Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.

Psychoneuroendocrinology 129 (2021) 105269

Contents lists available at ScienceDirect

Psychoneuroendocrinology

journal homepage: www.elsevier.com/locate/psyneuen

Competitive anxiety or Coronavirus anxiety? The psychophysiological responses of professional football players after returning to competition during the COVID-19 pandemic

Amir Hossien Mehrsafar [a,b], Ali Moghadam Zadeh [b,c,*], José Carlos Jaenes Sánchez [d,e], Parisa Gazerani [f,g,**]

[a] Department of Sport Psychology, Faculty of Sports Sciences, University of Tehran, Tehran, Iran
[b] Center for International Scientific Studies and Collaboration (CISSC), Ministry of Science, Research and Technology, Tehran, Iran
[c] Department of Psychology, Faculty of Psychology and Education, University of Tehran, Tehran, Iran
[d] Department of Social Anthropology, Basic Psychology & Health, Universidad Pablo de Olavide, Seville, Spain
[e] Andalusian Center of Sport Medicine, Seville, Spain
[f] Department of Health Science and Technology, Faculty of Medicine, Aalborg University, Aalborg, Denmark
[g] Department of Life Sciences and Health, Faculty of Health Sciences, Oslo Metropolitan University, Oslo, Norway

A R T I C L E I N F O

Keywords:
Football
COVID-19
Stress
Fear of COVID
COVID-19 anxiety
Elite athletes

A B S T R A C T

Objective: This study aimed to examine the relationship between competitive anxiety, fear/anxiety of COVID-19, and autonomic and endocrine stress responses in professional football players after returning to competition during the COVID-19 pandemic.

Methods: Ninety male professional football players (age: 26.33 ± 2.48 yr) volunteered to participate in this study, which included an official competition. Psychophysiological responses, including the Fear of COVID-19 Scale, the Coronavirus Anxiety Scale, and the Competitive State Anxiety Inventory-2 Revised, were collected 30 min before the competition. In addition, salivary alpha-amylase (sAA) and salivary cortisol (sCort) were collected at 8 a.m. and 15 min before the competition.

Results: The main findings, based on the Pearson correlation, showed significant positive correlations between COVID-19 anxiety and somatic competitive anxiety ($p = 0.01$), cognitive competitive anxiety ($p = 0.01$), and competition response of sCort and sAA ($p = 0.01$). Moreover, fear of COVID-19 was positively correlated with COVID-19 anxiety ($p = 0.01$). On the contrary, the awakening response of sCort and sAA was not found to be correlated with psychological parameters (all $p > 0.05$). The analysis also indicated that there was no significant correlation between self-confidence with other psychological and physiological variables (all $p > 0.05$). The regression analysis showed that cognitive anxiety was a relevant predictor for the competition response of sCort and sAA ($p < 0.05$). Moreover, COVID-19 anxiety was the only predictor of somatic and cognitive anxiety ($p < 0.05$).

Conclusions: The present study provides the first preliminary evidence that COVID-19 anxiety and competitive anxiety might pose a negative impact on the athletic performance of professional football players during COVID-19 pandemic competitions. Thus, research is needed to build a strategy to reduce the psychophysiological stress related to COVID-19 and competition response.

1. Introduction

The pandemic of the viral disease caused by the new coronavirus (COVID-19) is still ongoing, and returning to normal activities is still a challenge (Barnes and Sax, 2020). Accumulating evidence shows that the COVID-19 outbreak affects individuals globally at any age, ethnicity,

* Correspondence to: Faculty of Psychology and Education, University of Tehran, Jalal Al-e-Ahmad Avenue, Tehran, Iran.
** Correspondence to: Faculty of Health Sciences, Oslo Metropolitan University, 0130 Oslo, Norway.
E-mail addresses: a.mehrsafar@ut.ac.ir, a.mehrsafar@gmail.com (A.H. Mehrsafar), amoghadamzadeh@ut.ac.ir (A. Moghadam Zadeh), jcjaesan@upo.es (J.C. Jaenes Sánchez), gazerani@hst.aau.dk, parisaga@oslomet.no (P. Gazerani).

https://doi.org/10.1016/j.psyneuen.2021.105269
Received 25 January 2021; Received in revised form 5 May 2021; Accepted 6 May 2021
Available online 14 May 2021
0306-4530/© 2021 Elsevier Ltd. All rights reserved.

and gender (Brooks et al., 2020). The threat to health following viral infection results in severe respiratory system damage, failure of other organs, and death (Yi et al., 2020). Serious mental health effects are also becoming more evident. The fear of sickness or losing one's life over contamination, helplessness, and loneliness due to isolation is known, in many individuals, to lead to a spread of public mental health and psychological crises concerning anxiety, stress, or depression (Dubey et al., 2020).

A recent systematic review with meta-analysis presented high stress and anxiety as features of the negative mental impact of COVID-19 in the general public (Salari et al., 2020). A similar impact has also been investigated in youth (Al Omari et al., 2020). These studies emphasize the anxiety and fear related to COVID-19 (Mahmud et al., 2020). Fear is defined by the emotion caused by perceived threat or danger, which induces physiological alterations and, eventually, behavioral changes, such as hiding, fleeing, or freezing from perceived traumatic conditions (Mertens et al., 2020). Fear is regularly caused in response to particular stimuli occurring in the present or the expectation or anticipation of a potential threat perceived as a risk to human beings (Ng and Kemp, 2020). Anxiety, on the other hand, is considered to be a feeling of uneasiness and worry, usually generalized and not concentrated as an overreaction to a condition that is only considered mentally threatening. It is regularly associated with restlessness, muscular tension, problems with concentration, and fatigue (Levitt, 2015). According to previous reports (Ahorsu et al., 2020; Taylor, 2019), fear and anxiety are inter-related and both have been linked to pandemics.

Elite athletes are normally under competitive stress; however, as a part of the population, they are also affected by the physical and mental consequences of the COVID-19 pandemic (Mehrsafar et al., 2020). The mental impact of the pandemic for elite athletes originated from the cancellation or postponement of competitions, violation of training, and frequent removal and placement of lockdowns, generating uncertainty for their athletic career (Davis et al., 2020; Håkansson et al., 2020). Based on these and on a recent narrative review (Reardon et al., 2020), it is recommended that elite athletes receive special care regarding their mental health during the course of pandemics.

