

# **An intensive winter fixture schedule induces a transient fall in salivary IgA in English Premier League soccer players**

**Submission Type:** Short Communication

Ryland Morgans<sup>1,2</sup>, Patrick Orme<sup>1,3</sup>, Liam Anderson<sup>1,3</sup>, Barry Drust<sup>1,3</sup> and James P Morton<sup>1,3</sup>

<sup>1</sup>Liverpool Football Club  
Melwood Training Ground  
Deysbrook Lane  
Liverpool  
L12 8SY  
UK

<sup>2</sup>University of South Wales  
Faculty of Life Sciences and Education  
Upper Glyntaff, Pontypridd  
Wales  
CF37 4AT  
UK

<sup>3</sup>Research Institute for Sport and Exercise Sciences  
Liverpool John Moores University  
Tom Reilly Building  
Byrom St Campus  
Liverpool  
L3 3AF  
UK

**Address for correspondence:**

Dr James Morton  
Research Institute for Sport and Exercise Sciences  
Liverpool John Moores University  
Tom Reilly Building  
Byrom St Campus  
Liverpool  
L3 3AF  
United Kingdom  
Email: [J.P.Morton@ljmu.ac.uk](mailto:J.P.Morton@ljmu.ac.uk)  
Tel: +44 151 904 6233

## **Abstract**

We examined the effects of an intensive fixture schedule on salivary IgA (SIgA) concentration in professional soccer players from the English Premier League. Salivary samples were obtained from 21 males who participated in 7 games over a 30-day period during December 2013 and January 2014 (games 1-5 occurred in a 15-day period). Salivary-IgA decreased ( $P < 0.05$ ) at 2 days post-game 3 ( $45 \pm 9 \mu\text{g.mL}^{-1}$ ), 4 ( $52 \pm 7 \mu\text{g.mL}^{-1}$ ) and 5 ( $41 \pm 10 \mu\text{g.mL}^{-1}$ ) compared with game 1 ( $139 \pm 25 \mu\text{g.mL}^{-1}$ ). When the normal fixture schedule resumed (i.e. one game per week), SIgA returned towards baseline such that game 6 and 7 values were not different ( $P > 0.05$ ) from game 1 ( $91 \pm 18$  and  $99 \pm 21 \mu\text{g.mL}^{-1}$ , respectively). Data demonstrate for the first time that a congested winter fixture schedule induces detectable perturbations to mucosal immunity in professional soccer players.

**Keywords:** football, illness, infection,

## **Introduction**

The fixture schedule of competitive soccer games in the English Premier League (EPL) typically involves one game per week, usually on a Saturday-to-Saturday basis. In this way, the fitness and sports medicine staff is considered to have sufficient time to implement recovery strategies, manipulate training loads, and provide optimal energy intake to ensure players prepare appropriately for the subsequent game. In contrast, the winter period in the EPL is characterised by an intensive fixture schedule where players can play multiple games per week with limited recovery time. Such fixture schedules are especially prevalent over the Christmas and New Year period where it is not uncommon for players to participate in multiple games per week with only forty-eight hours recovery between consecutive games. This increase in workload may be particularly problematic given that susceptibility to illness and infection is exacerbated during the winter months (Orhant et al. 2010; Fricker et al. 2005).

In an attempt to monitor athlete wellbeing and assess susceptibility to infection, it is commonplace in endurance sports to monitor basal salivary immunoglobulin-A (SIgA; the predominant immunoglobulin expressed in mucosal fluids) during times of intensive training and competition (Gleeson et al. 1995). As a non-invasive assessment, routine monitoring of SIgA can be practically relevant given that it not only correlates with the onset of illness (Neville et al. 2008) but is also sensitive to physical stress (Gleeson and Pyne, 2000) and appears to vary in accordance with exercise intensity and duration (Mackinnon & Hooper, 1994; Mackinnon & Jenkins, 1993; Nieman et al. 2002). In relation to soccer-specific exercise, the stress of an acute training session induces a transient fall in SIgA that returns to basal levels within 18 hours (Fredericks et al. 2012). To the authors' knowledge, however, no

researchers have yet examined the variation in basal SIgA levels in elite soccer players during a period of intensive competition that is characterised by multiple games per week.

