing was significantly less frequent (Table 3).

Answer the third question

Significant differences considering the experienced stress and the coping strategies used by martial arts (combat sports) athletes (during the 4th wave of the pandemic) were found, starting from two types (SCS or GCS) and gender – Pillai's Trace = 0.326, $F(18, 1002) = 6.778$, $p = 0.003$, η^2 (partial eta squared) = 0.11, observed power = 1. The following significant differences were found: for *emotional tension* ($p = 0.005$, respectively $p = 0.014$) between $F_{SCS} 18.71 \pm 4.90$ and $M_{GCS} 15.86 \pm 5.33$, respectively $M_{SCS} 16.64 \pm 4.33$; for *intrapsychic stress* ($p = 0.000$, $p = 0.035$, respectively $p = 0.023$), between $F_{SCS} 18.94 \pm 4.04$ and $M_{GCS} 15.08 \pm 5.57$, $M_{SCS} 17.36 \pm 3.8$, respectively $F_{GCS} 16.81 \pm 4.00$, and also, between M_{SCS} and M_{GCS} ($p = 0.013$); for *emotion-focused coping strategies* ($p = 0.014$, respectively $p = 0.003$) between $F_{SCS} 21.40 \pm 4.41$ and $M_{GCS} 23.39 \pm 3.44$, respectively $M_{SCS} 23.70 \pm 4.68$; for *dysfunctional coping strategies* ($p = 0.007$, respectively $p = 0.005$) between $F_{SCS} 26.84 \pm 3.56$ and $M_{GCS} 24.45 \pm 5.12$, respectively $M_{SCS} 25.16 \pm 3.27$ and, also, between $F_{GCS} 27.63 \pm 2.88$ and M_{GCS} , respectively M_{SCS} ($p = 0.000$, for both differences) (Table 4).

Table 2. Differences in perceived stress levels among martial arts athletes from eight Europe Union countries ($n = 341$) – post-hoc analysis (Hochberg GT2 [46]).

Country (code)	N	Emotional tension		External stress		Intrapsychic stress	
		M	SD	M	SD	M	SD
Hungary (1)	24	18.16	5.06	15.60	3.62	15.42	2.96
Italy (2)	30	17.80	6.03	18.73	4.01	18.13	4.81
Latvia (3)	26	18.86	5.62	17.26	2.97	17.44	3.73
Lithuania (4)	84	14.94	5.83	15.24	3.98	14.87	4.33
Poland (5)	48	18.15	4.52	17.59	4.31	15.84	4.04
Romania (6)	76	17.17	5.09	16.50	4.23	16.29	4.60
Slovakia (7)	32	18.74	5.16	18.68	3.94	18.49	3.45
Spain (8)	21	17.46	4.72	15.44	3.50	18.21	3.96
F		3.30		4.96		4.93	
Levene's test		0.934 (p = 0.480)		1.13 (p = 0.345)		1.94 (p = 0.063)	
Differences		3:4*; 4:5*; 4:7*		2:4***; 2:8 ^M (p = 0.063); 4:5*; 4:7***; 7:8 ^M (p = 0.058)		2:4**; 4:7***; 4:8*	
Eta2 (η2)		0.072		0.119		0.112	

Note. * $p \leq 0.05$; ** $p \leq 0.01$; *** $p \leq 0.001$; ^M(marginally) significant difference. $\eta^2 = 0.06$ indicates a medium overall effect size.

Table 3. Differences between athletes who have been diagnosed with SARS-COV-2; (59 male and 40 female athletes) and martial arts athletes which reported that they were not ill with COVID-19.

Stress and coping strategies	SARS-COV-2 (n = 99)		Healthy (n = 242)		T	P	D
	M	SD	M	SD			
Emotional tension	19.91	5.59	17.28	6.08	3.705	<0.001	0.44
External stress	18.46	5.42	16.81	4.78	2.797	0.005	0.33
Intrapsychic stress	18.40	5.04	15.32	4.88	5.247	<0.001	0.62
Self-distraction	4.67	0.47	4.63	1.77	0.214	0.831	0.02
Active coping	4.67	0.94	4.81	2.19	−0.609	0.543	−0.07
Denial	4.16	1.68	3.46	1.23	4.283	<0.001	0.51
Substance use	3.33	0.47	3.56	1.54	−1.446	0.149	−0.17
Emotional support	4.75	1.72	4.90	1.90	−0.694	0.488	−0.08
Use of informational support	4.47	2.41	4.72	1.59	−1.116	0.265	−0.13
Behavioural disengagement	3.89	1.18	3.34	1.21	3.813	<0.001	0.45
Venting	5.00	1.64	4.78	1.44	1.222	0.223	0.14
Positive reframing	3.67	1.70	5.16	2.01	−6.490	<0.001	−0.77
Planning	5.33	1.25	5.61	1.89	−1.347	0.179	−0.16
Humour	5.44	1.50	5.17	1.95	1.241	0.216	0.14
Acceptance	4.67	1.25	4.99	2.27	−1.345	0.180	−0.16
Religion	4.33	1.27	4.07	1.75	1.382	0.168	0.16
Self-blame	5.17	1.73	5.08	1.60	0.475	0.635	0.05

