*Yasmeen Tabbassum,[*] Muhammad Zafar Iqbal Butt[**], Nabila Roohi[***]

Effect of Playing Venue on Testosterone Level, Psychological State and Territoriality Score of Inter-University Volleyball Players

Abstract:
Home advantage is considered a well-documented phenomenon in various sports competitions to measure its effect on a player's behavior and match outcomes. The present study examined testosterone level, psychological state and territoriality score of younger than 23 years old (male) university volleyball players at home and opponent home ground. Ninety-six male volleyball players were selected for this study. Pretest-posttest analysis was performed in a blood sample, collected 60 minutes before the start of a match and 15 minutes after the finish of a match. The competitive state anxiety inventory-2 test was administrated before the match and psychometric response on territoriality was also taken after the match. The statistical interpretation was carried out by the paired sample "t" test.

Testosterone level was significantly declined 11% on away ground. This study found a 10% increase in cognitive, a 13% elevation in somatic anxiety and a 17% decrease score of self-confidence while playing on away ground whereas a 6% decline observed in territoriality effects on players at away ground. This study concluded that playing venue affects a player's testosterone level and self-confidence score on away ground even he did not play a match. It was noticed as evidenced due to which his territoriality score was significantly reduced on away ground after the match.

Keywords: *Playing venue*, State anxiety, *Testosterone, Territoriality, Volleyball, Players.*

Introduction

Volleyball is one of the most widely played games all over the world (Laporta, Afonso, Valongo, & Mesquita, 2019). There are two teams in the game; each team is having six players. Each team with its six players plays on each side of the court which is separated by a net. Six players stand as substitute players for each team. This game can be categorized as a coordinated playing activity that comprises six components: service, reception, boosting, spiking, blocking and defense (Guclu, Yaman, Caliskan, Pasaoglu, Isik, & Tuncer, 2016).

The playing venue is considered as a significant factor strengthening home advantage to players (García-de-Alcaraz, & Marcelino, 2017). Usually, factors contributing to playing venues are crowd support, territoriality, and referees' biases towards the home team in favoring and venue familiarity. However, obstructing experiences faced by the away team are travel, disturbance and fatigue (West, 2018). As in animals, defending territories is normal behavior. It has been observed that protecting and defending one's territory (particularly by males) in any event of combat is mediated by surges in testosterone levels (Ligocki, Earley, & Hamilton, 2019). The primary sex hormone and an anabolic steroid in men is testosterone. Testosterone plays a key role in the production of male reproductive tissues such as testes and prostate in male humans, as well as promoting secondary sexual characteristics such as increased muscle and bone mass, and body growth. Testosterone has been related to the ability to perform volleyball skills at high speed and recovery capacity, and its release is driven not only by internal triggers but also regulated by the environmental stimulus.

Furthermore, psychological responses such as Competitive State Anxiety Inventory-2 (CSAI-2) has also been shown to be sensitive to the position of the playing venue. Increases in cognitive and somatic anxiety compared to training sessions have also been identified previously in official games (Arruda, Aoki, Paludo & Moreira, 2017).

[*] Yasmeen Tabbassum, Department of Sport Sciences and Physical Education, University of the Punjab, Lahore.

[**] Muhammad Zafar Iqbal Butt, Department of Sport Sciences and Physical Education, University of the Punjab, Lahore.

[***] Nabila Roohi, Physiology/Endocrinology Laboratory, Department of Zoology, University of the Punjab, Lahore.

Therefore, it is reasonable to suggest that elite performance during competition could be mediated by interactions between the emotional, hormonal and behavioral responses. Psychological measures have shown that players had higher self-confidence at the home venue, whereas, higher somatic and cognitive anxiety at the away venue (Arruda, Aoki, Paludo, & Moreira, 2017). Allen & Jones (2014) measured the testosterone level in amateur ice hockey players after the victory at the home venue and the victory at the away venue. There was a significant rise in testosterone concentrations at the home venue as compared to the away venue.

Territoriality is considered the most prominent factor of playing venue which contributes to increasing the assertive aggression of players defensively when they play there on the territory (Furley, Schweizer, & Memmert, 2018). It influences the testosterone concentration of players in their home ground before playing the match.

