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EFFECT OF PLAYING VENUE ON HORMONAL RESPONSES AND PSYCHOLOGICAL STATE OF INTER-UNIVERSITY VOLLEYBALL PLAYERS

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Abstract

The home advantage is a powerful wonder that happens in the realm of amateur and professional games where most teams win more than 50% of matches. The present study compared the effects of playing venue on hormonal responses and psychological state of inter-university volleyball players at home and away ground. A total of 96 male players age, 18 to 24 years from eight different public and private universities were selected as the subject in this study. Matches were scheduled in such a manner so that each team would play one match on home ground and one on away ground. The results of this study showed that a 13% reduction in the testosterone level of players was seen on the opponent's home ground before playing the match, whereas, 18% elevation in cortisol level of players was recorded on the opponent's home ground before-match. Psychological measures indicated that players' cognitive and somatic anxiety levels were increased on away ground (10% and 13%, respectively) whereas, their self-confidence level declined by 17% on an opponent's home ground before the commencement of the match. The present study supports the notion that there are differences in pre-competition hormonal and psychological states that may play a key role in 'the home advantage' which could affect players' behavior and match outcomes.

Key Words: *Anxiety, Cortisol, Playing Venue, Testosterone, Volleyball players.*

Introduction

The home favorable position is a very much archived wonder in games rivalry, for example, baseball, football, ice hockey, rugby, and basketball (Bruffy *et al.*, 2016; Fothergill *et*

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al., 2017). Despite the uncertain outcomes, different studies have concluded a positive relationship between the mental and social states' previous competitive events and home advantage (Almeda and Volossovitch, 2017; Pollard and Armatas, 2017). Several studies have acknowledged that players and teams perform appreciably better when they play at home as compared to away from home (Allen and Jones, 2014; Bruffy *et al*., 2016; Aquino *et al.,* 2017). For instance, it can be seen that home ground plays an important role as there are several examples of medals winnings of host countries in the Olympic Games (Kenyon and Bodet, 2018). Furthermore, meta-analytical reviews (Weed *et al.,* 2015) have shown that home teams will win roughly 60% of every athletic event.

Even though a home advantage position is more predominant in a few games than in others (Almeda and Volossovitch, 2017), there are few games in which players or teams are more successful away from their home ground. Experts have proposed different factors that might positively affect the home ground advantage like rule, travel, territoriality, referee's bias, large crowd and familiarity (Pollard and Armatas, 2017). These factors fairly make a favorable playing environment for players, positively affecting players' hormonal responses and anxiety levels before and during playing at their home ground and away from home (Bernardi and Steyn, 2020).

Testosterone (T), is an essential steroid hormone, it is serving anabolic capacities, for example, support and developing muscle and bone tissue. This steroid hormone partly determines the sexual characteristics of maleness, is also linked up with the assertive behavior of players, which contributes to their increased performance while competing on home as well as away grounds (Massimino *et al.,* 2019). This hormone also plays a crucial role in maintaining territoriality in *kingdom animalia*. Moreover, it is also associated with aggression and attack during the defense of their territory in animals (Apfelbeck *et al.,* 2017). Another research has been conducted to study the association between the location of a game and the psychological state of an athlete in the pre-game stage (Carré et al., 2006). In soccer players, the level of testosterone has been studied in the pre-competition stage. In this research, it was found that in a pre-game stage of the level of testosterone hormones was significantly lower in players who were competing at the opponent's venue as compared to those who were playing at their home venue. This research gave an important finding that when humans are playing at their home territory, a high level of testosterone is found in their body. In various rodent and primate studies, this territoriality phenomenon has also been observed (Davis and Marler, 2003).

Cortisol (C), a stress hormone, produced by the adrenal cortex, also responds to the competitive environment (Jiménez *et al.,* 2020). It has been observed that when an athlete performs at an away competition venue than his or her home ground, his state anxiety level increases due to fear of losing his or her social status or game victory (Carolina-Paludo *et al.,* 2020). The stress felt by players before, during and after a match has also been investigated (Filaire *et al.*, 2009).