Female athletes from SCS registered a higher level of emotional tension and intrapsychic stress than male athletes from both SCS and GCS. The scores were higher (for intrapsychic stress) when comparing, also, to female athletes from GCS. A significant difference was observed for male athletes, those practicing SCS obtaining a higher intrapsychic stress level than male athletes from GCS disciplines. Female athletes from SCS used less frequently emotion-focused coping strategies than male athletes from both SCS and GCS. Also, female athletes (from both SCS and GCS) used, with a higher frequency, dysfunctional coping strategies, compared to male athletes (from both SCS and GCS). No significant differences were found (between the four groups) when talking about problem-focused coping strategies (Table 4).

DISCUSSION

The coronavirus disease has changed (suddenly and permanently) nearly all aspects of human functioning, such a threat not being experienced by European countries (and not only) for a long

time. In an emergency situation, when measures of confinement were taken by most governments, the coping strategies (to deal with distress) were activated [50].

The results of our research show that the highest intrapsychic stress levels, during the 4th wave of the pandemic, were registered by Slovak athletes, external stress was the highest among Italian martial arts athletes, while the highest emotional tension levels were reported by Latvian athletes. The lowest values were observed in Lithuanian martial arts athletes, in all three stress dimensions. Moderate to large differences (η^2 – the overall effect size) were found between the eight investigated countries, when talking about martial arts athletes’ perceived stress. The significant differences observed between the investigated countries could be related to numerous factors: the political and economic situation in the country, the intensity of the COVID-19 pandemic (Italy, for example, “was one of the most impacted countries by the COVID-19 crisis” [15] or employment stability. In this context, it is important to mention, also, The Human Development Report [51] (an approach focused

Table 4. Comparisons of dependent variable male athletes vs. female athletes.

Dependent variable	(I) Gender and sport type	(J) Gender and sport type	P (Tamhane post-hoc test)	95% Confidence Interval	
				Lower Bound	Upper Bound
Emotional tension	M _{GCS}	M _{SCS}	0.867	−2.70	1.16
		F _{GCS}	0.414	−4.45	0.95
		F _{SCS}	0.005	−5.07	−0.62
	M _{SCS}	M _{GCS}	0.867	−1.16	2.70
		F _{GCS}	0.846	−3.35	1.39
		F _{SCS}	0.014	−3.86	−0.29
	F _{GCS}	M _{GCS}	0.414	−.95	4.45
		M _{SCS}	0.846	−1.39	3.35
		F _{SCS}	0.837	−3.71	1.51
	F _{SCS}	M _{GCS}	0.005	0.62	5.07
		M _{SCS}	0.014	0.29	3.86
		F _{GCS}	0.837	−1.51	3.71
External stress	M _{GCS}	M _{SCS}	0.104	−2.68	0.15
		F _{GCS}	0.976	−2.34	1.33
		F _{SCS}	0.141	−4.07	0.34
	M _{SCS}	M _{GCS}	0.104	−0.15	2.68
		F _{GCS}	0.827	−1.02	2.55
		F _{SCS}	0.976	−2.76	1.57
	F _{GCS}	M _{GCS}	0.976	−1.33	2.34
		M _{SCS}	0.827	−2.55	1.02
		F _{SCS}	0.593	−3.81	1.08
	F _{SCS}	M _{GCS}	0.141	−0.34	4.07
		M _{SCS}	0.976	−1.57	2.76
		F _{GCS}	0.593	−1.08	3.81
Intrapsychic stress	M _{GCS}	M _{SCS}	0.013	−4.22	−0.33
		F _{GCS}	0.242	−4.01	0.56
		F _{SCS}	0.000	−5.98	−1.73
	M _{SCS}	M _{GCS}	0.013	0.33	4.22
		F _{GCS}	0.953	−1.19	2.28
		F _{SCS}	0.035	−3.09	−0.07
	F _{GCS}	M _{GCS}	0.242	−0.56	4.01
		M _{SCS}	0.953	−2.28	1.19
		F _{SCS}	0.023	−4.06	−0.19
	F _{SCS}	M _{GCS}	0.000	1.73	5.98
		M _{SCS}	0.035	0.07	3.09
		F _{GCS}	0.023	0.19	4.06

