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EFFECT OF HOME ADVANTAGE ON STRESS HORMONE AND PRE-COMPETITIVE STATE ANXIETY LEVEL OF VOLLEYBALL PLAYERS

Yasmeen Tabassum, Lecturer, Department of Sport Sciences and Physical Education, University of the Punjab, Lahore, yasmeentabassum111@gmail.com
Sumera Sattar, Lecturer, Department of Health & Physical Education, Lahore College for Women University, Sumera.Sattar@lcwu.edu.pk
Muhammad Zafar Iqbal Butt, Chairman, Department of Sport Sciences and Physical Education, University of the Punjab, Lahore, zafarbutt666@hotmail.com
Muhammad Amir Iqbal, Physiology/Endocrinology Laboratory, Department of Zoology, University of the Punjab, Lahore, amir87zoologist@gmail.com
Fozia Tabassum, Assistant Professor, Health & Physical Education, Higher Education DepartmentPunjab, fouziajamshaid17@gmail.com
Nabila Roohi, Professor, Physiology/Endocrinology Laboratory, Department of Zoology, University of the Punjab, Lahore, nabilaruhi@gmail.com

Abstract- Playing venue is a prominent influential tool that affects players' psychological and physiological states before the competition. The main objective of the present analysis was to check the cortisol concentration and competitive state anxiety level before the match on home and away playing venue. A total of ninety-six players age 18-24 years from eight different public and private universities were monitored during eight competitive matches playing against each other on a home and opponent's home ground. The decline in cortisol level, before playing a match, as evidenced at home ground, however, a 16% elevation was recorded in cortisol level at the away playing venue, even before playing the match. Before-match cortisol concentration and the percent changes in this hormone were related to somatic and cognitive anxiety. In conclusion, the playing venue extensively influenced cortisol and anxiety levels before the commencement of volleyball matches at away ground. This hormonal response was related to players' psychological state, which might contribute to players' behavior and outcomes of matches.

Keywords: Volleyball player, Cortisol, Somatic anxiety, Cognitive anxiety

I. INTRODUCTION

Sports like Volleyball have a sporadic team which typifies by two main periods i.e., high-intensity activity and low-intensity recovery periods (Castagna et al., 2020). High-intensity activity periods comprise high-speed running, jumping, sprinting and bodily contact while low-intensity recovery periods contain e.g., standing, walking, and jogging (van Gogh et al., 2020). Volleyball is performed over the best of three and best of five sets with maximum energy to win a match (Reina et al., 2020). Thus, most probably the high-intensity demands may cause worry to the immune, endocrine and muscular systems (Kirwan et al., 2020). In this context, home advantage is a valid tool for monitoring a player's stress hormonal response and anxiety levels (Carolina-Paludo et al., 2020).

The term "Home Advantage" (Playing Venue) is recognized worldwide by specialists, players, commentators and managers virtually in all team sports like basketball, ice hockey, volleyball and football (Fothergill et al., 2017). Inan (2020) investigated that Schwartz and Barsky were the first persons who understood the home advantage in 1977. Almeda and Volossovitch (2017) further demonstrated the home advantage and said that teams performed at a home venue better as compared to an away venue. The authors provided all key factors of home advantage which may contribute to making home advantage for players which are, rule, crowd pressure, referee's biased, territoriality, traveling and familiarity (Ponzo and Scoppa, 2018).

Cortisol is a stressor hormone associated with the pressure or stress reaction. Cortisol is a steroid hormone; it assumes a significant role in keeping up ordinary physiological functions and is created in the adrenal cortex (Hu et al., 2010). Some of these incorporate increase in the breakdown of protein in muscles, increase in proteolytic catalysts, increase in blood glucose concentration, change of amino acids to carbs, restraint of protein synthesis, stimulation of gluconeogenesis, and assistance of lipolysis (Stadtman and Levine, 2003). Cortisol also assists with managing homeostatic equalization during times of long-haul physical and mental pressure.