A player's psychological state is highly concerned with a well-organized sports competition. Competitive state anxiety has defined a state of fear, apprehension, and uneasiness. This anxiety level is increased when a player perceived a threat by his opponent's competency, crowd pressure, and expectations of crowed or maintain his social status. Anxiety is the main marker to evaluate the player's mental, physical and behavioral symptoms through its three sub-scales, i.e. cognitive anxiety, somatic anxiety and self-confidence.

The main objective of the present study was to check the effect of playing venue on hormonal responses and psychological state of male inter-university volleyball players on home and an opponent's home ground.

Material and Methods

Ninety-six male university volleyball players whose ages ranged from 18 to 24 years and who were recruited from eight public and private universities in Lahore city participated in the study. A single player gets at least four chances of playing in his university time. All physically fit players who had participated in the Higher Education Commission (HEC) inter-university sports competition of 2016-17 season, representing their university were recruited for the present analysis. Players were involved in their routine training schedule. Consent was taken from each of the players as well as their directors and team management before the commencement of the study.

To collect the data of both home venue and away venue competition, volleyball matches were organized in such a way that every team got a chance to play one match on her home ground and one match on away venue with the same team.

Blood sample was taken one hour before the commencement of matches. A registered medical technician from a patent pathology laboratory, under the supervision of a qualified medical practitioner, was hired for the biochemical assays of recruited players for pre-test analysis, keeping in view all the ethical aspects. Then, players were allowed to play the match and fifteen minutes after the match, again medical staff took a blood sample for the post-test analysis (Arruuda

et al., 2014). The same practice was repeated in all eight volleyball matches with the time-lapse of one match after every three days early in the morning after getting an eight-hour normal sleep on average and a standard local breakfast (chapatti, gravy and eggs) having basic macro and micronutrients. Every time after taking the blood samples, it was centrifuged for 3000rpm for 5 mins for the separation of serum. As the investigation was based on human subjects hence, every hygienic measures was adopted during sampling. Further, medical staff shifts those samples to the pathological laboratory for assessment of testosterone and cortisol levels in the blood, before and after matches. Samples were stored at -80C for further biochemical analysis. Testosterone and cortisol assessment was done by Enzyme-Linked Immunosorbent Assay (ELISA) using research grade commercially available kits.

The psychometric assessment was taken 30 minutes before the match using Competitive State Anxiety Inventory 2 (CSAI-2) (Batista *et al.*, 2019). Both teams' participation in the matches was 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. The Illinois Competition Test or CSAI-2 consists of 27 items, with 9 items for each subscale, named as cognitive anxiety, somatic anxiety and self-confidence (Batista *et al.*, 2019). All items were rated on a 4-point Likert-type scale.

Statistical Analysis

Results were analyzed, statistically by paired sample "t" test (Carré *et al.,* 2006), to examine significant variations amongst the parameters of the study, in comparable groups. Secondly, descriptive statistics were applied to measure psychometric variables on the psychological state of players. A probability level of 0.05 or less was taken to indicate statistical significance.

Results

Figure 1 (a) presents a pre-test *vs* pre-test comparison of testosterone level of volleyball players, while, playing at home and away playing venues, respectively.

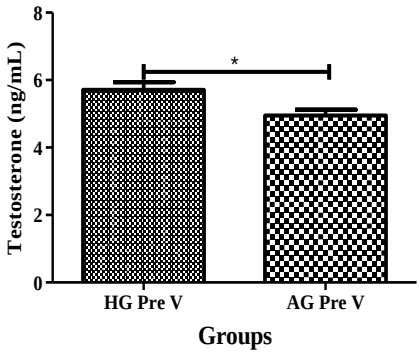

Fig. 1 (a): Average Level of Testosterone (ng/mL) in HG Pre V *vs* AG Pre V analysis

HG Pre V: Home Ground Pre-test Volleyball **AG Pre V:** Away Ground Pre-test Volleyball

*Significance at $P \leq 0.05$

Testosterone pre-test home venue was estimated as 5.71 ± 0.22 ng/mL which declined significantly by 13 % in a way pre-test estimation. The average level of testosterone in away ground pre-test condition was 4.95 ± 0.17 ng/mL (Table 1).

