




# The influence of a COVID-19 induced reduction in game time on the match activity profiles of elite Australian Rules Football players

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## ABSTRACT

Assess the influence of a 20% reduction in game time on the volume and intensity of elite AF players' match activity profiles. GPS technology was used to analyse the movement demands of 45 AF players from the same AFL club during 43 matches across the 2019 and 2020 seasons. GPS data were categorised into measures of volume (total match time [TMT] and total distance [TD]) and intensity (metres per minute [ $\text{m}\cdot\text{min}^{-1}$ ], high-intensity running [HIR] distance and  $\text{m}\cdot\text{min}^{-1}$  [ $>17 \text{ km}\cdot\text{h}^{-1}$ ], and very-high intensity running [VHIR] distance and  $\text{m}\cdot\text{min}^{-1}$  [ $>23 \text{ km}\cdot\text{h}^{-1}$ ]). Volume decreased in 2020 with reductions in TMT (effect size [ES]  $\pm$  95% confidence interval [CI] =  $-1.8 \pm 0.2$ ;  $p < .001$ ) and TD (ES =  $-1.8 \pm 0.2$ ;  $p < .001$ ) overall, across all positional groups, and quarters. Intensity increased, evidenced by increases in HIR  $\text{m}\cdot\text{min}^{-1}$  (ES =  $0.3 \pm 0.1$ ;  $p < .001$ ), and VHIR  $\text{m}\cdot\text{min}^{-1}$  (ES =  $0.3 \pm 0.2$ ;  $p = .006$ ). HIR  $\text{m}\cdot\text{min}^{-1}$  increased for midfielders (ES =  $0.6 \pm 0.3$ ;  $p = .017$ ). Defenders exhibited increases in HIR  $\text{m}\cdot\text{min}^{-1}$  (ES =  $0.2 \pm 0.2$ ;  $p = .007$ ), and VHIR  $\text{m}\cdot\text{min}^{-1}$  (ES =  $0.4 \pm 0.2$ ;  $p = .010$ ). Intensity of third quarters decreased at a greater rate in 2020 with reductions in  $\text{m}\cdot\text{min}^{-1}$  (ES =  $-0.2 \pm 0.1$ ;  $p = .004$ ) and HIR  $\text{m}\cdot\text{min}^{-1}$  (ES =  $-0.2 \pm 0.1$ ;  $p = .037$ ) compared to Q1. Systematic reductions in volume were found overall, across positional groups, and quarters. Average movement speed remained relatively stable overall, across quarters and positional groups. Increases in intensity were defined predominately by increases at high and very-high intensity speeds per minute, with defenders exhibiting the greatest increase in intensity and change to their match activity profiles. Longer quarter and three-quarter time breaks, and time between goals preserved intensity.

**Keywords:** Performance analysis of sport, Volume, Intensity, Global Positioning System, Physical performance, Professional team sports, COVID-19, Australian football.

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## INTRODUCTION

Australian rules football (AF) is a physically demanding and complex team sport, requiring players to perform and recover from repeated high-intensity activities (Brewer et al., 2010; Dawson et al., 2004). Since 1994, AF matches have been played over four, 20-minute quarters of match play plus time on (being the additional time in each quarter to account for when match time is stopped by the umpire; for example, when the ball goes out of bounds, players are injured and need to leave the playing arena, or goals and behinds are scored). However, as a consequence of the novel coronavirus (COVID-19) pandemic in 2020, the Australian Football League (AFL) made the unprecedented decision to reduce its matches by 20% through shortening the length of quarters to 16 minutes, plus time on, to allow flexibility in a condensed fixture. Other non-traditional changes for the 2020 season included an increase in the length of quarter and three-quarter time breaks from six to eight minutes, an increase in the time at which play is restarted following a goal, as well as a compressed 17-game season in which the 18 professional teams played each other once. The condensed fixturing meant teams were, in some instances, required to play matches within three or four days of each other, departing from the traditional six to twelve-day breaks between matches in typical seasons.

Since the introduction of global positioning system (GPS) technology to the AFL in 2005, when clubs were first permitted to use these technologies to track and monitor the volume and intensity of their players' in-game movements (Gray & Jenkins, 2010), studies have investigated and analysed not only the individual movement demands and player characteristics (Black et al., 2016; Johnston et al., 2012; Montgomery & Wisbey, 2016; Mooney et al., 2011; Sullivan et al., 2014), but also team and match related factors (Johnston et al., 2012; Kempton et al., 2015; Ryan et al., 2017; Wisbey et al., 2008). It is suggested the historical changes in the volume and intensity of AFL matches since 2005 is primarily driven by rule changes, the evolution of game style(s) and the professionalism within the sport (Janetzki et al., 2021). Indeed, GPS analysis used to monitor player movement demands across quarters (Aughey, 2010, 2011; Brewer et al., 2010; Coutts et al., 2010; Hiscock et al., 2012; Mooney et al., 2013) of AF matches, has confirmed players typically exhibit a quantifiable reduction in both volume and intensity after the first quarter (Coutts et al., 2010; Mooney et al., 2013). Similar studies have also investigated the movement demands of various positional groups (Brewer et al., 2010; Coutts et al., 2015; Johnston et al., 2019; Kempton et al., 2015; Montgomery & Wisbey, 2016; B. Wisbey et al., 2010), with midfielders found to have the greatest physical requirements (Brewer et al., 2010; Hiscock et al., 2012; Wisbey et al., 2009). Whilst there has been marked improvement in the validity and interunit reliability of GPS technologies used in team sports, caution is still recommended when analysing movement demands in excess of 20 km·h<sup>-1</sup> (Johnston et al., 2014), particularly with respect to measures of acceleration, deceleration and directional change (Bourdon et al., 2017).