A lot of research conducted to discover the impact of anxiety on the sports performance of a player (Hull et al., 2017). Anxiety is a state of nervousness, worry and apprehension due to his/her doubtful thoughts about his/her abilities to achieve the given target (Oglesby and Schmidt, 2017). Anxiety influences a player's performance both in a competitive setting and during practice sessions (Calverley et al., 2020). Trait anxiety is the tendency of an athlete to perceive the competitive sports situation as a threatening event, to which he/she responds nervously under tension on regular basis. Therefore, this habitual way of coping with stress becomes part of his/her personality. The intensity of trait anxiety is lower but consistent than state anxiety (Hyde et al., 2019). A physiological response by stimulating the sympathetic nervous system is called competitive state anxiety and it is the form of situational anxiety. Competitive state anxiety has its three sub-scales which are, cognitive anxiety, somatic anxiety and self-confidence.

II. Literature Review

Home advantage should be considered as a factor while studying soccer, rugby, basketball, baseball and ice hockey (Ramchandani et al., 2021). Home advantage is measured as a well-documented phenomenon in sports due to its six parameters which have been discussed in the second paragraph of the introduction. The sports teams which are performing at their home venue, it is considered as their advantage as the literature review explains that more than 50% of competitions are won by the teams which were performing within their domain (Hautbois et al., 2021). Rules, familiarity with competition, travel, the crowd are the elements of game location, as it has been proposed in various researches (Gray et al., 2017). The concept of dominance, at physical space the perception of proprietary rights and territoriality has an association with the advantage which is associated with performing at the home venue. In many animal species, it is well evident about territoriality behavior, in which the occupation of others is defended by the resident animals (Giuggioli et al., 2011). In the case of sports competitions, sometimes it happens that players express a territorial behavior that resembles animals, defined by rising on steroid hormones (Gray et al., 2017) and assertive behavior. Certainly, few steroid hormones, for example; cortisol, have an association with the environment of competition (Arruda et al., 2017). The steroid hormone cortisol is taken as a hormone marker to stimulate the hypothalamic-pituitary-adrenal axis (HPA) (Stephens et al., 2016). In the sports arena, a rise in the level of HPA axis activity has been linked with major psychological or physiological stress, leading to high cortisol concentration (Casto and Edwards, 2016). Increment in cortisol concentration has been found previous to official games when compared to simulated games or training sessions (Arruda et al., 2017); and progressing games that are contested at home venue compared to away venue (Carré et al., 2006). Along with, the psychological responses which include the condition of anxiety which have expressed about sensible to game location. the rise in cognitive and somatic anxiety also have been shown previously in official competitions in comparison to a training session (Arruda et al., 2017); during the contest (Filaire et al., 2009); and during the final competition compared to semifinal (Arruda *et al.,* 2018). Regarding the game location, studies have reported raised pre-match cognitive and somatic anxiety in players when playing in their opponent's venue (Carré et al., 2006). Otherwise, a higher self-confidence state was not pre-match playing in-home venue in comparison to away venue (Carré et al., 2006). Despite the results aforementioned, some studies do not found any effect of the game site or found opposite results on pre-competition hormonal and psychological responses in some team sports (Arruda et al., 2014; Cunniffe et al., 2015; Arruda et al. 2016).

Therefore, the present study was undertaken to examine the effect of the playing venue on pre-competition cortisol (C) and competitive state anxiety (cognitive anxiety, somatic anxiety and self-confidence) in intervarsity male volleyball players on home and away playing venue.

III. Research Methodology

The methodology section allows the critical evaluation of the overall validity and reliability of our investigation. Experimental and survey (paper-pencil) methods were used in this research to measure the cortisol response and anxiety approach of volleyball players.

A total number of 96 volleyball players, age between 18 to 25 years, were recruited for the study. As per HEC rules, players of this age group only are eligible to participate in the HEC Inter-university competition. They belonged to different public and private universities of Lahore city and had also participated in the Higher Education Commission (HEC) Inter-university sports competition 2016-17. These were professionally trained and mature players representing their universities in competitions on

different playing venues (Table 1). Census sampling was used to choose the participants as it was based only on those universities which were situated in Lahore City. There were 8 universities whose volleyball teams participated in HEC Intervarsity sports competitions. As per game rules, a volleyball team consists of 12 players but 6 players playing on one side of the court. Participants were guided about competitions on different venues, blood sampling and giving their responses on the competitive state anxiety questionnaire before the start of a match. All the matches were conducted early in the morning with the time-lapse of one match every three days. All participants were bound to take an eight-hour normal sleep before blood sampling and data evaluations. Standard local breakfast was offered to each player, having basic macro and micronutrients to manage the Hormonal response of the players at a standardized level.