Table 1 Average levels of Testosterone (ng/mL) in comparable groups

Game	#	Venue comparison	Test type	Testosterone level (ng/mL) Mean ± SEM	%age Difference	*P*-value
Volleyball n=96	a	Home vs Away	Pre Pre	05.71 ± 0.22 04.95 ± 0.17	13↓ *	0.0148
	2	Home vs Away	Post Post	05.26 ± 0.16 04.39 ± 0.11	17↓ ***	0.0002

***indicate significance at $P \leq 0.05$, 0.001, respectively

Figure 1 (b) provides summary data on post-test *vs* post-test comparison of testosterone level of volleyball players, while, playing at home and away playing venues.

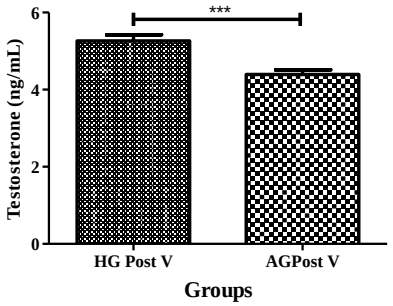

Fig. 1 (b): Average Level (ng/mL) of Testosterone in HG Post V *vs* AG post V analysis

HG Post V: Home Ground Post-test Volleyball **AG Post V:** Away Ground Post-test Volleyball

***Significant at ≤ 0.001

Testosterone post-test home venue was estimated at 5.26 ± 0.16 ng/mL which declined markedly by 17% in away post-test estimation. The average level of testosterone in away ground post-test determination was 4.39 ± 0.11 ng/mL (Table 1). Figure 2 (a) illustrates the pre-test vs pre-test comparison of cortisol levels in volleyball players, while, playing at home and away playing venues, respectively.

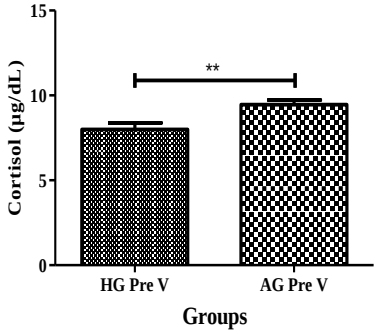

Fig. 2 (a): Average Level of Cortisol (µg/dL) in HG Pre V *vs* AG Pre V analysis

HG Pre V: Home Ground Pre-test Volleyball **AG Pre V:** Away Ground Pre-test Volleyball

**Significance at $P < 0.01$

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). Figure 2 (b) shows post-test *vs* post-test

comparison of cortisol level of volleyball players, while, playing at home and away playing venues, respectively.

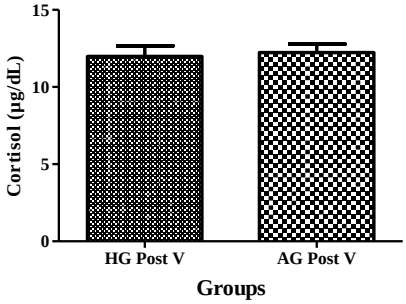

Fig. 2 (b): Average Level of Cortisol (µg/dL) in HG Post V *vs* AG Post V analysis

HG Post V: Home Ground Post-test Volleyball **AG Post V:** Away Ground Post-test Volleyball

Cortisol post-test home venue was estimated at 11.98 ± 0.68 µg/dL which did not vary significantly in away post-test estimation. The level of cortisol in away ground post-test determination was 12.23 ± 0.55 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
	b	Home vs Away	Post Post	11.98 ± 0.68 12.23 ± 0.55	2↑	0.7878