Literature to this point has analysed and reported on GPS AFL match data based on 20-minute quarters (and overall playing time of 80 minutes). Indeed, the unprecedented 20% reduction of match time in the 2020 season will have implications for coaches and conditioning staff in understanding changes to the match activity profiles of their players. This information not only has implications during matches but is also of importance to inform training prescription and recovery, establish training intensities, assess different positional workloads (Loader et al., 2012; McLellan et al., 2011), and for lawmakers considering any potential future reductions to the playing time of AFL matches. Therefore this study sought to: 1) investigate the effect of reduced match time on measures of volume (total match time [TMT] and total distance [TD]) and intensity (metres per minute [m·min<sup>-1</sup>], high-intensity running [HIR] distance, HIR m·min<sup>-1</sup>, very-high intensity running [VHIR] distance, and VHIR m·min<sup>-1</sup>) on the match activity profiles of AFL players, by comparing GPS match data from the 2019 and 2020 seasons, and 2) investigate the impact of longer quarter and three-quarter time breaks on player movement demands. It was hypothesised reduced game time would result in a reduction in

volume but lead to an increase in player intensity, and that longer quarter and three-quarter time breaks would preserve intensity.

## **METHODS**

### ***Participants***

Forty-five elite, male AF players (mean  $\pm$  standard deviation = age:  $25.6 \pm 4.3$  years, body mass:  $87.9 \pm 7.2$  kg and height:  $188.5 \pm 7.2$  cm) from one AFL club competing at the elite level across the 2019 and 2020 seasons participated in this study. The club provided written informed consent for retrospective analysis of deidentified data, and this analysis was approved by the University of South Australia's Human Research Ethics Committee.

### ***Data analysis***

Data were collected at 10 Hz using portable GPS devices (Catapult Innovations models S5 [2019] and Vector [2020], Melbourne, Australia). It has been established this GPS device provides a good level of interunit reliability and validity (Johnston et al., 2014), however the reliability of movement demands exceeding  $20 \text{ km}\cdot\text{h}^{-1}$  remains questionable. Players wore the same GPS device in a custom-made pouch sewn into the back of their playing jumper between their scapulae.

Following each match, data were downloaded using Catapult Sprint (version 5.1.6; Catapult Innovations). Time between quarters and the time players spent on the interchange bench were removed. All data were exported to Microsoft Excel (Microsoft Corporation, NY, USA) where individual data profiles were de-identified by the AFL club before further analyses.