Dependent variable	(I) Gender and sport type	(J) Gender and sport type	P (Tamhane post-hoc test)	95% Confidence Interval	
				Lower Bound	Upper Bound
Emotion-focused coping strategies	M _{GCS}	M _{SCS}	0.995	−1.81	1.20
		F _{GCS}	0.908	−1.66	3.56
		F _{SCS}	0.014	0.27	3.70
	M _{SCS}	M _{GCS}	0.995	−1.20	1.81
		F _{GCS}	0.734	−1.36	3.86
		F _{SCS}	0.003	0.58	4.00
	F _{GCS}	M _{GCS}	0.908	−3.56	1.66
		M _{SCS}	0.734	−3.86	1.36
		F _{SCS}	0.890	−1.69	3.77
	F _{SCS}	M _{GCS}	0.014	−3.70	−0.27
		M _{SCS}	0.003	−4.00	−058
		F _{GCS}	0.890	−3.77	1.69
Problem-focused coping strategies	M _{GCS}	M _{SCS}	0.900	−1.05	2.31
		F _{GCS}	0.532	−0.99	3.80
		F _{SCS}	0.724	−1.03	3.01
	M _{SCS}	M _{GCS}	0.900	−2.31	1.05
		F _{GCS}	0.895	−1.29	2.84
		F _{SCS}	0.991	−1.24	1.96
	F _{GCS}	M _{GCS}	0.532	−3.80	0.99
		M _{SCS}	0.895	−2.84	1.29
		F _{SCS}	0.998	−2.76	1.92
	F _{SCS}	M _{GCS}	0.724	−3.01	1.03
		M _{SCS}	0.991	−1.96	1.24
		F _{GCS}	0.998	−1.92	2.76
Dysfunctional coping strategies	M _{GCS}	M _{SCS}	0.861	−2.48	1.05
		F _{GCS}	0.000	−5.11	−1.27
		F _{SCS}	0.007	−4.33	−0.47
	M _{SCS}	M _{GCS}	0.861	1.05	2.48
		F _{GCS}	0.000	−3.78	−1.17
		F _{SCS}	0.005	−3.01	−0.36
	F _{GCS}	M _{GCS}	0.000	1.27	5.11
		M _{SCS}	0.000	1.17	3.78
		F _{SCS}	0.673	−0.74	2.32
	F _{SCS}	M _{GCS}	0.007	0.47	4.33
		M _{SCS}	0.005	0.36	3.01
		F _{GCS}	0.673	−2.32	0.74

Note: M_{GCS} (n = 74); M_{SCS} (n = 138), F_{GCS} (n = 52); F_{SCS} (n = 77)

on people and their opportunities), which indicates (among others) the Global Multidimensional Poverty Index and the Inequality-Adjusted Human Development Index (IHDI), reflecting the quality of life in a given country.

Using the same instrument to measure stress (as in the current study), researchers highlighted that during the height of the pandemic (between March 1, 2020 to July 12, 2020), martial arts athletes from Poland and Romania registered lower levels of stress than in the pre-pandemic period [39]. There are, also, other studies reporting that in April 2020 (when countries had been in alarm stage) a relatively low level of stress and anxiety was observed in athletes [50]. Comparing the data (from the 1st wave of the pandemic) [see 39] with the results obtained in the present study (during the 4th wave of the pandemic), a higher level of external stress, intrapsychic stress and emotional tension can be observed in martial arts athletes from the eight European countries. This increase, in the three stress dimensions, during the 4th wave of the pandemic (comparing to the 1st wave), can be explained as a consequence of prolonged negative events – a prolonged pandemic can generate an accumulation of experienced stress and greater health concerns, personal resources starting to run out and leading to poor adaptation to existing conditions [52, 53]. In addition, uncertain prospects for the future [54] and the chronic fatigue syndrome [55] can affect athletes' perceived stress during the COVID-19 crisis.

The results highlighted also that martial arts athletes who have tested positive for COVID-19 reported significantly higher levels of intrapsychic stress, emotional tension and external stress, compared to athletes which reported that they have not suffered from COVID-19. Significant differences were found, also, when investigating the frequency of using different coping strategies. Denial and behavioural disengagement were more frequent among martial arts athletes which reported that they were sick (at one point) with COVID-19, while positive reframing was significantly less frequent. It seems denial, behavioural disengagement, venting of emotions, acceptance and self-blame represent coping strategies used when an important stressor occurs, female and male martial arts athletes resorting to these strategies to reduce distress when they first faced the COVID-19 pandemic [39].