The aim of the present study was to therefore monitor resting SIgA levels in professional soccer players during an intensive winter fixture schedule. We studied professional players from an EPL team over a thirty-two day period throughout December 2013 and January 2014 where seven games were completed (five of which occurred in a fifteen day period). We hypothesised that SIgA would display a significant decrease during the intensive fixture schedule but would return to basal levels when the normal schedule of one game per week was resumed.

## **Methods**

**Participants.** Twenty-one soccer players from a professional EPL soccer team (age:  $26 \pm 4$  years; body mass:  $80.9 \pm 7.4$  kg; height:  $1.83 \pm 0.07$  m) provided informed written consent to participate. The study was approved by the Ethical Committee of Liverpool John Moores University.

**Salivary IgA Analysis.** Samples were obtained two days after each game in the morning period (between 0900 and 1000 h and prior to breakfast). Given that soccer match play induces a reduction in SIgA levels that return to basal levels within 18 hours (Fredericks et al. 2012), we reasoned that collection of samples 2 days post-game would allow us to ascertain the effects of the acute suppression in SIgA levels from that associated with more chronic levels of stress. Participants were provided with an Oral Fluid Collector (OFC; IPRO Interactive, Oxfordshire, UK) consisting of a synthetic polymer based material on a polypropylene tube. The OFC contains a

volume adequacy indicator, providing a clear colour change (changing from white to dark blue) when 0.5 mL ( $\pm 20\%$ ) is collected. Participants were instructed to swallow any saliva present within the oral cavity before placing the collection device on top of the tongue. Salivary IgA concentration was analysed immediately upon collection by author 3 according to a real time lateral flow device in accordance with the manufacturer's guidelines (IPRO Interactive, UK). This method has previously been validated against ELISA ( $R^2 = 0.78$ ) in 208 samples collected from a cohort of EPL soccer players with a range of SIgA concentrations from 28 – 628  $\mu\text{g.mL}^{-1}$  (Dunbar et al. 2011).

**Training and match load.** Training load was monitored on all training days using global positioning system (GPS) technology (STATSports Technologies Ltd©, Viper Software 2.0.6.1, Ireland). Match performance data were collected using a multiple-camera computerised tracking system (Prozone Sports Ltd®, Leeds, UK). Four players reported soft tissue injuries during the course of data collection and no player reported illness or infection. An overview of training load and match load data is shown in Table 1.

**Statistical Analysis.** Changes in SIgA were analysed using a one-way repeated measures general linear model (GLM) (SPSS, version 17, Windows). Additionally, changes in SIgA between players who played >50% of the total minutes played in the first 5 games (i.e. the congested schedule) versus those who played <50% of total minutes were also assessed using two-way repeated measures GLM. Differences between specific time-points were located using Bonferonni post-hoc analysis. Finally, changes in match load data during the 7 games (from those outfield players who started each game) were assessed using a between groups GLM. Data are presented as means  $\pm$ SD with P values <0.05 indicating statistical significance.

## Results

Salivary IgA significantly changed ( $P < 0.001$ ,  $\eta^2 = 0.232$ ) during the 32-day data collection period (see Figure 1A). Specifically, SIgA was significantly decreased on the sample points after game 3 ( $P = 0.001$ ), 4 ( $P = 0.003$ ) and 5 ( $P = 0.002$ ) when compared with game 1. However, when the normal schedule of competition and training was resumed (i.e. one game per week), SIgA returned towards basal levels. As such, SIgA levels at 2 days post-game 6 and 7 was not different from game 1 values ( $P = 0.09$  and  $0.13$ , respectively). When players were classified into those who played  $>50\%$  minutes of the total minutes played in games in 1-5 versus those who played  $<50\%$  of total minutes, changes in SIgA were still apparent ( $P = 0.001$ ), with no differences evident between groups ( $P = 0.79$ ) (see Figure 1B). Total distance ( $P = 0.43$ ), high-intensity distance ( $P = 0.16$ ) and sprint distance ( $P = 0.09$ ), as assessed in the starting outfield players, also did not differ between the 7 games (see Table 1).