Table 1 List of participated universities

#	**University**	**Sector**
1	University of the Punjab	Public
2	Government College University	Public
3	Minhaj University Lahore	Private
4	University of Management and Technology	Private
5	Lahore University of Management Sciences	Private
6	University of Veterinary & Animal Sciences	Public
7	Lahore Leads University	Private
8	Superior University Lahore	Private

A blood sampling practice was conducted in the dressing room of players 60 minutes before the commencement of the match. A professionally trained registered technician from a patent pathology laboratory, under the supervision of a qualified medical practitioner, drew the pre-test blood samples from all of the players keeping in view all the ethical aspects. Then players moved to the court for the match. The same practice was repeated on all 8 volleyball matches. Every time after taking the blood samples, serum was separated and stored at – 80°C for hormonal analysis. All of the serum samples were analyzed for cortisol by Enzyme-linked immunosorbent assay (ELISA).

The psychometric assessment was taken 30 minutes before the start of a match. Both teams were preceded by warm-up, light coordination exercises, show ball drills and stretching of the major muscle groups. Each player was asked to perform in his normal psychological mode with no extra pressure. Psychological data was measured using the Competitive State Anxiety Inventory 2 (CSAI-2) (Craft et al., 2003). This assessment tool (rating-scale) has been extensively used in the sport psychology literature and assesses each player's pre-game cognitive anxiety, somatic anxiety levels as well as pre-game state of self-confidence. The Illinois Competition Test or CSAI-2 consists of 27 items, with 9 items for each of the subscales, named as cognitive anxiety, somatic anxiety and self-confidence (Craft et al., 2003). All items were rated on a 4-point Likert-type scale.

Results were analyzed, statistically by paired sample "t" test using the latest version of SPSS (22) officially named IBM SPSS statistics (Carré et al., 2006), to work out the significant variations amongst the parameters of the study, in comparable groups. Secondly, descriptive statistics were applied to measure psychometric assessment on the psychological state of players.

IV. RESULTS

Cortisol level (µg/dL) of Volleyball Players

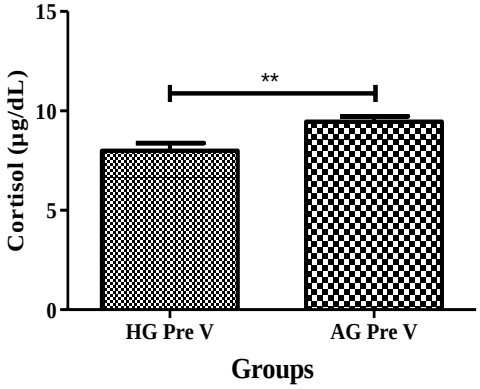

Fig. 1 Average Level of Cortisol (µg/dL) in HG Pre V *vs* AG Pre V analysis
HG Pre V: Home Ground Pre-test Volleyball **AG Pre V:** Away Ground Pre-test Volleyball
**Significance at $P < 0.01$

Figure 1 demonstrates a pre-test vs pre-test comparison of cortisol levels in volleyball players, while, playing in home and away playing venues, respectively. Cortisol pre-test home venue was estimated to be 7.99 ± 0.38 µg/dL which increased significantly by 18 % in away pre-test estimation. The level of cortisol in away ground pre-test determination was 9.45 ± 0.27 µg/dL (Table 2).

Table 2 Average levels of Cortisol (µg/dL) in comparable groups

Game	**#**	**Venue comparison**	**Test type**	**Cortisol level (µg/dL) Mean ± SEM**	**%age Difference**	***P*-value**
Volleyball n=96	a	Home vs Away	Pre Pre	07.99 ± 0.38 09.45 ± 0.27	18↑ **	0.0033

**indicate significance at $P < 0.01$.

Psychological state (Competitive State Anxiety Inventory-2, CSAI-2)

Table 3: Psychological State Score of Volleyball players

Group Statistics				
	Venue	**N**	**Mean ± SEM**	***P*-value**
Cognitive State Anxiety	Home ground	96	1.72 ± 0.03	0.037*
	Away ground		1.90 ± 0.04	
Somatic State Anxiety	Home ground		2. 17 ± 0.05	0.021*
	Away ground		2. 45 ± 0.03	
Self-Confidence	Home ground		2.67 ± 0.05	0.049*
	Away ground		2.21 ± 0.06	

*$P < 0.05$ is considered as significant variation

Table 3 presents the psychological condition of volleyball players on home and away grounds regarding state anxiety and self-confidence. The table shows that players feel more cognitive anxiety on away grounds as compared to their home grounds. The average cognitive state anxiety score on home ground was 1.72 ± 0.03, which increased by 10%, while, playing on away venue due to increased level of physical

exertion, crowd hooting and traveling factor. The cognitive state anxiety on away ground was estimated as 1.90 ± 0.04.