Dominance and its association with the concept of territoriality can be explained by an athlete who is playing at the home venue and perceives the advantage through aggression, status and dominance (Arruda, Aoki, Paludo, & Moreira, 2017). It has been found that in the species of many animals direct relation of aggression is present regarding its territoriality such as when the animals are contesting at their home territory, they defend themselves with greater vigor (Briffa & Lane, 2017). Increased level of arousal and aggression during a performance at the home venue is the finding of many studies that were conducted in the games of rugby (Cunniffe, Morgan, Baker, Cardinale, & Davies, 2015) and ice hockey. Agonistic behavior has broader meanings, but here we characterize it as any social behavior which possesses or provokes fighting due to its traits of aggression, threats and submission (Ramirez & Andreu, 2006). This kind of social behavior is considered as reciprocally related to testosterone levels in the blood (Carré & Olmstead, 2015) and the athlete's attitude is influenced by testosterone during sports competitions. Certainly, when the contest is organized at the home venue of a team then the level of testosterone becomes high in the blood of players of the team who are playing at their home ground. As compared to losing a competition, winning behavior in humans is mostly associated with the raised level of testosterone hormone (Casto and Edwards, 2016). The concept of dominance and testosterone relationship can be confirmed through findings of research along with territory and aggression.

The present investigation was designed to evaluate the variations in testosterone levels, competitive state anxiety and territoriality scores in eight volleyball teams before and after the match on home and an opponent's home ground.

Material and method

Ninety-six male volleyball players from eight different public and private universities in Lahore city participating in the Higher Education Commission (HEC) Inter-university Sports Competition 2016-17, were recruited as a sample for the present study. The following were the universities from which male volleyball players were selected as a sample; 1) University of the Punjab 2) Government College University 3) University of Management and Technology 4) Lahore University of Management Sciences 5) University of Veterinary & Animal Sciences 6) Minhaj University Lahore 7) Lahore Leads University and 8) Superior University Lahore.

Prior permission was obtained from all the sports directors of allocated universities to get access to their volleyball team players. Participants were guided and informed about competitions' schedules on different venues and the blood sampling process (before and after matches). Consent from all players as participants of the study was also taken before the competition.

To comply with the objectives of the study, we organized matches carefully. The matches were played in such a way that every team got the chance to play at least one match on its home ground and one match on away ground.

Blood sample collection was carried out in the dressing room of players 60 minutes before the commencement of the match and fifteen 15 minutes after the match. Pre-test and post-test phlebotomy was performed for assessment of hormonal responses of players by registered medical technicians on the home playing venue and away playing venues. After that, samples were sent to the research laboratory for serum separation. The samples were stored at -80°C for later use in the hormonal analysis. All the serum samples were analyzed for Testosterone by ELISA.

The Competitive State Anxiety Inventory-2 (CSAI-2) test was performed to evaluate the players' responses on cognitive and somatic anxiety and self-confidence levels. The CSAI-2 was filled out by players 30 minutes before the start of the match.

A self-generated questionnaire on Territoriality was also used to measure the territoriality behavior of players after the competition. Which consisted of 10 statements about the playing venue. The territoriality questionnaire was filled up 40 minutes after the match on the home and away ground.

Statistical Analysis

Results were analyzed, statistically by paired sample "t" test using the latest version of SPSS (22) officially named IBM SPSS statistics, 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 psychological state, playing venue factors and perception of efforts of players.

Results

The mean free testosterone level (ng/mL) was measured on the home ground and away ground. The difference from pre-test to post-test was calculated from pre-test to post-test free testosterone level (ng/mL) through paired sample t-test.

Testosterone level (ng/mL)

Table I and figure I show the results of the study as it is a very mild decrease in the mean serum free testosterone level (ng/mL) of players. In pre-test at the home ground which is 05.71 ± 0.22
ng/mL in comparison to post-test which is 05.26 ± 0.16 ng/mL with %age mean difference of 8%. On the other hand, there was a remarkable decrease in serum-free testosterone levels from pre-test value i.e. 04.95 ±. 017 ng/mL to serum-free testosterone level in post-test which is 04.39 ± 0.11 ng/mL with a mean %age difference of 11.

Table 1. Average levels of Testosterone (ng/mL) on home and opponent's home ground

Volleyball n=96	#	Playing Venue	Test type	Testosterone level (ng/mL) Mean ± SEM	%age Difference	*P*-value
	a	Home	Pre Post	05.71 ± 0.22 05.26 ± 0.16	8↓***	< 0.0001
	b	Away	Pre Post	04.95 ±. 017 04.39 ± 0.11	11↓***	< 0.0001

***indicate significance at $P < 0.001$

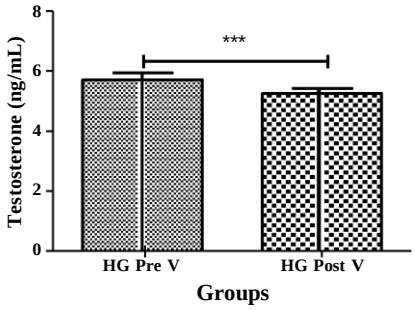

Fig. 1 (a): Average Level of Testosterone (ng/mL) in HG Pre V *vs* HG Post V analysis