## Discussion

Confirming our hypothesis, we provide novel data by demonstrating that SIgA displays a significant decline in professional EPL soccer players during an intensive winter fixture schedule. Our data are practically relevant as they demonstrate that SIgA provides a non-invasive assessment that is sensitive to the changes in either the physical and/or psychological stress associated with a short-term period of intensive competition.

The stress of intense exercise typically induces a transient fall in SIgA levels that tend to return towards baseline levels within hours to days providing there is sufficient recovery and no infection is present (Walsh et al. 2011). Our data are in agreement with this assertion as we also show that SIgA at two days post-game 2 was not

significantly different to that observed at two days post-game 1. This result was not unexpected given that both games were played within a five day period and hence recovery time was likely sufficient. However, SIgA at two days post-games 3, 4 and 5 were significantly different from those values observed post-game 1 and 2. Such data therefore suggest that the scheduling of games in this way (i.e. 4 games in 11 days) is not appropriate for optimal recovery given that detectable perturbations to mucosal immunity were clearly evident. It is noteworthy, however, that indicators of physical match load did not change over the data collection period though interpretation of this data is complicated by the fact that squad rotation was practiced and also that 7 games is likely insufficient to make associations between physical performance and related physiological variables such as SIgA, in accordance with the high match-to-match variability apparent in elite level soccer (Gregson et al. 2010).

Interestingly, the decline in SIgA was evident in players that played >50% (n = 11) and <50 % (n = 10) of the total minutes played in games 1 to 5 (i.e. the congested fixture schedule). It is difficult to comment on the role of training load between games in modulating SIgA responses given that both cohorts of players performed different training loads in order to promote recovery in 'starters' but yet also promote match readiness for 'non-starters' (see Table 1). Nevertheless, these data suggest that decrements in SIgA may also be due to additional factors such as the seasonal time of year (i.e. winter) but perhaps also the travel stress and psychological stress associated with this intense period of competition. Indeed, all 21 players were part of the squad that travelled to each game.

The measurement of SIgA in sporting contexts is typically used as a marker of over-training (Mackinnon & Hooper, 1994; Gleeson et al. 1995) and to predict susceptibility to infections (Neville et al. 2008). Indeed, the latter authors observed

that a fall in SIgA to levels <40% of the individual's baseline value (when considered healthy) indicates a 50% chance of contracting infection within 3 weeks. Although our data are limited in that our baseline sample was restricted to post-game 1 (therefore are not entirely representative of true basal levels obtained in pre-match days), we observed that a significant cohort of our sample presented with values less than 40% of basal on those samples collected post-game 3 (n = 14), 4 (n = 8) and 5 (n = 4). The collection of such data provided additional objective information to support the implementation of specific strategies (especially that of reduced training loads) to potentially minimise any risk of infection (Nieman & Bishop, 2006) and maintain player availability for team selection. Indeed, post-game 2 we initially observed reductions in SIgA (albeit not yet statistically significant), therefore all players underwent a reduction in training load compared to habitual loads typically experienced during a one game per week schedule, even for those 'non-starter' players (See Table 1). Although we observed no illness in our players during the data collection period, this was likely due to the resumption of the normal one game per week schedule following game 5.

In summary, we show for the first time that a congested winter fixture schedule is sufficient to induce detectable perturbations to mucosal immunity in professional EPL soccer players. Monitoring of SIgA during intense competition schedules may obviate the requirement to implement intervention strategies to help maintain athlete wellbeing and availability for team selection. Considering the field-based nature of the present study, obvious limitations include the inability to control environmental temperature and players' energy intake etc. Nevertheless, the use of highly trained professional soccer players in a 'real-world' environment also strengthens the ecological validity of our data.