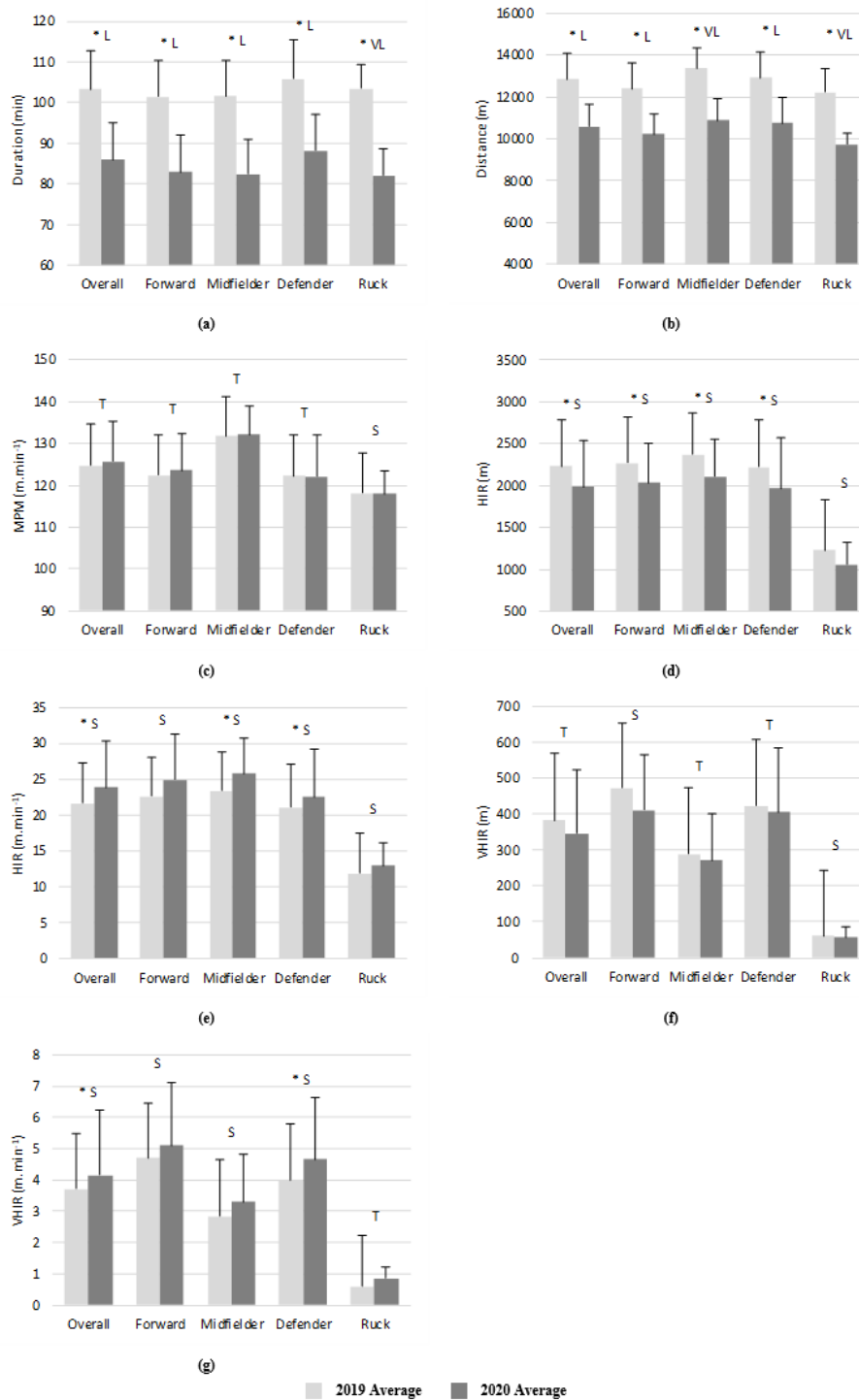
Changes in movement demand variables across seasons, as investigated by earlier studies (Aughey, 2013; Kempton et al., 2015; Ben Wisbey et al., 2010) including TD, TMT,  $\text{m}\cdot\text{min}^{-1}$ , HIR ( $>17 \text{ km}\cdot\text{h}^{-1}$ ) and VHIR ( $>23 \text{ km}\cdot\text{h}^{-1}$ ), were analysed to assess the shift in the volume and intensity of matches from 2019 and 2020. HIR and VHIR metrics (volume of distance [m] covered in each speed band) were also expressed relative to individual match time as a means of standardising data across seasons with different match durations. Data were analysed for changes overall, across quarters and positional groups (forward, midfield, defensive and ruck), which were determined based on the greatest percentage of time played in one position. Acceleration and deceleration counts were not analysed due to large differences in the S5 and Vector Catapult units used in 2019 and 2020 respectively.

In accordance with earlier protocols (Coutts et al., 2010), data were only included in the analysis if players participated in a minimum of 75% of TMT, which provided 557 and 359 complete data files in 2019 and 2020 respectively. Due to the reduction in match and quarter durations in 2020, all data from the two seasons were filtered individually with the relevant applicable threshold (minimum 75% of TMT).

### ***Statistical analysis***

Data for each metric were presented as the mean and standard deviation for 2019 and 2020, which was used to calculate the percentage change between seasons. Statistical significance was set using an alpha level of  $p < .05$ . Linear mixed models in IBM SPSS Statistics (PASW Statistics 26.0, Chicago, IL, USA) were used to calculate the change between seasons and standardised effect size, expressed as mean and 95% confidence intervals [CI], which was used to calculate the respective percentage change between seasons. The comparison between seasons was defined as a fixed effect, while individual players were included as a random effect. Effect sizes were quantified as trivial  $\leq 0.2$ , small  $> 0.2$ , moderate  $> 0.6$ , large  $> 1.2$ , very large  $> 2.0$  (Cohen, 2013).

## RESULTS



Note. \* Denotes statistical significance between 2019 and 2020 seasons ( $p < .05$ ).

Min: minutes, m: metres, MPM / m.min<sup>-1</sup>: metres per minute, HIR: high-intensity running, VHIR: very-high intensity running, T: trivial, S: small, L: large, VL: very large effect sizes.

Figure 1. Mean comparison between seasons 2019 and 2020 and positional groups (x axis), and (a) total match time, (b) total distance, (c) metres per minute, (d) high-intensity running, (e) high-intensity running metres per minute (f) very-high intensity running (g) very-high intensity running metres per minute (y axis). Data are mean  $\pm$  95% confidence interval.

