

Effect of Competition anxiety on salivary cortisol and immunoglobulin IgA kinetics in Egyptian handball players according to playing position

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Introduction

Athletic competition is an especial occasion with formal framework requires athletes to exert maximum effort over their individual aspect and as team participation cooperation (Casto, & Edwards 2016), coordination between athletes during competitions provide a good environment of studying the psychophysiological characteristics of competitions impact on athletes. Athletes in general are exposed to variety of stressors. Once athlete are judged from other athletes, trainers, audience, stuff, so social impact manipulates the physiological (Casto, & Edwards, 2012). Since a competition can affect an plyers' self-esteem and self-identity, sports competitions, tournaments and performance are also a perfect environment for researching the relationship between obstacles and opportunities. competitive conditions may be very stressful, furthermore, poor performance before and after tournaments results in a loss of social standing activity, (Rohleder, et al 2007). Athletes have a greater chance of this being clinically important because, in addition to the psychological pressures of fitness and competitiveness, the physical exercise they engage in introduces them to the possibility of injury and increases the risks of infection by pathogen due to higher intensity and depth of breathing as well as increased intestinal permeability (Clow, & Hucklebridge, 2001). Correlation between playing tasks or positions in field and the levels of cortisol and immunoglobulin is very controversial, where some studies found that players' physiological respond does not seem to be influenced by the type of exercise or a condition of preparation exercise duration, but may be more influenced by exercise-induced stress habitual reaction of players (Irving, et al 2006). Other studies, Caetano Júnior, et al (2017), referred its results of high differences in cortisol and immunoglobulin between players to the playing position. Suzuki et al (2000), regarded that training intensity vary in immunity responses, where endurance training causes immunological modifications linked to an increase in cortisol levels.

Moreira et al (2009) study resulted that salivary cortisol may be a stronger indicator of the stress response than serum cortisol since it detects the level of unbound cortisol more precisely serum measurements, unlike Simulating a similar environment was used to eliminate the environment physiology cortisol levels during strenuous laboratory exercise did not reach the same heights, this observation emphasizes the fact that the outcomes obtained in a laboratory environment.

Cortisol levels have been shown to rise after both strenuous (Elloumi et al. 2003) and nonstrenuous competitive games in other research (Doan et al. 2007), it is psychological, but not biochemical, in general, the competition's part is thought to be the increase in cortisol reaction is due to this. Elloumi et al. (2003) discovered that cortisol levels were significantly higher in women than in men raised after a rugby match, but when the game is over even in golf players Cortisol elevation during golf competition may be the product of psychological discomfort due to the intense nature of the sport.

Salivary cortisol reaction in top-level professional soccer players during a competitive training match Changes with a wide range of magnitudes where players succeeded to adapt the impact of high training loads through long time (Moreira et al 2009).

Circulating stress hormone level is very variant, the change in cortisol level depends on response to competition stressors, where competition demands apply psychological and physiological stressors on players (Casto, & Edwards 2016). Cortisol often suppresses functions that aren't necessary or helpful in a fight-or-flight situation. It suppresses the nervous system, reproductive system, and development mechanisms by modifying immune system responses. The brain regions that regulate mood, energy, and anxiety are often interacted with through this dynamic natural warning system, on other hand, Siart et al (2017), found that the release of Cortisol in players body, help them to react physically and physiologically, where differences between competing players interacts with stressor can be mirrored in their competition results, that cortisol increased attention, concentration, and help delaying pain and fatigue, which result from increased activation of stress system of the body.

Physical performance with low to moderate intensities found to improve the body's ability to overcome illness and boost immunity system. Immunoglobulins are essential components of the immune system. They're proteins made by plasma cells, which are immune detecting health or disease. Urinary proteins have been used as a

noninvasive biomarker to reliably track the body's tension under a number of psychophysiological stressors where exercise can cause immunosuppression, as well as to recognize the body's state in strenuous or unfamiliar activity, tournaments, overtraining, and insufficient recovery in sports (Anis et al 2017, Xu et al 2020).

Immunoglobulin A (IgA) is a crucial component of body mechanism to defend outer or inner threats, that is found in abundance on mucous membranes and can be measured in saliva and urine. It may be used to detect the immune function and physiologic well-being during any forms of physical activity (Sánchez-Salguero & Santos-Argumedo 2018).

Handball is a team game consists of two 30-minutes of intermittent bouts of high to low performing intensities, it contains multidirectional running, jumping, dripping, stopping and shooting, with different tasks of defending, attacking and goal keeping (Póvoas et al 2014), lately classified as a high load with 80% overall match workload where 85% maximum heart rate, that load represented in covered running speed and interaction during match according the playing position of the players.