In the semi-lockdown phase, where some athletic competitions are permitted (Tilp and Thaller, 2020), elite athletes seem to experience stress and anxiety related to the ongoing pandemic, together with competition-related stress (Campbell et al., 2018). The development of anxiety depends on the subjective characteristics and coping capacity of elite athletes (Palazzolo, 2020). Under a stressful situation (e.g., a real competition) (Garcia et al., 2013), subcortical regions (including the hypothalamus, brainstem monoaminergic nuclei, and amygdala) trigger robust neuroendocrine responses and, remarkably, the activation of the sympathetic–adrenal–medullary (SAM) pathway and the hypothalamic–pituitary–adrenal (HPA) axis, resulting in increased levels of cortisol (Ulrich-Lai and Herman, 2009). Cortisol is produced in response to the activation of the HPA axis, which participates in the modulation of stress responses. As opposed to cortisol, the salivary enzyme alpha-amylase (sAA) reflects autonomic nervous system (ANS) activation (Capranica et al., 2017; Strahler et al., 2017). Evidence from comparative studies shows that sAA is a more accurate marker of an individual's response to stress, because of the higher sensitivity of the sympathetic nervous system compared to the HPA hormone axis (Allwood et al., 2011; Rashkova et al., 2012). sAA is highly sensitive to stress-related changes (Engert et al., 2011), and a relationship between intra-individual changes in sAA, and physical (Kivlighan and Granger, 2006) and psychological stressors exist (van Stegeren et al., 2008). Elevated levels of stress biomarkers, including sAA and cortisol, before and during a sports competition, have been shown to exert a negative impact on athletes' performance (Alix-Sy et al., 2008; Azarbayjani et al., 2011; Filaire et al., 2009, 2013; Foretic et al., 2020; Lautenbach et al., 2014). It has been proposed that cortisol may affect cognitive processes and attentional control or reinforce risky behaviors, which may lead to more mistakes (Lautenbach et al., 2015).

Under pandemic conditions, an extra source of fear/anxiety is present in addition to competition-related anxiety. It is not known how these two sources of stressors (competition and pandemic) might interact with one another and whether the sum of negative impacts might occur in elite athletes or a completely new form of stressor might be shaped. Hence, in this study, we aimed to identify the relationship between competitive anxiety, anxiety/fear of COVID-19, and the physiological markers of cortisol and alpha-amylase in professional football players after returning to competition while the COVID-19 pandemic is still ongoing. We hypothesized that these two sources of fear/anxiety of COVID-19 plus competition anxiety can pose a greater negative impact on the mental health of professional football players and that we can potentially identify a correlation between saliva markers and subjective responses.

2. Methods

2.1. Participants

Participants were recruited through correspondence with football clubs associated with the Iranian Football League. Following the provision of information about the study and phone screening, eligible teams were invited. Ninety male professional football players (training: 11.67 ± 1.62 h/week^{-1}; training history: 10.03 ± 3.28 yr) volunteered to participate in our study (age: 26.33 ± 2.48 yr; body mass index: 23.07 ± 2.06 kg m^{-2}). All participants were healthy (with no psychiatric or clinical conditions), with a negative COVID-19 test and without a history of COVID-19 infection, and were non-smokers. Participants signed an informed consent form. This study was approved by the Committee of Research Ethics in Sport Sciences Research Institute of Iran (approval number: 1399.842) and conducted according to the Declaration of Helsinki (World Medical Association, 2013). The participants did not receive any compensation for their participation.

2.2. Psychometric assessments

2.2.1. Competitive State Anxiety Inventory-2 Revised (CSAI-2R)

To assess the multidimensional components of anxiety in athletes, the Competitive State Anxiety Inventory-2 (CSAI-2) was used. We utilized the revised version (17 items) (Cox et al., 2003), which assesses the subscales and *self-confidence* (five items; e.g., "*I'm confident about performing well*"), *cognitive anxiety* (five items; e.g., "*I am concerned about losing*"), and *somatic anxiety* (seven items; e.g., "*My body feels tense*"). Each item was given on a four-point scale with the anchors in range of (1) "Not at all" to (4) "Very much so". Higher scores on the somatic and cognitive anxiety subscales signify a higher degree of competitive anxiety, while higher scores on the subscale of self-confidence denote higher levels of self-confidence. The reliability of the Persian form of the CSAI-2R using Cronbach's alpha coefficient was acceptable in the range of 0.75–0.83. Moreover, three factors were extracted using principal component analysis, and confirmatory factor analysis confirmed three subscales with 17 items (Mehrsafar et al., 2016).

2.2.2. Fear of COVID-19 Scale (FCS)

The FCS was developed by Ahorsu et al. (2020) for the determination of fear of COVID-19 in the general population (in 717 Iranian participants). The items of the FCS were constructed based on an extensive review of existing scales on fear, expert evaluations, and participant interviews. This scale contains a 7-item of fear of COVID-19 descriptors (e.g., "*It makes me uncomfortable to think about COVID-19*"). Answers ranged from (1) "strongly disagree" to (5) "strongly agree". The minimum score possible for each question was 1, and the maximum was 5. The total score was calculated by adding up the scores of each item (ranging from 7 to 35). Higher scores indicate a higher fear of COVID-19. Validity using both classical test theory and the Rasch model were satisfactory on the seven-item scale. The reliability values, such as internal consistency ($\alpha = 0.82$) and test–retest reliability (ICC = 0.72), were acceptable (Ahorsu et al., 2020).

2.2.3. Coronavirus Anxiety Scale (CAS)

We utilized the CAS to determine COVID-19 anxiety. This five-item scale was developed by Lee (2020) as the first published scanner of the COVID-19 anxiety in 775 adults in the USA. Each item (e.g., "*I felt paralyzed or frozen when I thought about or was exposed to information about the coronavirus*") was rated on a five-point scale to reflect the frequency of the symptom, ranging from 0 (not at all) to 4 (nearly every day). The total score was the sum of the item scores (range, 0–20). Higher scores in each item denote higher levels of COVID-19 anxiety. The Cronbach's alpha reliability of the Persian version with 5-item was 0.91, and the confirmatory factor analysis confirmed a one-factor model with good fit statistical indexes (Mohammadpour et al., 2020).

2.3. Physiological assessments

To avoid contamination of saliva with drink or food, we asked our participants to refrain from eating at least one hour before the saliva sampling. We also requested participants to rinse their mouths completely with tap water before obtaining the samples. Additionally, they were instructed not to brush their teeth for at least 30 min before the sampling. Participants were asked to passively drool their saliva in a single-use plastic cup (2.5 mL) for 2 min. The content of the cup was then transported to polypropylene vials for storage at –20 °C until the physiological assay. After centrifugation at 1620 × *g* for 15 min (to produce a clear supernatant of low viscosity), the sCort level (nmol/L) was determined using an enzyme-linked immune sorbent assay kit (Zellbio™, Germany). The level of sAA (U/mL) was determined using a kinetic reaction assay (Salimetrics, State College, PA) without any modification to the manufacturer's protocol. Salivary cortisol intra- and inter-assay coefficients of variation of ˂8% were accepted. The detection limit of the kit was 0.1 nmol/L. Alpha amylase enzyme intra- and inter-assay coefficients of variation less than 0.10% were accepted.