Table 1. Overall and quarter values for all metrics from 2019 to 2020 (Mean  $\pm$  95% CI).

		2019	2020	Change	Effect Size	p-value
TMT (min)	Total	103.3 $\pm$ 9.4	86.0 $\pm$ 9.0	-16.7 $\pm$ 1.8	-1.8 $\pm$ 0.2	<.001
	Q1	26.1 $\pm$ 3.3	21.2 $\pm$ 2.7	-4.9 $\pm$ 0.5	-1.6 $\pm$ 0.2	<.001
	Q2	26.2 $\pm$ 3.0	21.2 $\pm$ 3.2	-4.8 $\pm$ 0.5	-1.5 $\pm$ 0.2	<.001
	Q3	26.5 $\pm$ 3.2	22.2 $\pm$ 3.6	-4.1 $\pm$ 0.4	-1.2 $\pm$ 0.1	<.001
	Q4	26.4 $\pm$ 3.5	22.1 $\pm$ 3.3	-4.2 $\pm$ 0.5	-1.2 $\pm$ 0.1	<.001
TD (m)	Total	12843 $\pm$ 1217	10562 $\pm$ 1105	-2061 $\pm$ 199	-1.8 $\pm$ 0.2	<.001
	Q1	3372 $\pm$ 434	2735 $\pm$ 361	-603 $\pm$ 59	-1.5 $\pm$ 0.2	<.001
	Q2	3265 $\pm$ 385	2692 $\pm$ 381	-548 $\pm$ 65	-1.4 $\pm$ 0.2	<.001
	Q3	3262 $\pm$ 399	2684 $\pm$ 378	-544 $\pm$ 62	-1.4 $\pm$ 0.2	<.001
	Q4	3135 $\pm$ 437	2599 $\pm$ 366	-501 $\pm$ 64	-1.3 $\pm$ 0.2	<.001
MPM (m.min <sup>-1</sup> )	Total	124.7 $\pm$ 9.8	125.7 $\pm$ 9.5	-0.1 $\pm$ 1.0	0.0 $\pm$ 0.1	.907
	Q1	129.9 $\pm$ 12.4	131.9 $\pm$ 11.2	0.9 $\pm$ 1.4	0.1 $\pm$ 0.1	.212
	Q2	125.3 $\pm$ 11.5	128.5 $\pm$ 11.3	2.4 $\pm$ 1.3	0.2 $\pm$ 0.1	<.001
	Q3	123.8 $\pm$ 11.2	123.4 $\pm$ 13.3	-1.3 $\pm$ 1.3	-0.1 $\pm$ 0.1	.049
	Q4	119.5 $\pm$ 12.1	120.5 $\pm$ 12.1	-0.1 $\pm$ 1.3	0.0 $\pm$ 0.1	.930
HIR (m)	Total	2226 $\pm$ 556	1986 $\pm$ 546	-198 $\pm$ 53	-0.4 $\pm$ 0.1	<.001
	Q1	625 $\pm$ 182	552 $\pm$ 173	-73 $\pm$ 19	-0.4 $\pm$ 0.1	<.001
	Q2	570 $\pm$ 174	516 $\pm$ 164	-53 $\pm$ 22	-0.3 $\pm$ 0.1	<.001
	Q3	560 $\pm$ 175	494 $\pm$ 154	-63 $\pm$ 19	-0.4 $\pm$ 0.1	<.001
	Q4	498 $\pm$ 169	463 $\pm$ 169	-26 $\pm$ 24	-0.2 $\pm$ 0.1	.046
HIR MPM (m.min <sup>-1</sup> )	Total	21.7 $\pm$ 5.6	23.8 $\pm$ 6.5	1.9 $\pm$ 0.6	0.3 $\pm$ 0.1	<.001
	Q1	24.2 $\pm$ 7.0	26.8 $\pm$ 8.2	2.0 $\pm$ 0.8	0.3 $\pm$ 0.1	<.001
	Q2	21.9 $\pm$ 6.6	24.7 $\pm$ 7.4	2.4 $\pm$ 0.8	0.3 $\pm$ 0.1	<.001
	Q3	21.4 $\pm$ 7.0	23.0 $\pm$ 7.6	1.2 $\pm$ 0.8	0.2 $\pm$ 0.1	.004
	Q4	19.0 $\pm$ 6.3	21.7 $\pm$ 8.0	2.8 $\pm$ 1.2	0.4 $\pm$ 0.2	<.001
VHIR (m)	Total	382 $\pm$ 186	345 $\pm$ 179	-23 $\pm$ 29	-0.1 $\pm$ 0.2	.135
	Q1	107 $\pm$ 62	95 $\pm$ 63	-11 $\pm$ 8	-0.2 $\pm$ 0.1	.016
	Q2	102 $\pm$ 69	95 $\pm$ 63	-7 $\pm$ 9	-0.1 $\pm$ 0.1	.169
	Q3	96 $\pm$ 65	85 $\pm$ 56	-10 $\pm$ 8	-0.2 $\pm$ 0.1	.028
	Q4	82 $\pm$ 57	78 $\pm$ 59	-1 $\pm$ 11	0.0 $\pm$ 0.2	.847
VHIR MPM (m.min <sup>-1</sup> )	Total	3.7 $\pm$ 1.8	4.2 $\pm$ 2.1	0.5 $\pm$ 0.3	0.3 $\pm$ 0.2	.006
	Q1	4.1 $\pm$ 2.4	4.6 $\pm$ 2.9	0.4 $\pm$ 0.4	0.2 $\pm$ 0.1	.028
	Q2	3.9 $\pm$ 2.6	4.5 $\pm$ 2.9	0.6 $\pm$ 0.4	0.2 $\pm$ 0.2	.017
	Q3	3.6 $\pm$ 2.5	4.0 $\pm$ 2.7	0.3 $\pm$ 0.3	0.1 $\pm$ 0.1	.125
	Q4	3.1 $\pm$ 2.2	3.6 $\pm$ 2.7	0.6 $\pm$ 0.5	0.2 $\pm$ 0.2	.023