Table 3 shows that players feel less somatic anxiety on home grounds as compared to their away grounds. The average somatic state anxiety score on home ground was 2.17 ± 0.05 that increased by 13%, while, playing on away venue. The somatic state anxiety score on away ground was estimated as 2.45 ± 0.03.

The results in table 3 further reveal that players feel more confident on their home grounds as compared to away ground. The average self-confidence score on home ground was 2.67 ± 0.05, which declined by 17% while playing on away venue. The self-confidence score on away ground was estimated as 2.21 ± 0.06 (Fig 2).

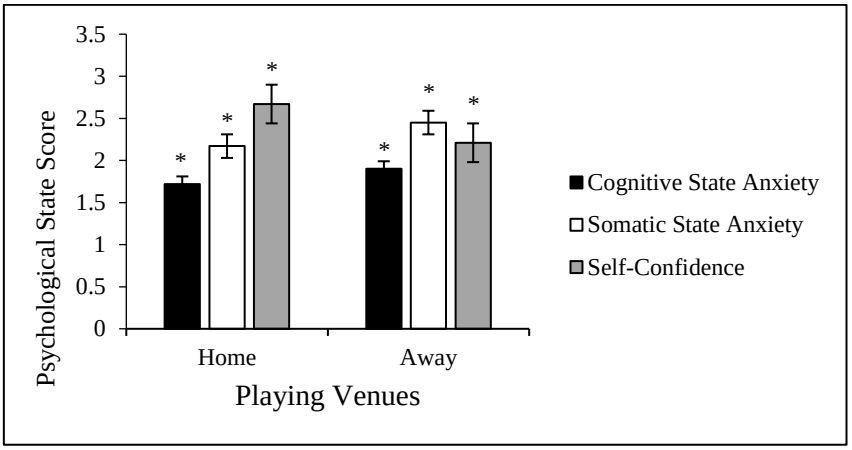

Fig. 2 Psychological State Score of Volleyball Players

*P< 0.05 is considered a significant variation

V. DISCUSSION

The present study was conducted on intervarsity male volleyball players to evaluate the pre cortisol and anxiety score of players on home ground and an opponent's home ground. As the home playing venue phenomenon and territoriality were considered a hypothesis. In our findings, the pre-competition cortisol level and anxiety score of players were recorded higher on an opponent's home ground before the start of a match. The results of the current study show that as players changed their home playing venue and moved on the opponent's home ground their cortisol and anxiety score was increased due to unfavorable playing venue conditions. Opposite to the concept of territoriality, their assertive behavior was turned into fear and an apprehension state.

In the present study, the volleyball players seem to perceive more stressful and threatening situations playing on away ground than home, demonstrated by a moderate and clear effect of playing venue on cortisol and state anxiety.

Whenever, any sign of disturbance is observed, HPA response through cortisol biosynthesis acts as an indicator of stress condition (van Dalfsen and Markus, 2018). In response to the unstable and stressful conditions, C begins to rise. For example, in a competitive state, a player encounters several psychological stimulators and stressors, perpetuating the rising of C that results in altered glucose level, cardiovascular activation and anti-inflammatory responses to tackle the overwhelming stress (Wright et al., 2010).

In an investigation by Arruda et al. (2017) conducted on pre and post-match conditions, a significant change in the concentration of cortisol due to an increased level of anxiety and match tension was evidenced. It was observed in a meta-analysis study, the psychological stressors were studied in the laboratory. The researchers artificially created stress stimulators in the laboratory to assess the change in cortisol production. They observed an increased level of C due to the occurrence of unstable and social evaluative elements especially when they occur for longer periods.