Behavioural disengagement express helplessness and negatively influence athletes' mood [56], while individuals who use denial in a stressful situation (a dysfunctional coping strategy which engages the defence mechanisms of the Ego) can employ in unhealthy behaviours [58 57] and, also, display a low level of self-control [58]. Therefore, counselling athletes (and not only) during the COVID-19 pandemic is essential for acquiring healthy behaviours. Positive stress (eustress) could be induced in athletes through mindful activities – the experience of one's body as trustworthy and safe [59], while the role of cognitive and behavioural strategies in a COVID-19 world has proven its effectiveness [60]. It is worth mentioning, also, “an integrative model of intervention against psychological (chronical and traumatic) stress”, comprising three major domains: emotional, cognitive, and behavioural (body) – see [61].

Positive reframing was significantly less frequent among martial arts athletes who suffered (at some point) from COVID-19. This is an important issue. Pété et al. [62] emphasized the essential role of stress reappraisal interventions to effectively manage pandemic-related impact in athletes. Positive reappraisal is associated with a reduced level of negative affect [63], the positive reframing techniques being found (over time) to be effective in reducing depression [64, 65]. More than that, positive reframing reduces distress in athletes [56] (do not forget that martial arts athletes who reported that they have been diagnosed with SARS-COV-2 registered higher levels of stress).

So far, there is limited research considering the recommendations that may be followed for returning athletes who have tested positive for COVID-19, the key message being that a thorough medical history, psychological and physical examination should be conducted, prior to returning to sports activities after COVID-19 infection [66].

Not least, using a single-factor multivariate analysis of variance, the differences considering stress levels and coping strategies used by martial arts athletes – depending on the type of combat sports (classified according to the form of the direct confrontation: workings of weapons; hits; throws and grips of immobilisation of opponent's body [67]) and gender – during the 4th wave of

the pandemic were investigated. There is a gap in the literature on such comparison between martial arts and combat sports disciplines.

In the current study, workings of weapons athletes represented fencers. Disciplines qualified for the hits category are: boxing, karate, kick-boxing, Muay Thai, taekwondo. By convention, combat sports athletes from both groups were qualified for the SCS (hits). Disciplines throws and grips of immobilisation of opponent's (GCS) represented by athletes: Brazilian jiu-jitsu, judo and wrestling. The four groups (2 female and 2 male) formed were examined starting from six dependent variables: intrapsychic stress, emotional tension, external stress, problem-focused coping strategies, emotion-focused and dysfunctional strategies. The results underlined that female athletes from SCS registered a higher level of emotional tension and intrapsychic stress than male athletes from both groups (SCS and GCS). The scores were higher (for intrapsychic stress) when comparing, also, to female athletes from GCS. The results are in line with those from the specialized literature, women reporting higher stress intensity compared to men [68], when talking, also, about women athlete [69] or female university students [70].

An interesting aspect is notable in terms of female athletes from GCS, with no significant differences compared to men. The results highlighted, also, a significant difference for male athletes, those practicing SCS obtaining a higher intrapsychic stress level than male athletes from GCS disciplines.

When talking about the coping strategies used by martial arts athletes (during the 4th wave of the pandemic), female athletes from SCS used less frequently emotion-focused coping strategies than male athletes from both SCS and GCS groups. At first sight, these results are surprising, taking into account the gender differences in coping with stress reported by the literature – women are using more emotion-focused coping strategies than men [71, 70]. As Khosla stated [72] the differences may be due to gender-related socialization experienced. In agreement with the socialization hypothesis (see, for example [73]), women and men are socialized to cope with stress in various ways (there are stereotypes which favour men to cope with stress less emotionally and more instrumentally, while

women are encouraged to express emotions and to use emotion focused strategies, with greater frequency). However, there are studies who argue that „gender differences were not evident in the use of emotion focused coping strategy” [72] (also, the investigated participants were not athletes).

More than that, researchers underlined that, in stressful conditions, men also used emotion focused coping [74] (in this case too, the participants were not athletes). When talking about martial arts athletes, it seems that male wrestlers (GCS), were characterized by emotion-focused coping (but also, by problem-focused strategies, depending on the level of conscientiousness) [75]. The same authors emphasized that „female wrestlers with high neuroticism and low conscientiousness preferred emotion-oriented coping”, while female wrestlers less agreeable were characterized by problem-focused coping. Also, differences between trained men (karate) and women (karate and judo) were highlighted, with female athletes using more frequently emotion-oriented strategies than men [76] (a reduced sample was used in this case and female group consisted of both SCS and GCS: 7 karate and 7 judo practitioners).