2.4. Procedure

One competition (in the first week of the competition season) was included in this study. This enabled us to study competitive conditions similar to real-life competitions during the COVID-19 pandemic. The competitions were run under the rules of the Football Federation of Iran, along with COVID-19 restrictions (e.g., without spectators, social distancing, COVID-19 tests, and reduced number of organizers, etc.). Moreover, the staff and players of opponent teams had a negative COVID-19 test no older than 24 h prior to the competition, according to the rules. This study was conducted in November 2020 during the Iranian football super league. Before the initiation of the main test, the participants and teams were familiarized with the experimental procedure in a separate session. A saliva sample was taken upon awakening in the day of competition (08:00 h ± 30 min). The participants completed the CSAI-2R, CAS, and FCS 30 min before the competition (15.30 h ± 30 min), and the saliva samples were taken 15 min before the competition (14.00 h ± 30 min) in the locker room (Filaire et al., 2009). A schematic of the experimental setting is shown in Fig. 1.

2.5. Statistical analyses

First, data were checked for normality and outliers. There were no missing data in the self-reported parameters and the salivary stress markers. The Kolmogorov–Smirnov normality test illustrated that most variables were not normally distributed. We used LN-transformation to restore normality. However, the means and standard deviations in the text and tables indicate the absolute values for displaying purposes. The relationships between the psychological components and the physiological parameters were examined using Pearson's correlation coefficients and coefficients of determination (r^2). The strength of correlation coefficients were interpreted in the rate of very weak to very strong (r = 0.00–0.19 as "very weak," 0.20–0.39 as "weak," 0.40–0.59 as "moderate," 0.60–0.79 as "strong," and 0.80–1.0 as "very strong").

In terms of whether self-report measures predict changes in salivary stress markers, we performed multiple regression analysis with the enter method. In more detail, we regressed the responses of sCort and sAA before competition and awakening as the dependent variables, and competitive anxiety, COVID-19 anxiety, and fear of coronavirus as the predictors. Moreover, multiple regression analysis with the enter method was conducted to test if the fear of COVID-19 and COVID-19 anxiety significantly predict the competitive anxiety subscales. The alpha level was fixed at 0.05. The statistical program package SPSS version 22 was utilized.

3. Results

The means and standard deviations (SDs) for the self-report measures (CSAI-2, CAS, and FCS) and salivary stress markers (sCort and sAA) and the correlation between these variables are shown in Table 1.

As shown in Table 1, Pearson's correlation coefficient showed significant positive correlations of somatic anxiety with respect to cognitive anxiety ($r = 0.706$, $r^2 = 0.498$, $p = 0.001$), fear of COVID-19 ($r = 0.224$, $r^2 = 0.050$, $p = 0.034$), COVID-19 anxiety ($r = 0.478$, $r^2 = 0.228$, $p = 0.001$), competition response of sCort ($r = 0.342$, $r^2 = 0.116$, $p = 0.001$), and competition response of sAA ($r = 0.437$, $r^2 = 0.190$, $p = 0.001$). However, the awakening response of sCort ($r = -0.036$, $r^2 = 0.0012$, $p = 0.733$) and sAA ($r = -0.013$, $r^2 = 0.0001$, $p = 0.900$) reflected no significant correlations with respect to somatic anxiety. In terms of cognitive anxiety, we observed that significant positive correlations with respect to fear of COVID-19 ($r = 0.217$, $r^2 = 0.047$, $p = 0.040$), COVID-19 anxiety ($r = 0.528$, $r^2 = 0.278$, $p = 0.001$), competition response of sCort ($r = 0.450$, $r^2 = 0.202$, $p = 0.001$), and competition response of sAA ($r = 0.468$, $r^2 = 0.219$, $p = 0.001$). On the contrary, there were no significant correlations for cognitive anxiety with respect to the awakening response of sCort ($r = 0.069$, $r^2 = 0.004$, $p = 0.517$) and the awakening response of sAA ($r = 0.095$, $r^2 = 0.009$, $p = 0.372$). The analysis indicated that there

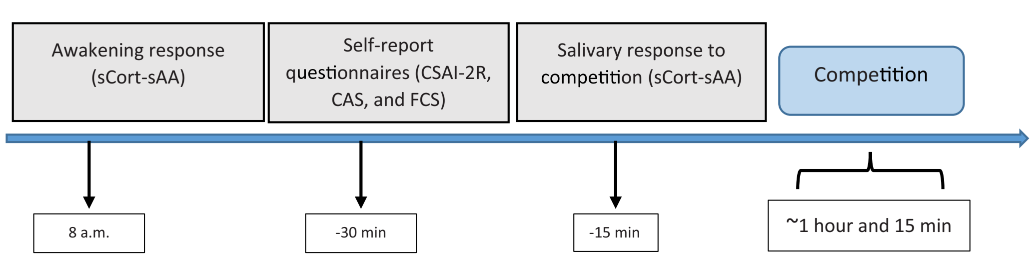

Fig. 1. Schematic representation of the experimental setting. Participants completed the CSAI-2R, CAS, and FCS 30 min before the football competition. Besides, saliva samples were collected at 8 a.m. and before competition (15 min before). The length of the competition was approximately 1 h and 15 min. Note: CSAI-2, Competitive State Anxiety Inventory-2; sAA, Salivary Alpha-Amylase; sCort, Salivary Cortisol; CAS, Coronavirus Anxiety Scale; FCS, Fear of Coronavirus Scale.

Table 1
Descriptive data and correlation between psychological (CSAI-2, CAS, and FCS) and physiological (sCort and sAA) variables in professional football players during COVID-19 pandemic.