Note. Total: total match values, Q1: quarter 1, Q2: quarter 2, Q3: quarter 3, Q4: quarter 4, TMT: total match time (min), TD: total distance (m), MPM: meters per minute (m.min<sup>-1</sup>), HIR: high-intensity running (m), VHIR: very-high intensity running (m).

Table 2. Mean quarter change overall and from quarter one in 2019 and 2020 (Mean  $\pm$  95% CI).

		2019	p-value	2020	p-value	Difference	Effect Size	p-value
TMT (min)	Total	0.1 $\pm$ 0.1	.031	0.4 $\pm$ 0.1	<.001	0.3 $\pm$ 0.2	0.1 $\pm$ 0.1	.003
	Q1							
	Q2	0.1 $\pm$ 0.4	.481	0.1 $\pm$ 0.4	.630	0.0 $\pm$ 0.6	0.0 $\pm$ 0.2	.932
	Q3	0.4 $\pm$ 0.4	.022	1.1 $\pm$ 0.4	<.001	0.7 $\pm$ 0.6	0.2 $\pm$ 0.2	.016
	Q4	0.3 $\pm$ 0.4	.082	1.0 $\pm$ 0.4	<.001	0.7 $\pm$ 0.6	0.2 $\pm$ 0.2	.021
TD (m)	Total	-70 $\pm$ 14	<.001	-39 $\pm$ 15	<.001	31 $\pm$ 21	0.1 $\pm$ 0.1	.005
	Q1							
	Q2	-103 $\pm$ 45	<.001	-65 $\pm$ 47	.007	38 $\pm$ 67	0.1 $\pm$ 0.2	.271
	Q3	-108 $\pm$ 45	<.001	-63 $\pm$ 47	.009	46 $\pm$ 67	0.1 $\pm$ 0.2	.177
	Q4	-233 $\pm$ 45	<.001	-131 $\pm$ 47	<.001	100 $\pm$ 68	0.3 $\pm$ 0.2	.004
MPM (m.min <sup>-1</sup> )	Total	-3.3 $\pm$ 0.3	<.001	-4.0 $\pm$ 0.4	<.001	-0.7 $\pm$ 0.5	-0.1 $\pm$ 0.0	.008
	Q1							
	Q2	-4.6 $\pm$ 1.0	<.001	-3.4 $\pm$ 1.4	<.001	1.2 $\pm$ 1.7	0.1 $\pm$ 0.2	.179
	Q3	-6.2 $\pm$ 1.0	<.001	-8.7 $\pm$ 1.4	<.001	-2.5 $\pm$ 1.7	-0.2 $\pm$ 0.1	.004
	Q4	-10.4 $\pm$ 1.1	<.001	-11.6 $\pm$ 1.4	<.001	-1.1 $\pm$ 1.7	-0.1 $\pm$ 0.1	.162
HIR (m)	Total	-39 $\pm$ 5	<.001	-29 $\pm$ 5	<.001	9 $\pm$ 8	0.1 $\pm$ 0.0	.018
	Q1							
	Q2	-55 $\pm$ 16	<.001	-40 $\pm$ 17	<.001	15 $\pm$ 25	0.1 $\pm$ 0.1	.240
	Q3	-66 $\pm$ 16	<.001	-63 $\pm$ 17	<.001	3 $\pm$ 24	0.0 $\pm$ 0.2	.835
	Q4	-126 $\pm$ 16	<.001	-90 $\pm$ 172	<.001	35 $\pm$ 25	0.2 $\pm$ 0.2	.005
HIR MPM (m.min <sup>-1</sup> )	Total	-1.6 $\pm$ 0.2	<.001	-1.7 $\pm$ 0.3	<.001	-0.1 $\pm$ 0.3	0.0 $\pm$ 0.0	.432
	Q1							
	Q2	-2.3 $\pm$ 0.6	<.001	-2.1 $\pm$ 0.8	<.001	0.3 $\pm$ 1.0	0.0 $\pm$ 0.1	.621
	Q3	-2.8 $\pm$ 0.6	<.001	-3.9 $\pm$ 0.8	<.001	-1.1 $\pm$ 1.0	-0.2 $\pm$ 0.1	.037
	Q4	-2.3 $\pm$ 0.6	<.001	-5.1 $\pm$ 0.8	<.001	0.0 $\pm$ 1.0	0.0 $\pm$ 0.1	.969
VHIR (m)	Total	-8 $\pm$ 2	<.001	-6 $\pm$ 2	<.001	2 $\pm$ 3	0.0 $\pm$ 0.1	.267
	Q1							
	Q2	-5 $\pm$ 6	.099	0 $\pm$ 7	.991	5 $\pm$ 10	0.0 $\pm$ 0.2	.290
	Q3	-11 $\pm$ 6	<.001	-10 $\pm$ 7	.005	0 $\pm$ 10	0.0 $\pm$ 0.2	.906
	Q4	-24 $\pm$ 6	<.001	-17 $\pm$ 7	<.001	7 $\pm$ 10	0.1 $\pm$ 0.2	.137
VHIR MPM (m.min <sup>-1</sup> )	Total	-0.3 $\pm$ 0.1	<.001	-0.3 $\pm$ 0.1	<.001	0.0 $\pm$ 0.1	0.0 $\pm$ 0.1	.680
	Q1							
	Q2	-0.2 $\pm$ 0.2	.055	-0.1 $\pm$ 0.3	.707	0.2 $\pm$ 0.4	0.1 $\pm$ 0.1	.412
	Q3	-0.5 $\pm$ 0.2	<.001	-0.6 $\pm$ 0.3	<.001	-0.2 $\pm$ 0.4	-0.1 $\pm$ 0.2	.441
	Q4	-1.0 $\pm$ 0.2	<.001	-0.9 $\pm$ 0.3	<.001	0.0 $\pm$ 0.4	0.0 $\pm$ 0.2	.920