## References

- Dunbar J, Jehanli A, Skelhorn S. Investigating the use of a point of care SIgA test in the sporting environment. *Proceedings of the 10<sup>th</sup> International Society of Exercise Immunology*; Abstract P.85.
- Fredericks, S., Fitzgerald, L., Shaw, G., & Holt, D.W. (2012). Changes in salivary immunoglobulin A (IgA) following match play and training among English Premiership footballers. *Medical Journal of Malaysia*, 67, 155-158.
- Fricker, P.A., Pyne, D.B., Saunders, P.U., Cox, A.J., Gleeson, M., & Telford, R.D. (2005). Influence of training loads on patterns of illness in elite distance runners. *Clinical Journal of Sports Medicine*, 15, 246-252.
- Gregson, W., Drust, B., Atkinson, G., & Salvo, V.D. (2010). Match to match variability of high speed activities in premier league soccer. *International Journal of Sports Medicine*, 31, 237-242.
- Gleeson, M., McDonald, W.A., Cripps, W.A., Pyne, D.B., Clancy, R.L., & Fricker, P.A. (1995). The effect on immunity of long term intensive training in elite swimmers. *Clinical and Experimental Immunology*, 102, 210-216.
- Gleeson, M., & Pyne, D.B. (2000). Exercise effects on mucosal immunity. *Immunology and Cell Biology*, 78, 536-544.
- Mackinnon, L.T., & Hooper, S. (1994). Mucosal (secretory) immune system responses to exercise of varying intensity and during overtraining. *International Journal of Sports Medicine*, 15, S179-S183.
- Mackinnon, L.T., & Jenkins, D.G. (1993). Decreased salivary immunoglobulins after intense interval exercise before and after training. *Medicine and Science in Sports and Exercise*, 25, 922-928.
- Neville, V., Gleeson, M., & Folland, J.P. (2008). Salivary IgA as a risk factor for upper respiratory infections in elite professional athletes. *Medicine and Science in Sports and Exercise*, 40, 1228-1236.
- Nieman, D.C., & Bishop, N.C. (2006). Nutritional strategies to counter stress to the immune system in athletes, with special reference to football. *Journal of Sport Sciences*, 24, 763-722.
- Nieman, D.C., Henson, D.A., Fagoaga, O.R., Utter, A.C., Vinci, D.M., Davis, J.M., & Nehlsen-Cannarella, S.L. (2002). Change in salivary IgA following a competitive marathon race. *International Journal of Sports Medicine*, 23, 69-75.
- Orhant, C., Carling, C., & Cox, A. (2010). A three year prospective study of illness in professional soccer players. *Research in Sports Medicine*, 18, 199-204.
- Walsh, N.P., Gleeson, M., Shephard, R.J., Gleeson, M., Woods, J.A., Bishop, N.C., Fleshner, M., Green, C., Pedersen, B.K., Hoffman-Goetz, L., Rogers, C.J., Northoff, H., Abbasi, A., & Simon, P. (2011). Position statement part one: immune function and exercise. *Exercise Immunology Reviews*, 17, 6-63.

**Table 1** – Overview of training load and match load data during the 32-day data collection period. Players were classified as those who started each game (STARTERS) and those who did not start (NON-STARTERS). H, denotes home game and A denotes away games. HSR denotes high speed running, > 19.8 km/h/ Sprinting denotes speeds >25km/h. \*RECOVERY consisted of indoor activities, which usually included ice baths, massage and foam rolling.

**Figure 1** – A) Salivary IgA concentration during the 32-day data collection period, as observed in all 21 players. Black bars represent game days and samples were collected on the morning of two days post-game. \* denotes significant difference from day 3 i.e. game 1 values,  $P < 0.05$ . B) Salivary IgA concentration during the 32-day data collection period in those players who played >50% of the total minutes played in games 1 to 5 versus those players who played <50% of the total minutes.