Variables	1. Somatic anxiety		2. Cognitive anxiety		3. Self confidence		4. Fear of coronavirus		5. Coronavirus anxiety		6. sCort (Awakening response)		7. sCort (Competition response)		8. sAA (Awakening response)		9. sAA (Competition response)	
	r	sig	r	sig	r	sig	r	sig	r	sig	r	sig	r	sig	r	sig	r	sig
1	–	–	0.706	0.001	-0.030	0.776	0.224	0.034	0.478	0.001	-0.036	0.733	0.342	0.001	-0.013	0.900	0.437	0.001
2			–	–	0.005	0.964	0.217	0.040	0.528	0.001	0.069	0.517	0.450	0.001	0.095	0.372	0.468	0.001
3					–	–	-0.076	0.477	-0.045	0.673	-0.020	0.851	0.164	0.123	-0.015	0.890	0.040	0.708
4							–	–	0.321	0.002	0.099	0.353	0.121	0.255	0.004	0.973	0.073	0.491
5									–	–	-0.085	0.428	0.258	0.014	0.166	0.118	0.277	0.008
6											–	–	0.230	0.030	-0.205	0.053	-0.076	0.479
7													–	–	-0.098	0.359	0.319	0.002
8															–	–	0.027	0.802
9																	–	–
Mean	10.988		11.277		12.144		15.955		11.055		37.140		17.967		62.287		23.505	
SD	2.506		2.486		1.303		4.027		3.010		9.627		3.599		11.12		5.332	

Note: sCort: salivary cortisol; sAA: salivary alpha amylase; n = 90.

were no significant correlations for self-confidence with respect to the other psychological (somatic anxiety: $r = -0.030$, $r^2 = 0.0009$, $p = 0.776$; cognitive anxiety: $r = 0.005$, $r^2 = 0.00002$, $p = 0.964$; fear of COVID-19: $r = -0.076$, $r^2 = 0.005$, $p = 0.477$; COVID-19 anxiety: $r = -0.045$, $r^2 = 0.002$, $p = 0.673$) and physiological (awakening response of sCort: $r = -0.020$, $r^2 = 0.0004$, $p = 0.851$; competition response of sCort: $r = 0.164$, $r^2 = 0.026$, $p = 0.123$; awakening response of sAA: $r = -0.015$, $r^2 = 0.0002$, $p = 0.890$; competition response of sAA: 0.040, $r^2 = 0.0016$, $p = 0.708$) variables.

Additionally, Pearson's correlation coefficient showed a significant positive correlation for fear of COVID-19 with respect to COVID-19 anxiety ($r = 0.321$, $r^2 = 0.103$, $p = 0.002$). The analysis illustrated that there were no significant correlations for fear of COVID-19 with respect to the awakening response of sCort ($r = 0.099$, $r^2 = 0.009$, $p = 0.353$), the competition response of sCort ($r = 0.121$, $r^2 = 0.014$, $p = 0.255$), the awakening response of sAA ($r = 0.004$, $r^2 = 0.000016$, $p = 0.973$), and the competition response of sCort ($r = 0.073$, $r^2 = 0.0053$, $p = 0.491$). Pearson's coefficient showed significant positive correlations for COVID-19 anxiety with respect to the competition responses of sCort ($r = 0.258$, $r^2 = 0.066$, $p = 0.014$) and sAA ($r = 0.277$, $r^2 = 0.076$, $p = 0.008$). However, the awakening response of sCort ($r = -0.085$, $r^2 = 0.0072$, $p = 0.428$) and sAA ($r = 0.116$, $r^2 = 0.0134$, $p = 0.118$) reflected no significant correlations with respect to COVID-19 anxiety. Pearson's correlation coefficient showed a significant positive correlation for the awakening response of sCort with respect to the competition response of sCort ($r = 0.230$, $r^2 = 0.052$, $p = 0.030$). However, there were no significant correlations for the awakening response of sCort with respect to the awakening response of sAA ($r = -0.205$, $r^2 = 0.042$, $p = 0.053$) and the competition response of sAA ($r = -0.076$, $r^2 = 0.0057$, $p = 0.479$). In terms of the competition response of sCort, we observed a significant positive correlation with respect to the competition response of sAA ($r = 0.319$, $r^2 = 0.101$, $p = 0.002$). On the other hand, there was no significant correlation for the competition response of sCort with respect to the awakening response of sAA ($r = -0.098$, $r^2 = 0.009$, $p = 0.359$). Finally, Pearson's correlation coefficient indicated no significant correlation for the awakening response of sAA with respect to the competition response of sAA ($r = 0.027$, $r^2 = 0.0007$, $p = 0.802$).

The regression analysis showed that the model for the awakening response of sCort was not significant ($R^2 = 0.052$, F [5,84] = 0.928, $p = 0.467$) and no variables were a relevant predictor. On the other hand, as shown in Table 2, the model for the competition response of sCort was significant, and this model explained 23.2% (R^2) of the variance (F [5,84] = 5.074, $p = 0.001$). Moreover, in this model, cognitive anxiety was the only predictor ($\beta_{standardized} = 0.395$, $t = 2.785$, $p = 0.007$). In terms of the sAA awakening response, the model was not significant ($R^2 = 0.044$, F [5,84] = 0.873, $p = 0.503$) and no variables were a relevant predictor (all $p > 0.05$). Moreover, the regression analysis with the enter method showed that cognitive anxiety was significant ($\beta_{standardized} = 0.309$, $t = 2.139$, $p = 0.031$), and this model explained 24.5% (R^2) of the variance in the competition response of sAA (F [5,84] = 5.462, $p = 0.001$).

As shown in Table 3, the model for somatic and cognitive anxiety was significant ($R^2 = 0.234$, F [2,87] = 13.295, $p = 0.001$; $R^2 = 0.281$, F [2,87] = 17.010, $p = 0.001$, respectively) and COVID-19 anxiety was only predictor (somatic anxiety: $\beta_{standardized} = 0.377$, $t = 4572$, $p = 0.001$; cognitive anxiety: $\beta_{standardized} = 0.422$, $t = 5.323$, $p = 0.001$). Finally, for self-confidence, the model was not significant ($R^2 = 0.006$, F [2,87] = 0.273, $p = 0.762$) and no variables were a relevant predictor (all $p > 0.05$).

4. Discussion

The purpose of this study was to determine the relationship between competitive anxiety, fear/anxiety of COVID-19, and the physiological stress markers (sCort and sAA) in professional football players. This

Table 2
Regression analyses with physiological markers of sCort and sAA as the dependent variable.