Moreover, responsiveness to psychological and physical stressors as well as competitive situations results in elevated C levels (Edwards & Kurlander, 2010). It also occurs in response to stressful physical activity like heavy exercise or any other patent's physiological potential (Marsland et al., 2017). In response to the release of the C hormone the cardiovascular activity becomes faster as blood is pumped more rapidly by the heart, elevated glucose production and anti-inflammatory response becomes more effective (Teixeira-Lemos et al., 2011).

It has been evaluated the psychophysiological responses of Rugby players in pre-match on home and away playing ground, and the players demonstrated a higher cortisol concentration in pre-match at away ground as compared to home (Cunniffe et al., 2015).
The researchers estimated a few factors that could be credited to this outcome, for instance, that players may see playing away from home as more undermining than playing in natural environmental factors at the home scene, taking into account that cortisol adjusts a few physiological instruments and social reactions to compromising conditions (Carolina-Paludo et al., 2020) just as the conceivable pressure identified with the group travel to away settings on pre-match cortisol fixation.
Other studies have demonstrated high cortisol levels in players before the pre-game playing on their home ground as compared to away due to the expectations level of spectators and match outcomes (Carré et al., 2006). It has been proposed earlier, crowd density may play an important role in the home advantage (Jiménez et al., 2020) and this crowd density is likely to increase the cortisol responses in the athletes playing away.
Moreover, some studies have reported that teams traveling to their opponent's venue are more likely to lose the games compared to home games due to fatigue and stress. However, no traveling effect was found elsewhere (Van Damme & Baert, 2019). In the current study, the away ground matches included approximately 1-hour and fifteen minutes trips by university bus and players were seen discomfort and distress (Tabassum et al., 2020). However, the authors did not include these two parameters of playing venue in the present study.

Another study observed that a change in somatic anxiety was expected due to evidence of a positive correlation of pre-match cortisol concentration and somatic anxiety state of players on an opponent's home ground (Filaire et al., 2009; Arruda et al., 2017). Moreover, increases in self-confidence in-home locations were predicted to be identified as previously found (Carré et al., 2006), as demonstrated in the current research. Arruda et al. (2014) also found no difference in cognitive and somatic anxiety and self-confidence in pre-game basketball athletes played at home and away from places, following the findings of the current research. Also, previous studies have not found an association between cortisol and somatic and cognitive anxiety. (Cunniffe et al., 2015). The physiological arousal level and human awareness may be the reason for a potential explanation. As speculated from previous research, when it was below higher levels, a person likely perceives physiological arousal (e.g. changes in cardiac autonomic responses and/or release of hormones).

Additionally, the idea that athletes who displayed a high level of pre-game cortisol may have subjectively indicated lower somatic anxiety is highlighted because before the data collection, their short-term stress response occurred. It is also worth highlighting that although the inter-university volleyball players' cortisol concentration was increased in pre-match. This conduct cannot inherently contribute to a "home benefit" per se when playing at your opponent's place. However, taking into account the playing position, it is important to consider the actions of the player pre-game. It was possible to note that there were also increases in pre-match cortisol concentration in the outside area, it seems that the players of the existing study were comforted on their home ground but they could not manage their state anxiety on an opponent's home ground due to which their cortisol concentration was increased and they lose all matches.
The present data suggest that the pre-match hormonal reaction and state anxiety are influenced by the playing position. Relative to their home venue, playing in the home ground of the opponent appears to induce greater neuroendocrine stress on volleyball players, shown by high cortisol concentration and state anxiety score on the outside compared to the home venue. Additionally, the effect of playing venue on pre-match cortisol and state anxiety does impact negatively the match results on an opponent's home ground. It is strongly suggested possible psychological interventions (imagery, goal-setting, cohesion and stress management techniques) for players to deal with a challenging situation at an away playing venue.

VI. CONCLUSION

Home advantage is a well-documented phenomenon, which affects a player's hormonal responses and psychological state due to its captivating factors on home and the opponent's home ground. The cortisol level of players increased on away ground due to increased levels of cognitive anxiety and somatic anxiety. The player should be mentally strengthened as they are skilled in in-game tactics and physical fitness areas. So that, they can manage any stressful situations that affect their behavior and performance before and during the match.

Note: This research is part of a Ph.D. dissertation of the corresponding author

Conflict of interests: Declare any conflict of interest or state "The authors declare no conflict of interests."

REFERENCES

1. Almeida, C. H., & Volossovitch. (2017). Home advantage in Portuguese football, effects of level of competition & mid-term trends. International Journal of Sports Physiology & Performance, 13, 1-12.