**Figure 1**

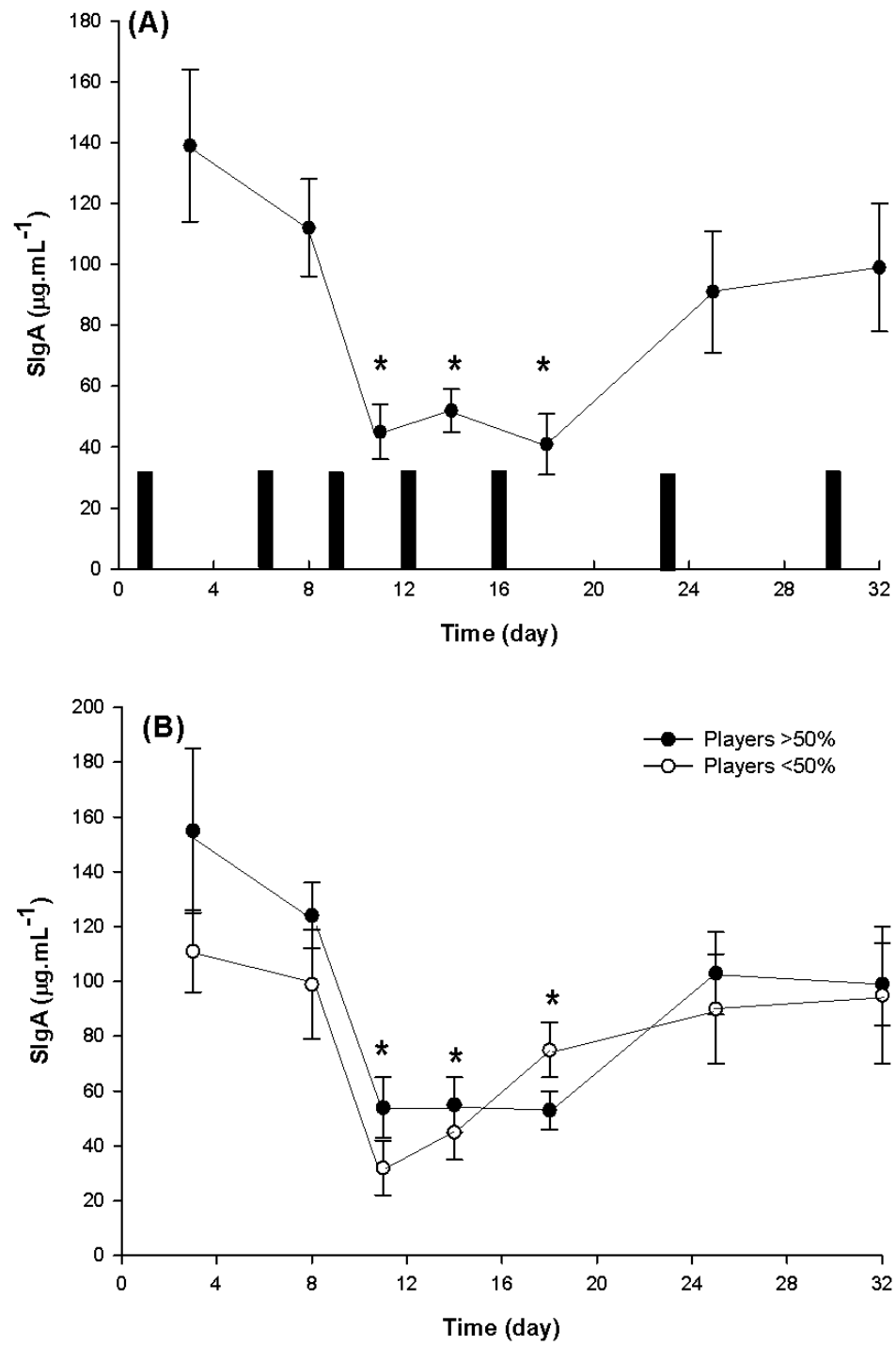


Table 1

Day	Activity	STARTERS				NON-STARTERS			
		<i>Duration (min)</i>	<i>Total Dist (m)</i>	<i>HSR (m)</i>	<i>Sprint Dist (m)</i>	<i>Duration (min)</i>	<i>Total Dist (m)</i>	<i>HSR (m)</i>	<i>Sprint Dist (m)</i>
1	Match (H)	90 ± 13	10476 ± 1657	677 ± 226	282 ± 166	8 ± 17	823 ± 1658	24 ± 72	14 ± 49
2	OFF								
3	Training	24 ± 7	1785 ± 600	6 ± 11	0 ± 0	61 ± 16	4925 ± 1245	308 ± 168	4 ± 8
4	Training	59 ± 4	4544 ± 566	117 ± 83	11 ± 15	54 ± 12	4319 ± 951	102 ± 92	10 ± 25
5	Training	45 ± 0	2137 ± 248	11 ± 10	0 ± 0	39 ± 21	1930 ± 1037	5 ± 6	0 ± 0
6	Match (A)	92 ± 9	10841 ± 1280	845 ± 277	364 ± 145	13 ± 21	1268 ± 1881	144 ± 229	24 ± 50
7	Training		RECOVERY*			48 ± 19	3154 ± 1168	12 ± 11	0 ± 0
8	Training	42 ± 6	1444 ± 395	7 ± 7	0 ± 1	46 ± 21	2653 ± 2099	145 ± 269	9 ± 19
9	Match (A)	93 ± 11	9823 ± 1058	632 ± 184	218 ± 88	2 ± 4	192 ± 430	17 ± 46	2 ± 4
10	Training		RECOVERY*			57 ± 14	3936 ± 785	17 ± 21	0 ± 0
11	Training	27 ± 21	508 ± 443	0 ± 1	0 ± 0	37 ± 15	1024 ± 1153	44 ± 137	0 ± 0
12	Match (H)	85 ± 15	9805 ± 1806	597 ± 222	197 ± 91	8 ± 15	1051 ± 1782	68 ± 111	36 ± 59
13	OFF								