Variable	sCort (Awakening response)				sCort (Competition response)				sAA (Awakening response)				sAA (Competition response)			
	B	β	t	sig	B	β	t	sig	B	β	t	sig	B	β	t	sig
Somatic anxiety	-0582	-0.152	-0.993	0.323	0.071	0.050	0.361	0.719	-0.420	-0.197	-1.290	0.200	0.973	0.219	1.608	0.112
Cognitive anxiety	0.948	0.245	1.553	0.124	0.572	0.395	2.785	0.007	0.297	0.138	0.876	0.384	1.381	0.309	2.193	0.031
Self confidence	-0.176	-0.024	-0.223	0.824	0.461	0.167	1.737	0.086	-0.066	-0.016	-0.150	0.881	0.366	0.043	0.450	0.654
Fear of coronavirus	0.330	0.138	1.223	0.225	0.026	0.029	0.289	0.773	-0.064	-0.048	-0.427	0.671	-0.131	-0.048	-0.472	0.638
Coronavirus anxiety	-0.597	-0.187	-1.426	0.157	0.029	0.024	0.204	0.839	0.358	0.202	1.543	0.127	0.097	0.026	0.224	0.823

Note: B: unstandardized beta; β: standardized regression weight; sCort: salivary cortisol; sAA: salivary alpha amylase; n = 90.

study demonstrated that somatic–cognitive anxiety is correlated with fear/anxiety of COVID-19 and the competition responses of sCort and sAA. Moreover, the relationship between fear of COVID-19 and COVID-19 anxiety was significant. Additionally, COVID-19 anxiety was related to the competition responses of sCort and sAA. In exploring the possible predictors of stress marker alterations, we identified that cognitive anxiety could predict the competition responses of sCort and sAA. Furthermore, COVID-19 anxiety predicted somatic and cognitive anxiety. Collectively, our results indicate that there are significant moderate correlations between cognitive and somatic anxiety as subscales of competitive anxiety with sCort and sAA before the competition. This result is consistent with previous studies (Filaire et al., 2009; Gordis et al., 2006; Madrigal and Wilson, 2017) that reported elevations of sCort and sAA associated with competitive anxiety prior to competitions (Casto and Edwards, 2016). It has been proposed that competitive anxiety increases sAA and sCort via interactions between the HPA axis and the ANS system (Ulrich-Lai and Herman, 2009).

We did not find any significant correlation (a very weak correlation) between competitive anxiety and the awakening responses of sCort and sAA. One earlier study documented that the awakening response of sCort on the day of competition was not elevated and the range of sCort was in the normal norm (Strahler et al., 2010). These results represent that professional football players show some neuroendocrine habituation in response to potentially stressful competitions. Physiologically, this can be explained by neurophysiological adaptations. Athletes prone to be stressed by regular competitions and might have an adaptation response related to the cortisol release at awaking (Gaab et al., 2006). It is known that the anticipation of competition can affect the quality of sleep in athletes (Simpson et al., 2017). As sleep quality is associated with the regulation of sCort and sAA following awakening, a relationship is quite likely (Strahler et al., 2017; Van Lenten and Doane, 2016). Future studies can determine the diurnal slopes of salivary stress markers with a more frequent sampling scheme and can examine their associations with measures of sleep quality and quantity.

Our results showed a weak correlation between fear of COVID-19 and competitive anxiety in professional football players in the phase of returning to competition during the COVID-19 pandemic. This result is consistent with a previous study (Mertens et al., 2020), although different target groups and some methodological differences between the two studies complicate a direct comparison. To the best of our knowledge, this study is the first investigation of the relationship between competitive anxiety and fear of COVID-19 in professional athletes. Further investigation is needed to explore the mechanism underlying these findings, but the speculation at this stage is that elite athletes in vulnerable situations such as sports competitions experience fear, sometimes to such an extent as to render them incapable of returning to competitions (Ford et al., 2017). Under the pandemic situation, fear of a high risk of infection can additionally affect the coping potential and performance of elite athletes. In line with this hypothesis, it has also been shown that there is a relationship between decreased performance and increased anxiety (Burton and Naylor, 1997; Ford et al., 2017). Therefore, the implementation of programs that reduce overall fear and anxiety must be considered for elite athletes performing competitions under semi-lockdown conditions.

Our results also illustrated significant moderate correlations between COVID-19 anxiety and competitive anxiety (somatic–cognitive anxiety), as well as the competition responses of sCort and sAA. Moreover, our results highlighted that COVID-19 anxiety could predict somatic and cognitive competitive anxiety. A previous study in French athletes showed higher scores of anxiety upon returning to competitions after a COVID-19-related lockdown (Ruffault et al., 2020); however, these athletes had no information on the future training setting and competition dates. Unfortunately, we cannot compare our results with this study due to differences in the participants, instruments, and experimental setups. According to the Catastrophe Model of Anxiety and Performance (Zhang et al., 2018), when cognitive anxiety is high,

Table 3
Regression analyses with competitive anxiety and self-confidence as the dependent variable.

Variable	Somatic anxiety				Cognitive anxiety				Self-confidence			
	B	β	t	sig	B	β	t	sig	B	β	t	sig
Fear of coronavirus	0.049	0.078	0.791	0.431	0.033	0.053	0.550	0.584	-0.022	-0.068	-0.606	0.546
Coronavirus anxiety	0.377	0.453	4.572	0.000	0.422	0.511	5.323	0.000	-0.010	-0.023	-0.205	0.838

Note: B: unstandardized beta; β: standardized regression weight; n = 90.

enhancements in physiological arousal (e.g., sCort, sAA, and somatic anxiety) result in dramatic and discontinuous performance oscillations. Under high cognitive anxiety, the path that performance follows is different depending on whether physiological arousal is increasing or decreasing. Specifically, as physiological arousal increases, so does performance, but most likely only up to a certain point. Beyond this point, further increases in physiological arousal result in a dramatic drop in performance. This condition is often dramatic, immediate, and irreversible, which is known as the performance catastrophe and can be manifested as a choking reaction under pressure. In our study, COVID-19 anxiety and competitive anxiety may therefore reflect a situation described by this model, and a combination of these two may cause extra-enhanced arousal, which could inversely affect the performance of football players. Moreover, it is known that the return to some forms of normal functioning in elite athletes is likely to entail exposure to environments associated with a greater risk of infection, such as transport to training and competitions, sports camps, and interaction with more people who perhaps have not had a COVID-19 test (e.g., providers, reporters, and photographers) (Bisciotti et al., 2020; Mohr et al., 2020). It has also been made clear that COVID-19 testing is associated with some errors (Vandenberg et al., 2020), such as measurement errors, which can cause biases in COVID-19 testing results. Moreover, the incubation period of the disease varies from person to person and it may affect the test results, which causes uncertainty in athletes about the COVID-19 status of others (McAloon et al., 2020). Narrative reports also show that when a positive test is determined in one player, the other players become very anxious and the team's concentration decreases, and they may not achieve the expected result in an upcoming competition (Graupensperger et al., 2020; Mehrsafar et al., 2020). The potential interaction between competitive anxiety and COVID-19 anxiety found in our professional football players can be explained by the "adding stress to the stressed" phenomenon, where symptoms may become overwhelming and may be interpreted as threatening or maladaptive, further exacerbating perceived stress. As such, an individual is at an increased risk for experiencing anxiety symptoms, as well as a decline in overall functioning.

