

Letter to editor

Changes in Cortisol and Immunoglobulin a Concentrations in Referees during a Professional Football Match

Dear Editor-in-chief

Football is an intermittent sport for players and referees, as both run at different intensities during a match to closely follow the actions on the pitch (Krustrup et al., 2009). Previous studies have reported that football referees run distances between 11 and 12 km per match, of which at least 10% is ran at high intensity (>18 km/h), reaching repeatedly 85 to 95% of their maximum heart rate (Weston et al., 2012), suggesting that a football match is a pronounced physiological stressor for referees. Moreover, referees are subjected to mental stress due to complex decision-making by dealing with players, coaches and audiences. Therefore, it seems clear that referees go through substantial physical and psychological stress during football matches that may be similar to the one experienced by players.

Cortisol plays a key role in the regulation of physical and mental stress. Salivary determination of cortisol concentration has been observed to be a reliable indicator of physiological and psychological stress caused by physical activity (Passelergue et al., 1995). In addition, immunoglobulin A (IgA), an antibody that has an important role in mucosal immunity against external pathogens in the upper respiratory track (URT) (Bishop and Gleeson, 2009; Marcotte and Lavoie, 1998), has been reported to be reduced by 75% in football players after a friendly international match (Penailillo et al., 2015). To date, no data of cortisol and IgA concentrations have been reported in referees after an official football match. For these reasons, we sought to examine changes in cortisol and IgA concentrations in referees after an official football match, and to investigate the relationship between changes in cortisol and IgA concentrations with physical demands of the match.

We recruited sixteen elite male referees (Mean $\pm$ SD: 28.2 ± 2.5 y; 1.78 ± 0.05 m; 74.5 ± 5.2 kg) from the Chilean football association umpiring under 19 (U19) "National Young football tournament 2012" matches (Santiago, Chile). Salivary cortisol and IgA were determined by

enzyme-linked immunosorbent assays (Salimetrics, PA, USA). All analyses were performed in duplicate according to the kits manufacturer's procedures. The intra-assays coefficient of variation in the present investigation was 3.4% and 5.4% for salivary cortisol and IgA, respectively. Physical load during the match was quantified using a global positioning sensor (GPS) watch (Timex Ironman Global Training, USA). Average heart rate (HR; bpm), total load, maximum speed (km/h), average speed (km/h) and total distance covered (m) during the match were determined by software provided by manufacturer. Total load (arbitrary unit, AU) was calculated by multiplying the average speed by the total distance covered. Wilcoxon and paired t-tests were used to compare changes in cortisol and IgA concentrations, respectively. Potential associations between changes in cortisol and IgA concentrations (% of Pre) with physical load parameters (average speed, maximal speed, total load and total distance covered) were tested using Spearman correlation coefficient (r). Statistical analyses were performed using GraphPad Prism program 6.0 (GraphPad Software, Inc., La Jolla, CA, USA). Statistical significance was set at $p \leq 0.05$.

Average HR of the referees during the match was 159 ± 11 bpm, corresponding to $83 \pm 6\%$ of their theoretical maximum heart rate. Total load was of 55.4 ± 9.5 , maximal speed was 26.2 ± 2.2 km/h, average speed was 7.1 ± 0.5 km/h, and total distance covered was 10709.3 ± 908.2 m. Cortisol concentration increased by 48.8% after the match (PRE: 4.87 ± 1.52 ng/ml; POST: 6.74 ± 2.49 ng/ml; $p = 0.03$, Figure 1A). Salivary IgA concentration decreased by 21.1% after the match (PRE: 414.8 ± 182 μ g/ml; POST: 316.4 ± 119.3 μ g/ml; $p = 0.005$, Figure 1B). Changes (% Pre) in cortisol and IgA concentrations were not correlated with all physical load parameters. However, total distance covered had a tendency to have a moderate correlation with changes in salivary IgA concentrations ($r = -0.49$; $p = 0.054$).

To the best of our knowledge, this is the first report showing cortisol and IgA responses in referees.

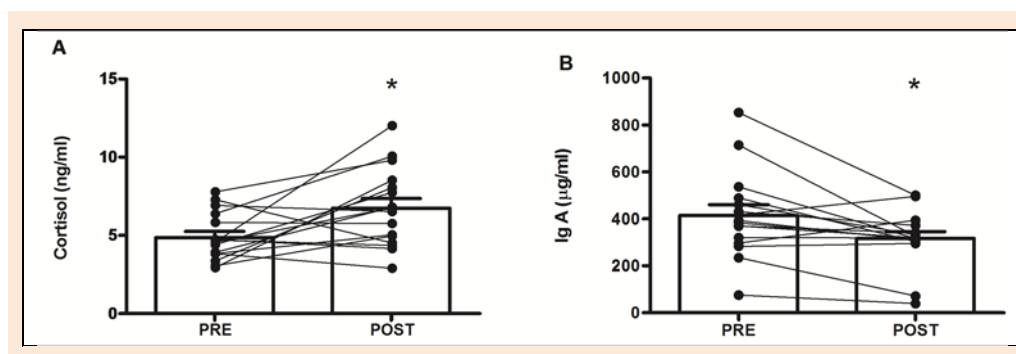


Figure 1. (A) Salivary cortisol concentration before (PRE) and after (POST) football match. (B) Salivary immunoglobulin A (IgA) concentration before (PRE) and after (POST) football match. Mean values $\pm$ SD. * Significantly different from PRE.