HG Pre V: Home Ground Pre-test Volleyball **HG Post V**: Home Ground Post-test Volleyball

***Significance at $P < 0.001$.

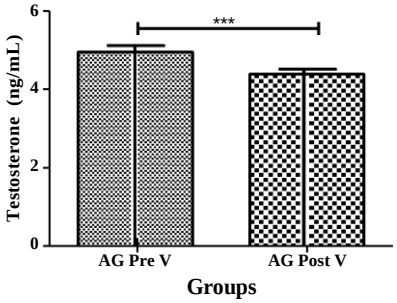

Fig. 1 (b): Average Level of Testosterone (ng/mL) in AG Pre V *vs* AG Post V analysis
AG Pre V: Away Ground Pre-test Volleyball **AG Post V:** Away Ground Post-test Volleyball
***Significance at $P < 0.001$.

Psychological state (Competitive State Anxiety Inventory-2, CSAI-2)
Table II and figure II show that players feel more cognitive state anxiety on away grounds as compared to their home grounds. The average cognitive state anxiety on the home ground was 1.72±.033. It was increased by 10% while playing on away venue. Cognitive state anxiety on away ground was estimated as 1.90±.041. The average somatic state anxiety on the home ground was 2.46±.035. It was decreased by 13% while playing on away venue. Somatic state anxiety on away ground was estimated as 2.14±.051. Players feel more confident on their home ground as compared to away ground. The average self-confidence on the home ground was 2.67±.052. It was declined by 17% while playing on away venue. Self-confidence on away ground was estimated as 2.21±.063.

Table 2: 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

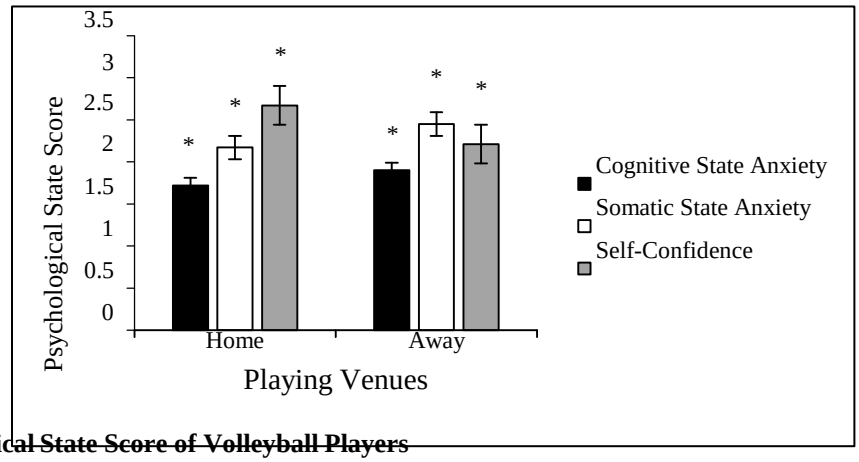

Fig. 2 Psychological State Score of Volleyball Players
*$P < 0.05$ is considered as significant variation

Table III and figure III reveal the effect of territoriality on players' behavior. The average level of territoriality on the home ground was 3.72±.073. It was decreased by 6% on away ground. The average level of territoriality was 3.49±.059 which reflects that the players feel more comfortable on home ground. The performance of players improves due to the influence of territoriality.

Territoriality Score

Table 3: Territoriality Score of Volleyball Players

Venue factors	Venue	N	Mean ± SEM	P-value
Territoriality	Home Ground	96	3.72±0.07	0.015*
	Away Ground		3.49±0.05	

**$P < 0.01$ is considered as significant variation

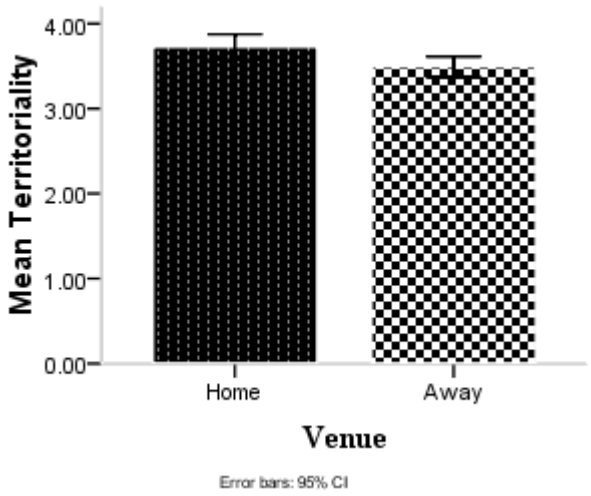

Fig. 3 Territoriality Score of Volleyball Players

*$P < 0.05$ is considered as significant variation

Discussion & Conclusion

The current study was conducted on inter-university male volleyball players. There are many findings of the present study which highlight the remarkable effect of playing venue on testosterone level, competitive state anxiety and territoriality scores of players.