** indicate significance at $P \leq 0.01$.

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

Table 3 and figure 3 present 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: 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	

*$P \leq 0.05$ is considered as significant variation

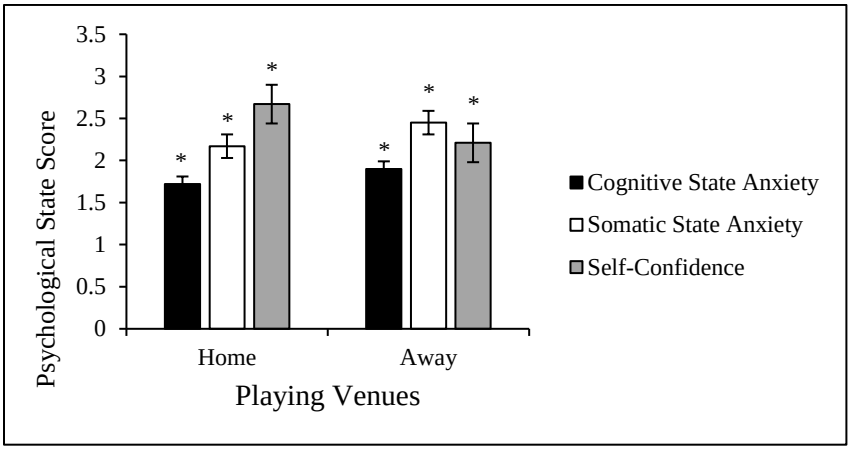

Fig. 3 Psychological State Score of Volleyball Players

*$P \leq 0.05$ is considered a significant variation

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 an away venue. The somatic state anxiety score on away ground was estimated as 2.45 ± 0.03.

The results in Table 4.6 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 an away venue. The self-confidence score on away ground was estimated as 2.21 ± 0.06 (Fig 3).

Discussion

Playing venue is considered a monitoring tool for hormonal responses and psychological states in sports official competitions. It has the power to influence a player's psychophysiological states due to its notable factors or conditions which we discussed at the beginning of the introduction. These factors anticipatory leave their effects on a player's psychological state and hormonal responses when he plays his on home ground as compared to an opponent's ground before playing the match. It has been logically explained in earlier studies (Arruda *et al.*, 2014; Casto and Edwards, 2016) that a player feels more comfort zone and shows an assertive behavior on his home ground due to the great contributing role of playing venue factors, for example, a player earns more moral and social support from the crowd, due to be familiarized with sports facilities and playing venue he executes in a better way his game tactics while playing home venue because of routine practice on it, a player demonstrates an aggressive and motivated behavior on his territory. Previous studies well-defined the referee's biases and undue favor for the home ground team and also he does not to be suffered from any stress due to traveling fatigue.

There are several key findings of this study, conducted on male inter-university volleyball players. It was observed by Arruda *et al.* (2014) when players perform at their home playing venue, their level of testosterone was raised and they also won the matches. This finding supports the results of the current study. Further, it was also documented in the current study that the cortisol level of players was elevated on the opponent's home ground because of fear of losing the victory status.

Testosterone (T) is an anabolic hormone that mediates sports competition by increasing motivation to compete and physical ability, particularly, among males (Handelsman *et al.*, 2018). In our findings, the testosterone level was significantly elevated on the home ground and decreased on away ground. The trend of reduced testosterone levels in players was seen on away playing ground situations in comparison to the testosterone level of the same players on their home ground, it was declined just because of the changing the playing venue (Arruda *et al.*, 2014).

Some studies found no alteration in the hormonal profile of playing at the home venue or away (Gray *et al.*, 2017). Whereas, some researchers found a significant difference in the hormonal profile of players who are participating in the competition, played at home venue as compared to those players who are playing away from the home ground. It has been reported earlier that the

concentration of testosterone hormone increases after winning the competition either it is in the home ground or away from the home ground (Fothergill *et al.*, 2017).