14	Training	18 ± 6	1253 ± 490	0 ± 1	0 ± 0	47 ± 32	3621 ± 2548	97 ± 187	8 ± 16
15	Training	52 ± 19	2586 ± 988	27 ± 27	2 ± 4	37 ± 27	1932 ± 1386	19 ± 25	2 ± 3
16*	Match (H)	77 ± 23	8840 ± 2371	507 ± 238	190 ± 145	19 ± 29	1340 ± 1894	20 ± 64	10 ± 32
17	OFF								
18	OFF								
19*	Training	39 ± 35	2252 ± 1998	8 ± 11	0 ± 0	44 ± 30	2928 ± 2109	123 ± 253	7 ± 18
20	Training	71 ± 22	5780 ± 1885	361 ± 209	24 ± 30	59 ± 28	4419 ± 1979	226 ± 146	7 ± 17
21	Training	68 ± 26	3408 ± 1375	15 ± 15	0 ± 1	64 ± 26	3530 ± 1367	18 ± 14	0 ± 0
22	Training	56 ± 18	2695 ± 865	35 ± 21	9 ± 13	54 ± 23	2714 ± 1120	28 ± 25	8 ± 11
23	Match (A)	95 ± 9	10550 ± 1131	633 ± 242	227 ± 122	15 ± 27	1283 ± 2266	50 ± 100	15 ± 48
24	Training		RECOVERY*			63 ± 21	3880 ± 1336	115 ± 76	20 ± 29
25	OFF								
26	Training	76 ± 27	5537 ± 2032	133 ± 89	19 ± 21	65 ± 35	4928 ± 2601	131 ± 224	20 ± 39
27	Training	64 ± 23	4482 ± 1641	38 ± 26	4 ± 8	69 ± 24	4753 ± 1661	108 ± 143	3 ± 8
28	Training	53 ± 19	2690 ± 987	31 ± 23	6 ± 7	46 ± 30	2214 ± 1439	18 ± 14	4 ± 6
29	Match (H)	92 ± 16	9926 ± 1845	629 ± 239	242 ± 126	10 ± 20	920 ± 1757	27 ± 63	7 ± 16
30	OFF								
31	OFF								
32	Training	49 ± 26	3494 ± 1855	24 ± 25	1 ± 2	36 ± 27	2709 ± 2089	15 ± 18	0 ± 2