2. Arruda, A. F., Aoki, M. S., Freitas, C. G., Drago, G., Oliveira, R., Crewther, B. T., & Moreira, A. (2014). Influence of competition playing venue on the hormonal responses, state anxiety & perception of effort in elite basketball athletes. Physiology & Behavior, 130(2), 1-5.

3. Arruda, A. F., Aoki, M. S., Miloski, B., Freitas, C. G., Moura, N. R., & Moreira, A. (2016). Playing match venue does not affect resting salivary steroids in elite Futsal players. Physiology & Behavior, 155(3), 77-82.

4. Arruda, A. F., Aoki, M. S., Paludo, A. C., & Moreira, A. (2017). Salivary steroid response & competitive anxiety in elite basketball players, Effect of opponent level. Physiology & Behavior, 177, 291-296.

5. Arruda AF, Aoki MS, Miloski B, Freitas CG, Moura NR, Moreira A. (2018). Playing match venue does not affect resting salivary steroids in elite Futsal players. Physiology & Behavior, 155(3), 77-82.

6. Calverley, H., Davis, D. P., Harvey, D. J., & Mesagno, D. C. (2020). Examining Group Differences in Emotion Regulation Strategies & the State & Trait Anxiety of Lifeguards & Non-Lifeguards in a Real-World Precompetitive Situation. International Journal of Aquatic Research & Education, 12(2), 4.

7. Carolina-Paludo, A., Nunes-Rabelo, F., Maciel-Batista, M., Rúbila-Maciel, I., Peikriszwili-Tartaruga, M., & Simões, A. C. (2020). Game location effect on pre-competition cortisol concentration & anxiety state. A case study in a futsal team. Revista de Psicología del Deporte, 29(1), 105-112.

8. Carré, J., Muir, C., Belanger, J., & Putnam, S. K. (2006). Pre-competition hormonal & psychological levels of elite hockey players, relationship to the 'home advantage'. Physiology & Behavior, 89(3), 392-398.

9. Castagna, C., Krustrup, P., & Póvoas, S. (2020). Cardiovascular fitness and health effects of various types of team sports for adult and elderly inactive individuals-a brief narrative review. Progress in Cardiovascular Diseases, 63(6), 709-722.

10. Casto, K. V., & Edwards, D. A. (2016). Before, during, and after: how phases of competition differentially affect testosterone, cortisol, and estradiol levels in women athletes. Adaptive Human Behavior and Physiology, 2(1), 11-25.

11. Craft, L. L., Magyar, T. M., Becker, B. J., & Feltz, D. L. (2003). The relationship between the Competitive State Anxiety Inventory-2 & sport performance, a meta-analysis. Journal of Sport & Exercise Psychology, 25(1), 44-65.

12. Cunniffe, B., Morgan, K. A., Baker, J. S., Cardinale, M., & Davies, B. (2015). Home versus away competition, effect on psychophysiological variables in elite rugby union. International Journal of Sports Physiology & Performance, 10(6), 687-694.

13. Edwards, D. A., & Kurlander, L. S. (2010). Women's intercollegiate volleyball & tennis, Effects of warm-up, competition, & practice on saliva levels of cortisol & testosterone. Hormones & Behavior, 58(4), 606-613.

14. Filaire, E., Alix, D., Ferr&, C., & Verger, M. (2009). Psychophysiological stress in tennis players during the first single match of a tournament. Psych Neuroendocrinology, 34(1), 150-157.

15. Fothergill, M., Wolfson, S., & Neave, N. (2017). Testosterone & cortisol responses in male soccer players, the effect of home & away venues. Physiology & Behavior, 177(1), 215-220.

16. Giuggioli, L., Potts, J. R., & Harris, S. (2011). Animal interactions and the emergence of territoriality. PLoS Computational Biology, 7(3), e1002008.

17. Gray, P. B., McHale, T. S., & Carré, J. M. (2017). A review of human male field studies of hormones and behavioral reproductive effort. Hormones and Behavior, 91, 52-67.

18. Hautbois, C., Vernier, F., & Scelles, N. (2021). Influence of competitive intensity on stadium attendance. An analysis of the French football Ligue 1 over the period 2009-2019 through a visualization system. Soccer & Society, 1-23.