Testosterone (T) is an anabolic hormone that mediates sports competition by increasing competitive motivation and physical capacity, particularly among males (Arruda, Aoki, Freitas, Drago, Oliveira, Crewther & Moreira, 2014).

It was investigated in the athletic teams that have been observed winning more matches on their home ground as compared to opponents' ground. Generally, it was determined that playing on the home ground causes less decline in serum-free testosterone levels as compared to playing on away venues. It was due to an increased score of territoriality factor and a higher level of self-confidence on home ground (Gray, McHale, & Carré, 2017).

Another study, retaining elevated testosterone on the home venue as compared to away because playing venue is a strong phenomenon that leads to winning more games in beginner and professional games (Diana, Zurloni, Elia, Cavalera, Jonsson & Anguera, 2017).

Several studies have found that in anticipation of the competitive situation the T level rises and has an impact on players' performance and result in a team winning during the competition (Chichinadze, Lazarashvili, Chichinadze, & Gachechiladze, 2012; Fothergill, Wolfson, & Neave, 2017). These results are similar to those of Wolfson and Neave (2003) in which they found that perceived invasion of one's territory has an impact as a protective response when the players are in the pre-game state at their home venue for the competition because their T level becomes increased than when they are not playing in their territory.

The victory in the competition has a relation with high social status which has been explained in the Biosocial Model of Status (BMS), in which researchers explained that behavior during the competition and its aggression has

support from T, which helps the achieved position to be maintained in the hierarchy (Arruda, A. F., Aoki, M. S., Paludo, A. C., & Moreira, 2017).
The findings of the present study suggest that volleyball players' testosterone level was increased at the home ground due to the higher score of self-confidence of players and it was significantly declined on the opponent home ground due to increased scores of cognitive and somatic anxiety.

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, Hardy, & Markland, 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 stress 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 investigation of Hendricks, (2014) and Hendricks, Smith, & Legutki (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 searching 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. A study was done by Arruda, Aoki, Freitas, Drago, Oliveira, Crewther & Moreira (2014) found that players' cognitive and somatic anxiety scores were improved on way ground whereas their self-confidence was increased on home ground.

In our investigation, players' self-confidence was raised on the home ground due to crowd support, execution of game tactics, assertive behavior whereas, their cognitive and somatic anxiety levels were increased due to crowd hotting, referee's biases and less familiarity with sports facilities on opponent's home ground.

In another hand, territorial behavior is common in animals and it has been recognized that the acquirement and defense of their regions or territories (especially by males) is at any rate mostly mediated by surges in testosterone. In human social orders, aggression has been ritualized as competition and sport. Higher testosterone levels have been related to fights, danger and attacks in male judo competitors and with professional players' (of basketball) commitments to the game result. It is estimated by the score/time playing ratio. Similarly, surges in testosterone have been stated for in winning tennis players even though the direction of causality remains blurred. Regarding territoriality, there is some evidence in this context that humans are increasingly predominant and activated inside a territory of their own.

A few studies have demonstrated raised aggression and excitement at home grounds to ice hockey and rugby. Some studies have evaluated the relation between perceived territoriality and the competition playing venue in the winning games (Jiménez, Aguilar, & Alvero-Cruz, 2012). If it is true that testosterone levels are surely connected with self-confidence and predominance; and with the humans' behavior to fight well to defend their home territory while playing on home venue than away venue in sport. Then there might be differences in competitors' testosterone levels. Results based on testosterone level denote the self-confidence and comfort level of players on the home venue (Muller, 2017). The findings of the present study explored that volleyball players' territoriality score was increased on the home ground due to an increased level of testosterone and self-confidence of players whereas their territoriality score was seen significantly in reduction on opponent's home ground due to an increased level of somatic and cognitive anxiety and reduction in testosterone levels of players

This study aimed to explore possible changes in testosterone levels of male volleyball university players according to their playing venues. It was deduced that there is a significant difference in testosterone levels of volleyball players, playing on a home and away venue. This resulted in formulating the outcome that the performance level of volleyball players while playing on away venue was not as high as it was on their home venue due to surges in testosterone levels. Testosterone levels along with self-confidence and territoriality, all these factors confirmed their significance on game results by enhancing the performance of volleyball players on the home venue. A total no. of 4 matches were played at the home ground only 1 match lost by the home team and 3 won. The teams performed better in the home ground venue than away ground. Playing venue significantly affected testosterone level and psychological state of male volleyball players.