Our results showed no significant correlations between self-confidence with fear/anxiety of COVID-19 or sCort and sAA in professional football players after returning to competition during the COVID-19 pandemic. According to the literature, a positive correlation between successful sports performance and self-confidence exists (Hays et al., 2009), and athletes with higher self-confidence might be able to better manage their stress under competitive conditions (Weinberg and Gould, 2018). Self-confidence plays an essential role in the anxiety–performance relationship, according to the Butterfly Catastrophe Model of Anxiety and Performance (Hardy, 1996). Self-confidence is a bias factor that moderates the interaction between cognitive anxiety and physiological arousal and its impact on performance. Specifically, high self-confidence swings the typical performance fold, or the "cusp" point, under high cognitive anxiety to a higher level of physiological arousal. To our knowledge, ours is the first study to report on the self-confidence of football competition during the COVID-19 pandemic. Further research is needed to confirm or challenge this result and to determine the mechanism(s) underlying these complex relationships.

4.1. Strengths and limitations

The present study has several strengths: (1) the inclusion of professional football players from the super league adds new findings to the existing literature on the returning phase during the COVID-19 pandemic; (2) assessing physiological and psychological stress variables allowed us to determine the biological markers of the HPA axis and the ANS system under physiological stress and competition.

This study carries some limitations, one of which being the inclusion of elite male football players. However, sex differences, competitive levels, type of sport (individual and team sport), and age categories have been reported to impact competitive anxiety and hormonal stress patterns differently (Fernando et al., 2010; Leis and Lautenbach, 2020; Rice et al., 2019). Considering the health conditions of those closely related to participants (people living in the same home, family member, etc.) could affect one's anxiety and fear of COVID-19 (Koçak et al., 2021), and so future studies should also consider these factors. One of the considerable points in the COVID-19 pandemic is that football competitions were permitted to start without fans and spectators. Previous investigations have highlighted that home and away competitions (or home advantages) can affect the emotional responses and performance of elite athletes (Fothergill et al., 2017). We utilized some different questionnaires, including the Competitive State Anxiety Inventory-2, the Coronavirus Anxiety Scale, and the Fear of Coronavirus Scale. Qualitative methods (e.g., interviews) may complement the results and mediator or moderator analyses in future studies by means of obtaining more detailed information about the experiences, attitudes, challenges pertaining to COVID-19, and competition stress during the COVID-19 pandemic in the football players (or even players of other sports). Keeping time constraints before the competition in mind, it was not possible to utilize extended psychological assessments in this study. Future studies may broaden the assessment tools used to obtain more information (e.g., injury anxiety, perceived stress, and mood states, etc.). Other stress-responsive systems are also worthy of investigation. For instance, inflammatory (such as interleukin-6 and tumor necrosis factor-alpha) and immunological (such as immunoglobulin A) markers might be of particular interest, as these are elevated with increased training and competition load. It should be noted that diurnal slopes and more awakening responses (e.g., immediately after waking, 30 min after waking, and 12 h after waking) were not collected on the days of competition in our study. Moreover, changes in the levels of sCort and sAA might be explained by changes in other factors, e.g., travel, sleep parameters, burnout, injuries, high-intensity training, and recovery times. In terms of confounding factors, the habit of COVID-19 stress during a long league should be considered. Future studies are proposed to consider the psychological COVID-19 factors over a long period of time. Of note, since COVID-19 has become so highly mutated and contagious (Sahoo et al., 2020), it is likely that when athletes become infected, they can, in turn, infect large numbers of people. Therefore, better psychological and physical monitoring and more decisive measures are needed in this situation, more so than before.

5. Conclusion

This explorative study provided the first evidence of an association between COVID-19 anxiety, competitive anxiety, and the levels of sCort and sAA—markers of the HPA axis and the ANS system among professional football players. Recognition of the value of these findings for ongoing and planned competitions would highlight the need for practical ways to reduce fear and anxiety, such as mental health consultations and providing recommendations for the athletes. Additionally, further efforts are suggested to build up a longer-term and sustainable strategy to reduce the psychophysiological stress response in pre- and post-pandemic situations.

CRediT authorship contribution statement

A.H.M. and **A.M.Z.** conceived the study and collected and analyzed the data. All authors wrote the manuscript. **P.G.** and **J.C.J.S.** provided critical revisions on the successive drafts. All authors read and approved the final manuscript.

Declaration of Competing Interest

The authors report no conflicts of interest.

Data Availability

Full data for this research are available through the corresponding author upon request.

Acknowledgments

This work has been supported by the Center for International Scientific Studies and Collaboration (CISSC), Ministry of Science, Research and Technology of Iran (number: 789). The authors' special thanks go to Dr. Miguel Angel Serrano Rosa for his guidance during this study and to the coaches and athletes who participated in this study.