We observed increased cortisol (~50%) and decreased IgA (~20%) salivary concentrations after a football match in referees, similar to previous studies in professional football players (Fredericks et al., 2012; Peñailillo et al., 2015). We speculate that these changes were due to the physical and mental demands of football, increasing the risk of a depressed immune system after a football match.

In line with our previous study performed in elite football players (Peñailillo et al., 2015) we observed no correlation between changes in salivary cortisol and IgA concentrations after the match, or any parameter determining the physical load during the match in professional football referees. Interestingly, there total distance covered had a trend to be moderately correlated to changes in IgA ($r = -0.49$; $p = 0.054$). In support of this finding, a previous study in professional football players found a high correlation ($r = -0.7$) between changes in IgA and distance covered after a football training session. However, it is important to note changes in salivary concentrations of IgA following football match have reported conflicting results, due to fitness level of individuals (Tomasi et al., 1982) and the large variability of IgA response to exercise (Peñailillo et al., 2015). Thus, this result should be taken with caution.

In conclusion, we found that a football match increased cortisol and decreased IgA salivary concentrations in professional football referees, possibly related to the physical and mental stress induced during the match. This physical stress may depress their immune system putting them at risk of URT infection. To decrease this risk, it might be beneficial for referees to increase their fitness level and to adopt recovery strategies post-match.

Acknowledgements

The authors thank all the referees associated to the Chilean National Football Association for their participation in this study. There were no conflicts of interest

Marco Kokaly¹, Luis Peñailillo¹, Claudio Villagrán¹, Karen Mackay¹, Sebastian Jannas¹, Louise Deldicque² and Hermann Zbinden-Foncea¹✉

¹Exercise Science Laboratory, School of Kinesiology, Faculty of Medicine, Universidad Finis Terrae, Chile

²Institute of Neuroscience, Université catholique de Louvain, Belgium

References

- Bailey, R.P., Collins, D., Ford, P., Mac-Namara, A., Toms, M. and Pearce, Bishop, N.C. and Gleeson, M. (2009) Acute and chronic effects of exercise on markers of mucosal immunity. *Frontiers in Bioscience* **14**, 4444-4456.
- Fredericks, S., Fitzgerald, L., Shaw, G. and Holt, D.W. (2012) Changes in salivary immunoglobulin A (IgA) following match-play and training among English Premiership footballers. *Medical Journal of Malaysia* **67**(2), 155-158.
- Krustrup, P., & Bangsbo, J. (2001). Physiological demands of top-class soccer refereeing in relation to physical capacity: effect of intense intermittent exercise training. *Journal of Sports Science* **19**(11), 881-891.
- Krustrup, P., Helsen, W., Randers, M.B., Christensen, J.F., MacDonald, C., Rebelo, A.N. and Bangsbo, J. (2009). Activity profile and physical demands of football referees and assistant referees in international games. *Journal of Sports Science* **27**, 1167-1176.
- Marcotte, H. and Lavoie, M.C. (1998) Oral microbial ecology and the role of salivary immunoglobulin A. *Microbiology and Molecular Biology Reviews* **62**(1), 71-109.
- Passelegue, P., Robert, A. and Lac, G. (1995) Salivary cortisol and testosterone variations during an official and a simulated weightlifting competition. *International Journal of Sports Medicine* **16**(5), 298-303.
- Peñailillo, L., Maya, L., Nino, G., Torres, H. and Zbinden-Foncea, H. (2015) Salivary hormones and IgA in relation to physical performance in football. *Journal of Sports Science* **33**(20), 2080-2087.
- Tomasi, T., Trudeau, F., Czerwinski, D. and Erredge, S. (1982) Immune parameters in athletes before and after strenuous exercise. *Journal of Clinical Immunology* **2**, 173-178.
- Weston, M., Castagna, C., Impellizzeri, F.M., Bizzini, M., Williams, A. M. and Gregson, W. (2012) Science and medicine applied to soccer refereeing: an update. *Sports Medicine* **42**(7), 615-631.

✉ **Hermann Zbinden-Foncea, PhD**

School of Kinesiology, Universidad Finis Terrae, 1509 Pedro de Valdivia Avenue, Providencia, Santiago, Chile

E-mail: hzbinden@uft.cl