Author's contribution

- All the authors contributed equally in writing the manuscript.

Acknowledgment:

- We would like to thank all the volleyball players and coaches for helping us in this study.

Practical Implication and Future Recommendations

- This study will help players, officials and coaches to manage/optimize aggression of players at home and away playing areas due to which players can perform at a better level.
- This study can be done on a larger population to generalize it.
- This study can be done on some other sports to increase its validity.
- This study can be done on female athletes due to the difference in their testosterone level in comparison to male athletes.
- This study can be done to measure other psychological parameters like arousal, stress, etc. to increase invalidity for the measuring parameter of serum-free testosterone level.
- This study can be done on strength sports athletes due to the difference in their testosterone level in comparison to endurance athletes.

REFERENCES

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.

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.

Briffa, M., & Lane, S. M. (2017). The role of skill in animal contests: a neglected component of fighting ability. Proceedings of the Royal Society B: *Biological Sciences*, 284(1863), 20171596.

Carré, J. M., & Olmstead, N. A. (2015). Social neuroendocrinology of human aggression: examining the role of competition-induced testosterone dynamics. *Neuroscience*, 286, 171-186.

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 Buman Behavior and Physiology*, 2(1), 11-25.

Cheng, W. N. K., Hardy, L., & Markland, D. (2009). Toward a three-dimensional conceptualization of performance anxiety: Rationale and initial measurement development. *Psychology of Sport and Exercise*, 10(2), 271-278.

Chichinadze, K., Lazarashvili, A., Chichinadze, N., & Gachechiladze, L. (2012). Testosterone dynamics during the encounter, role of emotional factors. *Journal of comparative physiology*, 198(7), 485-494.

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 and Performance*, 10(6), 687-694.

Diana, B., Zurloni, V., Elia, M., Cavalera, C. M., Jonsson, G. K., & Anguera, M. T. (2017). How game location affects soccer performance: T-pattern analysis of attack actions in home and away matches. *Frontiers in psychology*, 8, 1415.

Jiménez, M., Aguilar, R., & Alvero-Cruz, J. R. (2012). Effects of victory and defeat on testosterone and cortisol response to competition: evidence for same response patterns in men and women. *Psych-neuroendocrinology*, 37, 1577–1581.

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.

Furley, P., Schweizer, G., & Memmert, D. (2018). Thin slices of athletes' nonverbal behavior give away game location: Testing the territoriality hypothesis of the home game advantage. *Evolutionary Psychology*, 16(2),147-159.

Guclu, M., Yaman, M., Caliskan, G, Pasaoglu, H., Isik, E., & Tuncer, A. F. (2016). An examination of psychological and biochemical parameters of American football players and volleyball players: A Discriminate analysis. The Anthropologist, 25(1-2),160-167.

García-de-Alcaraz, A., & Marcelino, R. (2017). Influence of match quality on men's volleyball performance at different competition levels. *International Journal of Performance Analysis in Sport*, 17(4):394-405.

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.

Hendricks, K. S. (2014). Changes in self-efficacy beliefs over time: Contextual influences of gender, rank-based placement, and social support in a competitive orchestra environment. *Psychology of Music*, 42(3), 347-365.

Hendricks, K. S., Smith, T. D., and Legutki, A. R. (2016). Competitive comparison in music: influences upon self-efficacy beliefs by gender. *Gender and Education*, 28(7), 918-934.

Laporta, L., Afonso, J., Valongo, B., & Mesquita, I. (2019). Using social network analysis to assess play efficacy according to game patterns: a game-centred approach in high-level men's volleyball. *International Journal of Performance Analysis in Sport*, 19(5), 866-877.

Ligocki, I., Y, Earley, R., L., & Hamilton, I. M. (2019). How individual and relative size affect participation in territorial defense and cortisol levels in a social fish. *Journal of Experimental Zoology Part A: Ecological and Integrative Physiology*, 331(4), 217-226.

Muller, M. N. (2017). Testosterone and reproductive effort in male primates. *Hormones and Behavior*, (91), 36-51.

West, J. (2018). A review of the key demands for a football goalkeeper. *International Journal of Sports Science & Coaching*, 13(6),1215-1222.

Ramirez, J. M., & Andreu, J. M. (2006). Aggression, and some related psychological constructs (anger, hostility, and impulsivity) Some comments from a research project. *Neuroscience & Biobehavioral Reviews*, 30(3), 276-291.