References

Ahorsu, D.K., Lin, C.-Y., Imani, V., Saffari, M., Griffiths, M.D., Pakpour, A.H., 2020. The fear of COVID-19 scale: development and initial validation. Int. J. Ment. Health Addict. 1–9. https://doi.org/10.1007/s11469-020-00270-8.
Al Omari, O., Al Sabei, S., Al Rawajfah, O., Abu Sharour, L., Aljohani, K., Alomari, K., Al Zubidi, B., 2020. Prevalence and predictors of depression, anxiety, and stress among youth at the time of CoViD-19: an online cross-sectional multicountry study. Depress Res. Treat. 2020, 8887727.
Alix-Sy, D., Le Scanff, C., Filaire, E., 2008. Psychophysiological responses in the pre-competition period in elite soccer players. J. Sports Sci. Med. 7 (4), 446–454.
Allwood, M.A., Handwerger, K., Kivlighan, K.T., Granger, D.A., Stroud, L.R., 2011. Direct and moderating links of salivary alpha-amylase and cortisol stress-reactivity to youth behavioral and emotional adjustment. Biol. Psychol. 88 (1), 57–64.
Azarbayjani, M.A., Dalvand, H., Fatolahi, H., Hoseini, S.A., Farzanegi, P., Stannard, S.R., 2011. Responses of salivary cortisol and a-amylase to official competition. J. Hum. Sport Exerc. 6 (2), 385–391.
Barnes, M., Sax, P.E., 2020. Challenges of "return to work" in an ongoing pandemic. N. Engl. J. Med. 383 (8), 779–786.
Bisciotti, G.N., Eirale, C., Corsini, A., Baudot, C., Saillant, G., Chalabi, H., 2020. Return to football training and competition after lockdown caused by the COVID-19 pandemic: medical recommendations. Biol. Sport 37 (3), 313–319.
Brooks, S.K., Webster, R.K., Smith, L.E., Woodland, L., Wessely, S., Greenberg, N., Rubin, G.J., 2020. The psychological impact of quarantine and how to reduce it: rapid review of the evidence. Lancet 395 (10227), 912–920.
Burton, D., Naylor, S., 1997. Is anxiety really facilitative? Reaction to the myth that cognitive anxiety always impairs sport performance. J. Appl. Sport Psychol. 9 (2), 295–302.
Campbell, E., Irving, R., Bailey, J., Dilworth, L., Abel, W., 2018. "Overview of psychophysiological stress and the implications for junior athletes" (W.). Am. J. Sports Sci. Med. 6 (3), 72–78.
Capranica, L., Condello, G., Tornello, F., Iona, T., Chiodo, S., Valenzano, A., Cibelli, G., 2017. Salivary alpha-amylase, salivary cortisol, and anxiety during a youth taekwondo championship: an observational study. Medicine 96 (28), e7272.
Casto, K.V., Edwards, D.A., 2016. Testosterone, cortisol, and human competition. Horm. Behav. 82, 21–37.
Cox, R.H., Martens, M.P., Russell, W.D., 2003. Measuring anxiety in athletics: the revised competitive state anxiety inventory–2. J. Sport Exerc. Psychol. 25 (4), 519–533.
Davis, P.A., Gustafsson, H., Callow, N., Woodman, T., 2020. Written emotional disclosure can promote athletes' mental health and performance readiness during the COVID-19 pandemic. Front. Psychol. 11, 599925.
Dubey, S., Biswas, P., Ghosh, R., Chatterjee, S., Dubey, M.J., Chatterjee, S., Lavie, C.J., 2020. Psychosocial impact of COVID-19. Diabetes Metab. Syndr. Clin. Res. Rev. 14 (5), 779–788.
Engert, V., Vogel, S., Efanov, S.I., Duchesne, A., Corbo, V., Ali, N., Pruessner, J.C., 2011. Investigation into the cross-correlation of salivary cortisol and alpha-amylase responses to psychological stress. Psychoneuroendocrinology 36 (9), 1294–1302.
Fernando, C.J., Cludia, D., Manuel, F.A., 2010. Coping strategies, multidimensional competitive anxiety and cognitive threat appraisal: Differences across sex, age and type of sport. Serb. J. Sports Sci. 1, 23–31.
Filaire, E., Alix, D., Ferrand, C., Verger, M., 2009. Psychophysiological stress in tennis players during the first single match of a tournament. Psychoneuroendocrinology 34 (1), 150–157.
Filaire, E., Ferreira, J.P., Oliveira, M., Massart, A., 2013. Diurnal patterns of salivary alpha-amylase and cortisol secretion in female adolescent tennis players after 16 weeks of training. Psychoneuroendocrinology 38 (7), 1122–1132.
Ford, J.L., Ildefonso, K., Jones, M.L., Arvinen-Barrow, M., 2017. Sport-related anxiety: current insights. Open Access J. Sports Med. 8, 205–212.
Foretic, N., Nikolovski, Z., Peric, I., Sekulic, D., 2020. Testosterone, cortisol and alpha-amylase levels during a handball match; analysis of dynamics and associations. Res. Sports Med. 28, 360–370.
Fothergill, M., Wolfson, S., Neave, N., 2017. Testosterone and cortisol responses in male soccer players: the effect of home and away venues. Physiol. Behav. 177, 215–220.
Gaab, J., Sonderegger, L., Scherrer, S., Ehlert, U., 2006. Psychoneuroendocrine effects of cognitive-behavioral stress management in a naturalistic setting—a randomized controlled trial. Psychoneuroendocrinology 31 (4), 428–438.
Garcia, S.M., Tor, A., Schiff, T.M., 2013. The psychology of competition: a social comparison perspective. Perspect. Psychol. Sci. 8 (6), 634–650.
Gordis, E.B., Granger, D.A., Susman, E.J., Trickett, P.K., 2006. Asymmetry between salivary cortisol and α-amylase reactivity to stress: Relation to aggressive behavior in adolescents. Psychoneuroendocrinology 31 (8), 976–987.
Graupensperger, S., Benson, A.J., Kilmer, J.R., Evans, M.B., 2020. Social (un) distancing: teammate interactions, athletic identity, and mental health of student-athletes during the COVID-19 pandemic. J. Adolesc. Health 67 (5), 662–670.
Håkansson, A., Moesch, K., Jönsson, C., Kenttä, G., 2020. Potentially prolonged psychological distress from postponed olympic and paralympic games during COVID-19—career uncertainty in elite athletes. Int. J. Environ. Res. Public Health 18 (1), 2.
Hardy, L., 1996. A test of catastrophe models of anxiety and sports performance against multidimensional anxiety theory models using the method of dynamic differences. Anxiety Stress Coping 9 (1), 69–86.
Hays, K., Thomas, O., Maynard, I., Bawden, M., 2009. The role of confidence in world-class sport performance. J. Sports Sci. 27 (11), 1185–1199.
Kivlighan, K.T., Granger, D.A., 2006. Salivary α-amylase response to competition: relation to gender, previous experience, and attitudes. Psychoneuroendocrinology 31 (6), 703–714.
Koçak, O., Koçak, Ö.E., Younis, M.Z., 2021. The psychological consequences of COVID-19 fear and the moderator effects of individuals' underlying illness and witnessing infected friends and family. Int. J. Environ. Res. Public Health 18 (4), 1836.
Lautenbach, F., Laborde, S., Achtzehn, S., Raab, M., 2014. Preliminary evidence of salivary cortisol predicting performance in a controlled setting. Psychoneuroendocrinology 42, 218–224.
Lautenbach, F., Laborde, S., Klämpfl, M., Achtzehn, S., 2015. A link between cortisol and performance: an exploratory case study of a tennis match. Int. J. Psychophysiol. 98 (2), 167–173.
Lee, S.A., 2020. Coronavirus anxiety scale: a brief mental health screener for COVID-19 related anxiety. Death Stud. 44 (7), 393–401.
Leis, O., Lautenbach, F., 2020. Psychological and physiological stress in non-competitive and competitive esports settings: a systematic review. Psychol. Sport Exerc. 51, 101738.
Levitt, E.E., 2015. The Psychology of Anxiety. Routledge.
Madrigal, L.A., Wilson, P.B., 2017. Salivary hormone and anxiety responses to free-throw shooting competition in collegiate female basketball players. J. Clin. Sport Psychol. 11 (3), 240–253.
Mahmud, M.S., Talukder, M.U., Rahman, S.M., 2020. Does 'Fear of COVID-19'trigger future career anxiety? An empirical investigation considering depression from COVID-19 as a mediator. Int. J. Soc. Psychiatry 1, 20764020935488.
McAloon, C., Collins, Á., Hunt, K., Barber, A., Byrne, A.W., Butler, F., McEvoy, D., 2020. Incubation period of COVID-19: a rapid systematic review and meta-analysis of observational research. BMJ Open 10 (8), 039652.
Mehrsafar, A.H., Moghadamzadeh, A., Gharayaghzandi, H., Sanaeifar, F., 2016. Psychometric properties of the Persian version of the revised competitive state anxiety inventory-2. Q. Educ. Meas. 6 (23), 189–211. https://doi.org/10.22054/jem.2016.5738.
Mehrsafar, A.H., Gazerani, P., Zadeh, A.M., Sánchez, J.C.J., 2020. Addressing potential impact of COVID-19 pandemic on physical and mental health of elite athletes. Brain Behav. Immun. 87, 147–148.
Mertens, G., Gerritsen, L., Duijndam, S., Salemink, E., Engelhard, I.M., 2020. Fear of the coronavirus (COVID-19): predictors in an online study conducted in March 2020. J. Anxiety Disord. 74, 102258.
Mohammadpour, M., Ghorbani, V., Moradi, S., Khaki, Z., Foroughi, A.A., Rezaei, M.R., 2020. Psychometric properties of the Iranian version of the coronavirus anxiety scale. Iran. J. Psychiatry Clin. Psychol. 26 (3), 374–387. https://doi.org/10.32598/ijpcp.26.3482.1.
Mohr, M., Nassis, G.P., Brito, J., Randers, M.B., Castagna, C., Parnell, D., Krustrup, P., 2020. Return to elite football after the COVID-19 lockdown. Manag. Sport Leis. 1–9.
Ng, K.H., Kemp, R., 2020. Understanding and reducing the fear of COVID-19. J. Zhejiang Univ. Sci. B 21 (9), 752–754.
Palazzolo, J., 2020. Anxiety and performance. L'Enceph. 46 (2), 158–161.