Note. Total: overall mean quarter values, Q1: quarter 1, Q2: quarter 2, Q3: quarter 3, Q4: quarter 4, TMT: total match time (min), TD: total distance (m), MPM: meters per minute (m.min<sup>-1</sup>), HIR: high-intensity running (m), VHIR: very-high intensity running (m).

### Overall

There was a decrease in overall volume from 2019 to 2020, evidenced by large decreases in TMT and TD ( $p < .001$ ; Figures 1a & b; Table 1). Despite a small decrease in HIR in 2020 ( $p < .001$ ; Figure 1d; Table 1), intensity increased in 2020 with small increases in HIR m.min<sup>-1</sup> ( $p < .001$ ; Figure 1e; Table 1), and VHIR m.min<sup>-1</sup> ( $p = .006$ ; Figure 1g; Table 1).

### **Positions**

All positional groups experienced decreases in TMT and TD ( $p < .001$ ; Figures 1a & b). Defenders exhibited the greatest increase across high and very-high intensity speeds with small increases in HIR  $m \cdot min^{-1}$  ( $p = .007$ ; Figure 1e), and VHIR  $m \cdot min^{-1}$  ( $p = .010$ ; Figure 1g). Midfielders experienced a small increase in HIR  $m \cdot min^{-1}$  ( $p = .017$ ; Figure 1e). There was a tendency for a small increase in HIR  $m \cdot min^{-1}$  for forwards ( $p = .053$ ; Figure 1e).

### **Quarters**

Large decreases in TMT and TD were found across all quarters ( $p < .001$ ; Table 1), indicating a significant decrease in volume across quarters from 2019 to 2020. On average, the decrement in TMT ( $p = .003$ ; Table 2) and TD ( $p = .005$ ; Table 2) across quarters was less in 2020 compared to 2019. Similarly, TMT ( $p = .021$ ; Table 2) and TD ( $p = .004$ ; Table 2) declined at a smaller rate across fourth quarters in 2020.

HIR  $m \cdot min^{-1}$  increased across all quarters in 2020 ( $p < .001$ ; Table 1). VHIR  $m \cdot min^{-1}$  increased across first, second and fourth quarters in 2020 (Table 1). MPM decreased in third quarters in 2020 ( $p = .049$ ; Table 1).