Cortisol (C) is a catabolic hormone, belonging to the steroid category which has an association with uncontrolled and unstable conditions (Casto and Edwards, 2016). It is also called the stressor hormone. When any emergency and a competitive situation are encountered, it prepares the human body to respond to the stressor stimulus. The challenging conditions and appraisal of threatening are associated with increased cortisol levels that might be due to the hypothalamic-pituitary-adrenal axis (HPA) responses to both psychological and physical stress from the external environment (Popma *et al.*, 2017).

In the present study, the level of cortisol was significantly elevated on away ground due to an increased level of cognitive anxiety, somatic anxiety, physical exertion, less support of the crowd, referee's biased decision against visiting team and traveling fatigue. It was observed, in the current study, that level of cortisol also decreased on the home ground due to the balance and supportive environment of the playing venue.

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. In a meta-analysis of Marsland *et al.* (2017), 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 and Kurlander, 2010). It also occurs in response to stressful physical activity like heavy exercise or any other patent physiological potential (Marsland *et al.* (2017)). In response to the release of 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).

The autonomous nervous system is linked with the perception of somatic anxiety, where psychological manifestations are observed in response to stress such as increased respiration, increased heart rate, unpleasant feelings and increased muscular tension along with nervousness (Cheng *et al.,* 2009).

When the player is in a more challenging condition, the anxiety becomes more severe in each dimension. In the present study, we observed that unstable hierarchy perception like background knowledge of opponent skills may create an additional level of stress when the opposing player is stronger than himself. Both cognitive and somatic anxiety begins to rise in case of additional stress which may be in the form of doubt of his abilities, personal issues, results of matches, or unpleasant feelings about the match. In the current study, we evaluated the increased score of self-confidence of players on home ground before match whereas cognitive and somatic anxiety score was noted higher on an opponent's home ground before the commencement of the match

In the investigation of Hendricks (2014) and Hendricks *et al.* (2016) a positive association is found in the performance for home venue and self-confidence before the competition and an apparent relationship were found *viz.* self-confidence and performance far away from the home venue. It was revealed by investigating the relationship between pre-game mental status and performance researches has proved that in the pre-competition state, self-confidence is an important variable with its influence on an athlete's performance. It was observed, in the current study, that level of cortisol also increased on the home ground due to an increased level of the crowd expectations, though, this psychological parameter was not evaluated in the current study.

Whereas, in another research, a positive relation was observed between pre and post-fight Cortisol levels in Judaists and somatic anxiety (Moreira *et al.,* 2012). Somatic anxiety, Testosterone and pre-round C in the competition of golf also expressed the same similar trends (Filaire *et al.,* 2009).

In sports competitions, variations in behavior and physical expressions are caused by hormonal changes which are due to the triggering of HPA to respond to the externally stimulating factors. The relationship between cognitive anxiety and salivary Testosterone is negative, when the player is performing away from his home venue, he feels worried, apprehension and

nervousness, this condition occurs when the player is unfamiliar with the playing venue in the presence of moderate Testosterone.

Researches have revealed that playing location also influences hormonal responses due to psychological factors such as the level of state anxiety (Arruda *et al.,* 2017). In contrast, as the player switches off from his playing venue and moves on the opponent's home ground, all the playing venue factors which were giving him moral support, familiarity, assertive behavior turned into a negative state. Due to which his stress and anxiety level go too higher and this is main reason that becomes the cause of declined i testosterone level and self-confidence score. Whereas his cortisol level, cognitive, somatic scores are increased due to which he has to face more physical exertion while playing the match.

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 players' testosterone level was elevated on the home ground due to favorable conditions which increased their self-confidence. The cortisol level of players increased on away ground due to an increased level 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 could affect their behavior and performance before and during a match.

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