Sport is a stress-generating environment [77], a significant release of stress hormones being observed in athletes, as a result of psychophysical stress linked to sports competition [78]. In these conditions (adding Khosla finding [72] – „there are some doubts in our understanding of how gender as a variable influences coping processes”), we can argue that female athletes from SCS have used less frequently than men – during the 4th wave of the pandemic, emotion-focused coping strategies (emotional support, humour, positive reframing, acceptance and religion) in a stressful situation.

Considering the problem-focused coping strategies, no significant differences were found between the four investigated groups. Even if some researchers emphasized that men use more problem-focused strategies [79, 80], other studies reported the opposite (women are using problem-focused strategies to deal with stress more often than men) [81]. Also, researchers asserted that no significant differences were observed between women and men when talking about problem-focused strategies of handling stressful experiences [82, 83]. In martial arts,

authors found no significant differences for task-oriented strategy between men and women [76]. „Gender differences in coping strategies is not clear, especially with respect to problem-focused coping strategy” [72].

In the current study, female athletes (from both SCS and GCS) used, also (during the 4th wave), with a higher frequency, dysfunctional coping strategies (venting, self-blame, substance use, behavioural disengagement, self-distraction and denial – taken together), compared to male athletes (from both SCS and GCS). Researchers found that the use of self-blame by women is linked to psychological distress and a higher level of anxiety, in response to stressful circumstances [84] (do not forget that athletes from F_{SCS} group obtained higher emotional tension and intrapsychic stress levels than male athletes). Also, higher levels of self-blame along with lower levels of positive reframing are representing a risk factor for the development of negative affect in women [85]. Little is known regarding the coping strategies used by female and male martial arts athletes from SCS and GCS (considered separately). In 2020, authors emphasized that female and male martial arts athletes (without being separated into SCS and GCS) used the following coping strategies to deal with stress generated by the lockdown period and the 1st wave of the pandemic: venting, substance abuse, acceptance and denial [39]. Women additionally used behavioural disengagement. It stands out, therefore, the need for athletes’ counselling during COVID-19 crisis (which has almost reached its seventh wave), especially in the case of female athletes from SCS groups.

This study has some limitations. The first limitation refers to the explicit measures (using questionnaires), the issue of possible desirable responses being known [86] (however, the relatively large number of martial arts athletes investigated represents a strength of the research). Also, a possible recall bias is not excluded. The results may be different if athletes from a single sport discipline would be investigated. Moreover, the moment when martial arts athletes suffered from COVID-19 was not examined, as a different variable (only whether they have been tested positive or not for COVID-19, until the 4th wave). Finally, there is also a risk that some of the athletes which reported that they were not ill with COVID-19 were asymptomatic and untested.

Apart from these remarks, another methodological issue is also worth emphasizing. When the foundations of the science of martial arts were being created (first, in 2000, the theory of combat sports [67], then a scientific journal [87], and finally the presentation of this new scientific sub-discipline during the international AHFE conference in the USA [88]), it would be difficult to predict that these and earlier [39] research martial arts (combat sports) athletes. The COVID-19 pandemic took everyone by surprise. It is not surprising, however, that the science of martial arts so quickly became a detailed sub-discipline of innovative agonology [89-91] – science dedicated to the broadly understood struggle.

CONCLUSIONS

Martial arts athletes who have tested positive for COVID-19 reported significantly higher levels of intrapsychic stress, emotional tension and external stress, compared to athletes which reported that they have not suffered from COVID-19. Denial and behavioural disengagement (as dysfunctional coping strategies) were more frequent among athletes which reported that they were sick with COVID-19, while positive reframing was significantly less used.

Female athletes representing SCS registered a higher level of emotional tension and intrapsychic stress than male athletes from both SCS and GCS groups. F_{SCS} group used less frequently emotion-focused strategies to deal with stress during the 4th wave of the pandemic, compared to male athletes from both SCS and GCS, apparently, a surprising result. Not least, female athletes from both SCS and GCS used (during the 4th wave), with a higher frequency, dysfunctional coping strategies (venting, self-blame, substance use, behavioural disengagement, self-distraction and denial – taken together), compared to male athletes.

The research can be of interest for martial arts athletes, coaches, parents and sports psychologists seeking to promote the most effective strategies to deal with negative stress, in a context in which the pandemic may have long-term consequences for athletes’ mental health and psychological well-being.

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