MPM also decreased on average at a greater rate across quarters in 2020 ( $p = .008$ ; Table 2), particularly third quarters ( $p = .004$ ; Table 2). On average, the decrement in HIR  $m \cdot min^{-1}$  across quarters was unchanged in 2020 ( $p = .432$ ; Table 2), however HIR  $m \cdot min^{-1}$  declined at a greater rate across third quarters in 2020 ( $p = .037$ ; Table 2). The average rate of decline in HIR distance across quarters, however, was less in 2020 compared to 2019 ( $p = .018$ ; Table 2), particularly in fourth quarters ( $p = .005$ ; Table 2).

## **DISCUSSION**

This study analysed the effect of reduced game time on the match activity profiles of elite AF players by comparing players' GPS match data from the 2019 and 2020 seasons. The main findings were that in 2020, overall volume decreased across all GPS metrics, and across quarters and positional groups. Small increases in intensity were recorded at high (i.e.  $>17 \text{ km} \cdot \text{h}^{-1}$ ) and very-high (i.e.  $>23 \text{ km} \cdot \text{h}^{-1}$ ) intensities overall (Figures 1e & g; Table 1), with defenders the only positional group to record increases at both intensities (Figures 1e & g). Midfielders also recorded a small increase in intensity but only at high-intensity speed, whilst forwards only exhibited a tendency for an increase in intensity at this threshold (Figure 1e). The increase in quarter and three-quarter time breaks had no impact on players' intensity in the subsequent quarter (Table 2). These results have implications for coaches, conditioning staff and players in understanding the increased intensity and physical match demands on players because of reduced game time and compressed fixturing of matches.

Unsurprisingly, the reduction in the length of quarters for the 2020 season, from 20 to 16 minutes and overall match playing time from 80 to 64 minutes, resulted in a reduction of overall volume, reflected across all positional groups and quarters. This is further evidenced by large decreases in TD and TMT overall, across quarters and for forwards and defenders (Figures 1a & b; Table 1). Ruckmen and midfielders exhibited the greatest reduction in volume with very large decreases in distance, along with very large and large decreases in duration respectively (Figures 1a & b). Therefore, these findings and the change(s) in GPS derived player output metrics between the 2019 and 2020 seasons are contextualised by the relevant measures of GPS intensity variables.

### **Overall changes**

In 2020, player average movement speed at high and very-high intensity levels increased (Figures 1e & g; Table 1). Furthermore, the absence of a change in  $\text{m}\cdot\text{min}^{-1}$  and the amount of VHIR distance along with a reduction in HIR distance (Figures 1c, f & d; Table 1), suggests the reduction in match time for the 2020 season only increased the intensity of player output when made relative to playing time at high and very-high intensity speeds.

The somewhat randomised and flexible fixture implemented in 2020 saw 'clusters' of matches played within a very short period, where the focus between games was largely on recovery rather than recovery *and* training in preparation for the next match. Teams were sometimes afforded three- or four-day breaks between matches, departing from the traditional six to twelve-day breaks they had become accustomed to in preceding seasons. Research has found distance, acceleration and sprint output were at their highest in-season levels following a twelve-day break between matches, in comparison to six, seven and eight day turnarounds (Hiscock et al., 2012).

### **Positional changes**

Forwards demonstrated the greatest reduction in TMT and TD (Figures 1a & b; Table 1), which is perhaps suggestive of an increased utilisation of the interchange bench for this positional group in 2020. It might have been expected forwards would therefore exhibit greater intensity across their activity profile (Burgess et al., 2012). However, the findings of this investigation suggest reduced match and possibly in-game time, had no impact on the intensity of forwards at all intensity speed measures, with no change in  $\text{m}\cdot\text{min}^{-1}$ , HIR  $\text{m}\cdot\text{min}^{-1}$ , and VHIR  $\text{m}\cdot\text{min}^{-1}$  (Figures 1c, e & g). This finding supports earlier research (Kempton et al., 2015) which found forwards exhibited the least variability in their match activity profile of any positional group, which has been attributed to their specific roles and constraints imposed by playing position.

Earlier research (Brewer et al., 2010; Hiscock et al., 2012; Wisbey et al., 2009) has established midfielders have higher in-game movement demands, cover greater distance, and record higher average speed values than other positions. The findings of this study provided mixed support for these earlier studies, depending on the measure of intensity. The present investigation found midfielders maintained a higher average of overall distance across the two seasons of interest and recorded the greatest increase in HIR  $\text{m}\cdot\text{min}^{-1}$  in 2020 (Figure 1e). The most likely explanation for this is the combined effect of superior aerobic capacities and a tendency to be rotated through the interchange bench more frequently compared to other playing positions, enabling them to fulfil their tactical roles at higher relative intensity (Coutts et al., 2015; Esmaili et al., 2020; Mooney et al., 2011; B. Wisbey et al., 2010).