Marin et al (2013) regarded that handball match has an intermission with recovery time that supposed to decrease the stress impact on player's body. Playing experience, time to expose to stressful performance and competing help adapting the players to overcome the game stressors.

This study aims profiling the psychophysiological impact of official handball match on salivary cortisol and immunoglobulin IgA levels as detectors of body reaction to match physiological demands and how players can react psychologically and be reflected in their physiological responses.

Methods

Descriptive curriculum carried out matching the aim of the study, where to profile the psychophysiological variables of handball players during official handball. Sample was collected intentionally from Tanta handball team, it is a tenth degree in Egyptian handball league, they well experienced in playing, in "professionals" ranking. 16 elite handball players participated in this study, distributed into four groups (4 pivots, 4 wings, 4 goalkeepers, 4 backcourts), with average age of 21.625, weight of 77.250 and heart rate of 93.500, table (1) shows the homogeneity of the sample.

Table (1) Mean, standard deviation and Kolmogorov-Smirnov Test for Normality of sample variables

Variables	Mean	Standard deviation	Kolmogorov-Smirnov	Error	Significance
Age	21.625	0.423	0.459	0.984	Non
Height	172.750	3.160	0.832	0.472	Non
Weight	77.250	2.593	1.116	0.139	Non
Training experience	9.850	2.049	0.782	0.573	Non

Z value at significance 0.05=1.96, $p>0.05$, no significant differences found between participants.

Healthy participants were asked to sign consent of free will participation supplement (1).

Measurements: The physiological pre-measurements were taken an hour and 30 minutes before the official match of the Egyptian handball league (it was a win match). Post-measurements were taken just after the match finished. Pre-measurements were divided into two tests, one is a psychological test with self-check questionnaire, to detect the stress of competing before match, and the other one is the physiological test to detect the related endocrine changes in athlete's body, both pre and post measurements were taken in the Tanta club official handball playground. Athletes reported their pre-match up status with the reliable (SCAT); sport competition anxiety test, (Martens, R. 1977), where athletes response to fifteen consecutive questions about their feelings for the coming competing situation. Athletes were asked to fill in the questionnaire one hour before the match with no time restrictions, in order to begin warm-up and focus in the match. The test is good for monitoring the performance anxiety of an athlete, by conducting the rest at regular interval and noting the changes over time. The SCAT is a three points Likert-type scale, consists of 15 phrases, with 5 phrases, 1, 4, 7, 10 and 13 are neutralized and not scored. Positive phrases score 1 point (hardly ever), 2 points (sometimes) and 3 points (often). The phrases number 6 and 11 are reversed phrases with scoring, 1 (often), 2 (sometimes) and 3 (hardly). The questionnaire 8 phrases 2, 6, 8, 9, 11, 12, 14, and 15 regard the somatic feelings related to the competition stress on athletes' bodies; other two phrases 3 and 5 regarded the cognitive status of the athletes related to competition anticipation. The scores for the whole 10 phrases are summed together indicating the anxiety level of the responder from 10 to 30 score; ≥ 24 score reflects the highest level of anxiety, score lies between 17, and 24 reflects average level of anxiety, score with <17 reflects a low level of

anxiety (Martens, R. 1977; Martens, R., et al 1990; Martens, R., 1990; Dunn, J. G. H. & Causgrove Dunn, J. 2001).

Physiological tests recruited to sample homogeneity and psychophysiological reaction. Saliva samples were collected 30 minutes before match. Samples collected in standard salivates by giving the players chunks of sterilized cotton with area of (1cm²) to absorb the saliva under their tongues, the cottons were drained out in sterilized coded cups, then saliva were drained with syringes into the vacutainers for laboratory analysis in private accredited lab; supplement (2). Samples were analyzed using enzyme-linked immunosorbent assay (ELISA). Heart rate measured just before and after the match up to detect the psychological impact of the match on players.

Statistical analyses: data were treated using SPSS software. All data are reported as mean, median, standard deviation, Kolmogorov-Smirnov Test for Normality, Chi-Square Test and Wilcoxon Signed Ranks Test matching non parametric sample groups.

Results: table 2, 3, 4, 5 represent the analytic treatment of the pre and post data (physiological – psychological (scat questionnaire)).

Table (2), significant difference between sample groups (pivots- wings- goalkeepers-backcourts), in physiological pre-measurements (pulse- cortisol- IgA)

variables	Ranking mean pivot	Ranking mean wings	Ranking mean Goal keeper	Ranking mean Backcourt	chi-square (Kruskal Wallis)
	n=4	n=4	n=4	n=4	
pulse	5.750	11.000	8.000	9.250	2.615
cortisol	9.875	6.625	9.125	8.375	1.029
IgA	6.375	6.625	10.000	11.000	2.979

Chi-square table value at freedom degree (3) and significance 0.05 = 7.81

Table (2) shows the calculated chi-square of Kruskal Wallis ranged: (1.029 to 5.198) was below the Chi-square table value, showing insignificant differences between sample groups in (pulse- cortisol- IgA) pre-measurement variables.