Rashkova, M.R., Ribagin, L.S., Toneva, N.G., 2012. Correlation between salivary α-amylase and stress-related anxiety. Folia Med. 54 (2), 46–51.
Reardon, C.L., Bindra, A., Blauwet, C., Budgett, R., Campriani, N., Currie, A., Purcell, R., 2020. Mental health management of elite athletes during COVID-19: a narrative review and recommendations. Br. J. Sports Med., bjsports-2020-102884
Rice, S.M., Gwyther, K., Santesteban-Echarri, O., Baron, D., Gorczynski, P., Gouttebarge, V., Purcell, R., 2019. Determinants of anxiety in elite athletes: a systematic review and meta-analysis. Br. J. Sports Med. 53 (11), 722–730.
Ruffault, A., Bernier, M., Fournier, J., Hauw, N., 2020. Anxiety and motivation to return to sport during the french COVID-19 lockdown. Front. Psychol. 11, 610882.
Sahoo, J.P., Mishra, A.P., Behera, L., Nath, S., Samal, K.C., 2020. New mutant COVID-19 strain (VUI–202012/01)–more contagious than current status. Biot. Res. Today 2 (12), 1331–1333.
Salari, N., Hosseinian-Far, A., Jalali, R., Vaisi-Raygani, A., Rasoulpoor, S., Mohammadi, M., Khaledi-Paveh, B., 2020. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. Glob. Health 16 (1), 1–11.
Simpson, N.S., Gibbs, E.L., Matheson, G.O., 2017. Optimizing sleep to maximize performance: implications and recommendations for elite athletes. Scand. J. Med. Sci. Sports 27 (3), 266–274. https://doi.org/10.1111/sms.12703.
Strahler, J., Skoluda, N., Kappert, M.B., Nater, U.M., 2017. Simultaneous measurement of salivary cortisol and alpha-amylase: application and recommendations. Neurosci. Biobehav. Rev. 83, 657–677.
Strahler, K., Ehrlenspiel, F., Heene, M., Brand, R., 2010. Competitive anxiety and cortisol awakening response in the week leading up to a competition. Psychol. Sport Exerc. 11 (2), 148–154.
Taylor, S., 2019. The Psychology of Pandemics: Preparing for the Next Global Outbreak of Infectious Disease. Cambridge Scholars Publishing,.
Tilp, M., Thaller, S., 2020. Covid-19 has turned home-advantage into home-disadvantage in the German Soccer Bundesliga. Front. Sports Act. Living 2, 165.
Ulrich-Lai, Y.M., Herman, J.P., 2009. Neural regulation of endocrine and autonomic stress responses. Nat. Rev. Neurosci. 10 (6), 397–409.
Van Lenten, S.A., Doane, L.D., 2016. Examining multiple sleep behaviors and diurnal salivary cortisol and alpha-amylase: within-and between-person associations. Psychoneuroendocrinology 68, 100–110.
van Stegeren, A.H., Wolf, O.T., Kindt, M., 2008. Salivary alpha amylase and cortisol responses to different stress tasks: impact of sex. Int. J. Psychophysiol. 69 (1), 33–40.
Vandenberg, O., Martiny, D., Rochas, O., van Belkum, A., Kozlakidis, Z., 2021. Considerations for diagnostic COVID-19 tests. Nat. Rev. Microbiol. 19, 171–183.
Weinberg, R.S., Gould, D., 2018. Foundations of Sport and Exercise Psychology, 7E.,. Human Kinetics.
World Medical Association, 2013. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. Jama 310 (20), 2191–2194.
Yi, Y., Lagniton, P.N., Ye, S., Li, E., Xu, R.-H., 2020. COVID-19: what has been learned and to be learned about the novel coronavirus disease. Int. J. Biol. Sci. 16 (10), 1753–1766.
Zhang, S., Woodman, T., Roberts, R., 2018. Anxiety and fear in sport and performance. Oxf. Res. Encycl. Psychol. Retrieved 5 May. 2021, from https://oxfordre.com/psychology/view/10.1093/acrefore/9780190236557.001.0001/acrefore-9780190236557-e-162.