Despite spending more time on the ground and having the smallest reduction in TMT of any positional group in 2020, defenders experienced the greatest increase in very-high intensity ( $>23 \text{ km}\cdot\text{h}^{-1}$ ) measures than any other positional group, recording a small increase in VHIR  $\text{m}\cdot\text{min}^{-1}$  (Figure 1g). This may be explained by the finding detailed in Figure 1(a) whereby defenders spent, on average, more time on the ground relative to other positional groups, thereby affording them the opportunity to engage in more very-high intensity activity. The style of play adopted by the team and the diverse tactical roles of defenders (Kempton et al., 2015) may also confound this finding. However, given these findings are contextualised by analysis of relative movement speeds, it is concluded defenders experienced the greatest increase in intensity at very-high intensity speed than any other positional group as a consequence of reduced quarter and match time.



Other than the expected reduction in volume (TD and TMT) for ruckmen (Figures 1a & b), no significant changes in measures of intensity were found. This is potentially attributable to the small sample size of ruckmen analysed across the two seasons and the different game styles adopted by these athletes.

### **Quarter changes**

Whilst players exhibited greater overall reductions in volume with decreases in TD and TMT in 2020 (Figures 1a & b; Table 1), this investigation found the decrement in distance and duration across quarters was greater in 2019 compared to 2020, particularly in fourth quarters (Table 2). This suggests reduced game time in 2020 stabilised the volume of players' match activity profiles.

Furthermore, whilst overall intensity increased in 2020, particularly at higher speeds, this study found  $m \cdot \text{min}^{-1}$  decreased on average at a greater rate across quarters in 2020 than in 2019 (Table 2). This was particularly evident in third quarters, in which the rate of decrement in  $m \cdot \text{min}^{-1}$  and HIR  $m \cdot \text{min}^{-1}$  was greater in 2020. These findings suggest increased intensity earlier in the match, which this investigation found to be a product of reduced match time, resulted in a greater reduction in intensity across the course of a match, which is in keeping with the findings of earlier research (Coutts et al., 2010). Interestingly, these decrements ensued despite an increase in time for recovery between the first and second, and third and fourth quarters.

At higher intensities (HIR and VHIR speeds), there was no change on average in the rate of decrement in relative intensity measures across quarters (Table 2). Interestingly in 2020, there was no significant change in the rate at which relative intensity measures of  $m \cdot \text{min}^{-1}$ , HIR  $m \cdot \text{min}^{-1}$  and VHIR  $m \cdot \text{min}^{-1}$  decreased across second and fourth quarters (Table 2). These findings suggest the increase quarter and three-quarter time breaks, up from six to eight minutes in 2020, had no impact in relative terms on player intensity in the subsequent quarter. However, this investigation found the decrease in HIR distance across quarters on average, particularly in fourth quarters, to be significantly less in 2020 (Table 2). This change is perhaps attributable to the combined effect of reduced game time and the increased three-quarter time break.

### **Limitations**

The data provided in this paper described and analysed the effect of reduced game time on the match activity profiles of elite AF players. However, the findings of this study are limited by the fact they are drawn from examination of data from one team. It should be acknowledged data were collected from different GPS models (from the same manufacturer) given the manufacturer's change in hardware at the end of 2019. Therefore, the extent of the analysis in this paper was limited to the GPS measures which were analysed, given the manufacturer's recommendation not to compare acceleration and deceleration data. A small pilot study was conducted to ascertain whether a correction factor could be applied, however the *adjusted R-squared* value of .0391 confirmed the correlation between these data was insufficient.

It is well established that player activity profiles are influenced by several confounding factors, such as time between matches, travel, and individual and team tactics. Future research should look at investigating the effect of these factors in the context of reduced game time on players' match output. These findings could also be contextualised with reference to injury incidence to assess this relationship with an increase in intensity, particularly at higher speeds, due to reduced game time.

## **CONCLUSIONS**

The results show that a 20% reduction of game time produced an expected decrease in volume with TD and TMT declining. Interestingly, the hypothesised increase in intensity was not systematic, with increases in

intensity predominantly found at high and very-high intensity speeds across matches, positional groups, and quarters. No real changes were found in average player movement speed. Defenders were the only positional group to record significant increases in their match activity profile at relative measures of high and very-high intensities. Furthermore, the impact of increased quarter and three-quarter time breaks had no influence on relative measures of intensity in the second and fourth quarters.

## **AUTHOR CONTRIBUTIONS**

S. J. J., conceptualised the research question, analysed the data, and prepared the manuscript. C. R. B., conceptualised the research question and method of analysis, assisted with the analysis and interpretation of data, and substantively revised the manuscript. A. O. N., conceptualised the research question, undertook the data collection, and substantively revised the manuscript. N. P., conceptualised the research question, undertook the data collection, and substantively revised the manuscript. E. M. W. H., conceptualised the method of analysis, assisted with the interpretation of data and statistical analysis, and substantively revised the manuscript. P. C. B., conceptualised the research question and method of analysis, assisted with the analysis and interpretation of data, and substantively revised the manuscript.

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## **DISCLOSURE STATEMENT**

No potential conflict of interest was reported by the authors.

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