Table (3) significant difference between sample groups (pivots- wings- goalkeepers-backcourts), in physiological post-measurements (pulse- cortisol- IgA)

variables	Ranking mean pivot	Ranking mean wings	Ranking mean Goal keeper	Ranking mean Backcourt	chi-square (Kruskal Wallis)
	n=4	n=4	n=4	n=4	
pulse	9.375	10.875	4.500	9.250	8.354
cortisol	6.500	5.250	11.125	11.125	9.017
IgA	9.250	3.250	9.875	11.625	9.093

Chi-square table value at freedom degree (3) and significance 0.05 = 7.81

Table (3) shows the calculated chi-square of Kruskal Wallis ranged: (8.354 to 9.093) was higher than Chi-square table value, showing significant differences between sample groups in (pulse-cortisol- IgA) post-measurement variables.

Table (4) significant difference among sample groups (pivots- wings- goalkeepers-backcourts), in physiological post-measurements (pulse- cortisol- IgA)

Physiological variables	groups	Ranking mean	Ranking mean differences			
			pivot	wings	Goal keeper	Back court
pulse	pivot	9.3750		1.500	4.875	0.125
	wings	10.8750			6.375*	1.625
	Goalkeeper	4.5000				4.750
	Back court	9.2500				
cortisol	pivot	6.5000		1.250	4.625	4.625
	wings	5.2500			5.875*	5.875*
	Goalkeeper	11.1250				0.000
	Back court	11.1250				
IgA	pivot	9.2500		6.000	0.625	2.375
	wings	3.2500			6.625*	8.375*
	Goalkeeper	9.8750				1.750
	Back court	11.6250				

***=higher reading**

Table (4) shows significant differences among sample groups in (pulse- cortisol- IgA) post-measurement variables.

Table (5), significant difference between sample groups (pivots- wings- goalkeepers-backcourts), in psychological measurement of SCAT (somatic- cognitive- anxiety level)

Variables	Mean	Standard deviation	Kolmogorov-Smirnov	Error	Significance
cognitive	4.375	1.408	0.753	0.622	Non
Somatic	13.250	3.958	0.851	0.464	Non
Anxiety	17.625	5.071	0.791	0.560	Non

Z value at significance 0.05=1.96, $p>0.05$, no significant differences found between participants.

Table (5) shows insignificant differences between sample groups psychological measurement of SCAT (somatic- cognitive- anxiety level).

Discussion

The impact of physiological and Psychological stress of competitions varies with in the players of the same team according to the individual differences, demands of the playing position (Caetano Junior, P.C., et al 2017), and any outer encounters such as referees judgement and audience (Tsorbatzoudis, H., et al 2005). Hill, E. E., et al (2008), pointed that the high intensity of performance provokes salivary cortisol level. Also Kayacan, Y., et al (2017), Tiernan, C., et al (2019), emphasized that cortisol is a rapid reliable detector for the psycho-physiological stress of competing, where its level rises within minutes of stress exposure, so it can be used for customizing the training programs, stress management, monitoring fatigue and overtraining in athletes. Recent study resulted significant increase in cortisol level with 33% in pre-match measurement; according to the maximum reference range dedicated to the lab, this increase varies according to several reasons such as playing experience, playing positions, competition weights and warming up time and intensity matching the results of previous studies: (Archer J., 2006; Alix-Sy et al., 2008; Filaire et al., 2009; Papacosta, E., & Nassis, G. P., 2011; Casto, K.V., and Edwards, D.A., 2016; Kayacan, Y. et al, 2017;), since the recent study was a win match of the Egyptian league matches, then the pre-match cortisol didn't seem to affect the players performance during the match, align with the result of (Crewther, B., et al 2011), but contradicted with (Kivlighan et al 2005; Filaire, E., et al 2009; Siart, B., et al 2017), where they regarded the rise in cortisol pre-match was because of the social stress on athletes. Cortisol levels dramatically rose with 74.53% in post-match samples according to the pre-test, matching the results of (Casto, K. V., & Edwards, D. A. 2016a; Casto, K.V., & Edwards, D.A., 2016b). Tsai et

al, (2014), and Crewther et al., (2015) emphasized that the increase of post-match cortisol is due to the impact of match stressors, however Kayacan, Y., et al (2017), found that cortisol levels rose before and during handball match, but significantly decreased at the end of it, Bruzda-Zwiech, A., et al (2017) interpreted that the reduction of cortisol levels after match is correlated with the adaptation of match psychological and physiological stressors.