19. Hu, J., Zhang, Z., Shen, W. J., & Azhar, S. (2010). Cellular cholesterol delivery, intracellular processing & utilization for biosynthesis of steroid hormones. Nutrition & Metabolism, 7(1), 47.

20. Hull, L., Petrides, K. V., Allison, C., Smith, P., Baron-Cohen, S., Lai, M. C., & Mandy, W. (2017). "Putting on my best normal", social camouflaging in adults with autism spectrum conditions. *Journal of autism & developmental Disorders,* 47(8), 2519-2534.

21. Hyde, J., Ryan, K. M., & Waters, A. M. (2019). Psychophysiological Markers of Fear & Anxiety. Current psychiatry Reports, 21(7), 56.

22. Inan, T. (2020). Does the Home Advantage Depend on Crowd Support in Major European Football League? International Journal of Applied Exercise Physiology, 9(6), 166-172.

23. Jiménez, M., Alvero-Cruz, J. R., Solla, J., García-Bastida, J., García-Coll, V., Rivilla, I., and Clemente-Suárez, V. J. (2020). Competition seriousness and competition level Modulate testosterone and cortisol responses in soccer players. International Journal of Environmental Research and Public Health, 17(1), 350-364.

24. Kirwan, R., McCullough, D., Butler, T., de Heredia, F. P., Davies, I. G., and Stewart, C. (2020). Sarcopenia during COVID-19 lockdown restrictions: long-term health effects of short-term muscle loss. Gero Science, 32(2), 1-32.

25. Marsland, A. L., Walsh, C., Lockwood, K., & John-Henderson, N. A. (2017). The effects of acute psychological stress on circulating and stimulated inflammatory markers: a systematic review and meta-analysis. Brain, Behavior, and Immunity, 64(2), 208-219.

26. Oglesby, M. E., & Schmidt, N. B. (2017). The role of threat level & intolerance of uncertainty (IU) in anxiety. An experimental test of IU theory. Behavior therapy, 48(4), 427-434.

27. Ponzo, M., & Scoppa, V. (2018). Does the home advantage depend on crowd support? Evidence from same-stadium derbies. Journal of Sports Economics, 19, 562-582.

28. Ramchandani, G., Millar, R., & Wilson, D. (2021). The relationship between team ability and home advantage in the English football league system. German Journal of Exercise and Sport Research, 1-8.

29. Reina, M., García-Rubio, J., Esteves, P. T., and Ibáñez, S. J. (2020). How external load of youth basketball players varies according to playing position, game period and playing time. International Journal of Performance Analysis in Sport, 23(1), 1-14.

30. Stadtman, E. R., & Levine, R. L. (2003). Free radical-mediated oxidation of free amino acids & amino acid residues in proteins. *Amino acids,* 25(3-4), 207-218.

31. Stephens, M. A. C., Mahon, P. B., McCaul, M. E., & Wand, G. S. (2016). Hypothalamic–pituitary–adrenal axis response to acute psychosocial stress: Effects of biological sex and circulating sex hormones. Psychoneuroendocrinology, 66, 47-55.

32. Tabassum, Y., Butt, M. Z. I., & Roohi, N. (2020). Influence of Playing Venue on Testosterone and Cortisol. Global Social Sciences Review, 5 (4), 93-101.

33. Teixeira-Lemos, E., Nunes, S., Teixeira, F., & Reis, F. (2011). Regular physical exercise training assists in preventing type 2 diabetes development: focus on its antioxidant and anti-inflammatory properties. Cardiovascular Diabetology, 10(1), 12-23.

34. van Dalfsen, J. H., & Markus, C. R. (2018). The influence of sleep on human hypothalamic–pituitary–adrenal (HPA) axis reactivity: A systematic review. Sleep Medicine Reviews, 39(1), 187-194.

35. van Gogh, M. J., Wallace, L. K., and Coutts, A. J. (2020). Positional demands and physical activity profiles of netball. The Journal of Strength & Conditioning Research, 34(5): 1422-1430.

36. Wright, R. J., Newby, D. E., Stirling, D., Ludlam, C. A., Macdonald, I. A., & Frier, B. M. (2010). Effects of acute insulin-induced hypoglycemia on indices of inflammation: putative mechanism for aggravating vascular disease in diabetes. *Diabetes Care,* 33(7), 1591-1597.