Variation of cortisol levels between athletes in this study may be an evidence of individual differences in adapting to competition stressors according to playing experience, as shown in previous studies (Levine, S., 2000; Clow, A., & Hucklebridge, F., 2001).

Post-match tests showed significant increase in cortisol level comparing to pre-match tests showing the great impact of match physiological and psychological demands especially in most stressful playing positions as goal keepers and backcourt players who recorded the highest salivary cortisol readings, that explains the anticipatory excitement among players during making a break through or preventing expected goals, this evidence emphasized in previous studies (Mehta et al., 2008; Póvoas, S. C., et al. 2014; Meyer, V. J., et al, 2015; Van Paridon, K. N., et al, 2017; Caetano Junior, P.C., et al, 2017). These studies regarded the post-match increase in cortisol wasn't conditional whether with win or lose result of the match, unlike other studies which reported remarkable decrease in post-match cortisol level in winning match contradicted with the recent study results (Jiménez et al., 2012).

Immunoglobulin IgA reported significant increase in post-match test with 121.82% comparing to pre-match test with 36.8%; according to the maximum reference range, the increase was different among the players with different playing position, showing that the psychological effect of playing position demands on players' endocrine system, in line with previous studies (Sari-Sarraf, V., et al 2008; Ide, B. N., et al 2019). Salivary Immunoglobulin IgA has been showing contradicting results over previous studies, although it represents the related psychophysiological effect, but it also differs in results according to the athletes' levels and adaptation to competing stressors. Previous studies regarded the reduction in salivary IgA to acute level of performance which affects the immunity response and may lead to injury and immunity suppression as the study of Mariscal, G., et al (2019) found significant decrease in salivary IgA after match-up especially players played over 30 minutes in handball match

In other studies salivary Immunoglobulin IgA didn't show significant difference between pre and post-match test, and the

researchers referred that result to the high physiological adaptation of the players, or the minor effect of the match impact on mucosal immunity (Moreira, A., et al 2009; Moreira, A., et al 2012; Park, S. H., et al 2020).

Anxiety is a psycho-physiological situation that determines the athlete's behavior during competing. Anxiety stimulates nervous system to produce catecholamine which affects the function of all body organs, Anxiety also affects mental, cognitive and physical capabilities of athletes (Jarvis M., 2002), while increased level of anxiety passively affects the performance of athletes. In this study; researchers used the sport anxiety scale (SCAT) to detect the self-report of pre-match up status. Players recorded their SCAT test within the two concerns of somatic and mental queries. Somatic anxiety is a perceptual situation of physiological response of players, reflecting uneasiness during competing with higher heart rate, urination, cold perspiration, and decrease in sleeping quality, on the other hand the cognitive anxiety is also considered a competition stressor outcome, reflecting bad attention, low decision function and injury fear and anticipation (John G.H., et al, 2020). SCAT resulted average to low scale of anxiety according to the scale norms, this result is contradicted to the resulted salivary tests of cortisol and immunoglobulin IgA which indicates the inaccurate of self-report understanding of players to the competing stressors. Overall anxiety level resulted insignificant differences among players groups (goalkeepers- backcourt- pivot- wings), the little differences found were ranked according to the playing position demand related to the physiological output (Massuca, L., et al 2015). Highest somatic anxiety recorded for goalkeepers then backcourt, wings and the lowest recorded for the pivot players this little variance may refer to the nature and experience status of goal keepers, usually goal keeping position demands less distant moving like running and sprinting, which can affect the goalkeepers body composition and cardiorespiratory efficiency, that can results more anxious anticipation of blocking ball shots (Reigal, R. E., et al 2019). Lower somatic anxiety for pivot players showing the more experience in attacking demands of their playing position. Highest cognitive anxiety recorded for the backcourt players showing less coping and attention for defending demands in their playing position that can also represent less self-confidence (Verner-Filion, J., et al 2014). On other hand, lower cognitive anxiety level was recorded for pivot players showing the best self-judgment related to high performance and winning achievement. Although all playing positions recorded low to medium levels of anxiety according to the results of

SCAT questionnaire, the physiological results contradicted with it, that all cortisol and immunoglobulin IgA recorded high reading in pre and post tests showing high impact of competing stressors on players' bodies.

Conclusions

Goal keepers, back court, pivot and wings groups recorded insignificant differences in anxiety level pre-match up, however, related reading between cortisol and IgA levels. Cortisol and IgA levels were different among the groups; the higher reading was for goal keepers, and then back courts and pivot groups, wings group recorded the lowest cortisol and IgA levels, that explained the impact of the playing position on the plyers' bodies, as well as emphasized on the playing experience as an adaptive agent manipulating the psycho-physiological responses.

Disclosure

All researchers have no conflict of interest.

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