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Journal article

**PlayerLoad variables : Sensitive to changes in direction and not related to collision workloads in rugby league match play**

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**Section:** Original Investigation

**Article Title:** Playerload Variables are Sensitive to Changes in Direction and Not Related to Collision Workloads in Rugby League Match-Play

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## ABSTRACT

**Purpose:** Determine: 1) how change of direction (COD) workloads influence PlayerLoad variables when controlling total distance covered, and 2) relationships among collision workloads and PlayerLoad variables during rugby league match-play. **Methods:** Participants completed 3 protocols (crossover design) consisting of 10 repetitions of a 60 m effort in 15 s. The difference between each protocol was the COD demands required to complete 1 repetition; no COD (SL), 1 x 180° COD (1COD), or 3 x 180° COD (3COD). During rugby league matches, relationships among collision workloads, tri-axial PlayerLoad (PL<sub>VM</sub>), anterior-posterior + medio-lateral PlayerLoad (PL<sub>2D</sub>), and PL<sub>VM</sub> accumulated at locomotor velocities below 2 m.sec<sup>-1</sup> (i.e. PL<sub>SLOW</sub>) were examined using Pearson correlations (*r*) with coefficients of determination (*R*<sup>2</sup>). **Results:** Comparing 3COD to SL drills: PL<sub>VM</sub>.min<sup>-1</sup> (*d* = 1.50 ± 0.49, *large*, likelihood = 100%, *almost certainly*), PL<sub>2D</sub>.min<sup>-1</sup> (*d* = 1.38 ± 0.53, *large*, likelihood = 100%, *almost certainly*), and PL<sub>SLOW</sub>.min<sup>-1</sup> (*d* = 1.69 ± 0.40, *large*, likelihood = 100%, *almost certainly*) were greater. Collisions.min<sup>-1</sup> demonstrated a distinct (i.e. *R*<sup>2</sup> < 0.50) relationship from PL<sub>VM</sub>.min<sup>-1</sup> (*R*<sup>2</sup> = 0.30, *r* = 0.55), and PL<sub>2D</sub>.min<sup>-1</sup> (*R*<sup>2</sup> = 0.37, *r* = 0.61). Total distance.min<sup>-1</sup> demonstrated a *very large* relationship with PL<sub>VM</sub>.min<sup>-1</sup> (*R*<sup>2</sup> = 0.62, *r* = 0.79), and PL<sub>2D</sub>.min<sup>-1</sup> (*R*<sup>2</sup> = 0.57, *r* = 0.76). **Conclusions:** PlayerLoad variables demonstrate: 1) *large* increases as COD demands intensify, 2) separate relationships from collision workloads, and 3) *moderate* to *very large* relationships with total distance during match-play. PlayerLoad variables should be used with caution to measure collision workloads in team sport.





















During rugby league matches,  $PL_{2D}$  demonstrated: 1) *nearly perfect* relationships with  $PL_{VM}$ ,  $PL_{AP}$ ,  $PL_{ML}$ , and  $PL_V$ , and 2) a distinct relationship from collision workloads. Furthermore, when controlling for total distance covered, *large* effect size differences were demonstrated between  $PL_{2D}$  during straight line and multiple change of direction efforts (3 COD). These findings indicate that  $PL_{2D}$  does not provide any additional information on collision workloads than other PlayerLoad variables. Although small-sided games with contact produced greater  $PL_{2D}$  than small-sided games without contact,<sup>9</sup> increases in  $PL_{2D}$  may not always be the result of collision workloads;  $PL_{2D}$  is sensitive to change in direction workloads and has a separate relationship with collision workloads during rugby league matches. Practitioners should use this variable with caution when quantifying collision workloads in team sport.

$PL_{AP}$  revealed the weakest relationship with change of direction workloads; only *moderate* differences were found between the straight line and 3 COD conditions, whereas other PlayerLoad variables demonstrated *large* differences. This finding demonstrates that when these change of direction tasks were completed, there was a greater increase in loading in the medio-lateral and vertical planes than in the anterior-posterior plane. Considering that  $PL_{AP}$  is a component of  $PL_{2D}$ , practitioners should note that both  $PL_{AP}$  and  $PL_{2D}$  may not be as appropriate for quantifying change of direction workloads as  $PL_{ML}$ ,  $PL_V$ , and  $PL_{SLOW}$ . Given that greater blood lactate concentration, heart rate and oxygen uptake have been demonstrated following running with change of direction requirements than straight line running,<sup>25-27</sup> our findings suggest that PlayerLoad variables may be capable of providing important information on the demands of training sessions or matches in team sport.

Although the present study provides novel and practically applicable findings; there a number of limitations that need to be considered. Firstly, we investigated the influence of change of direction workloads on PlayerLoad variables during three conditions that were





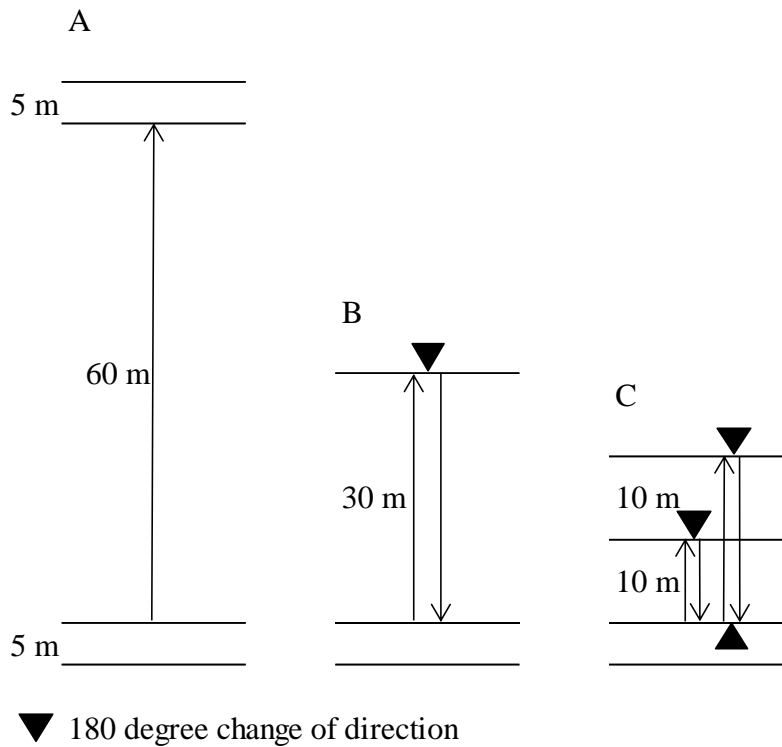


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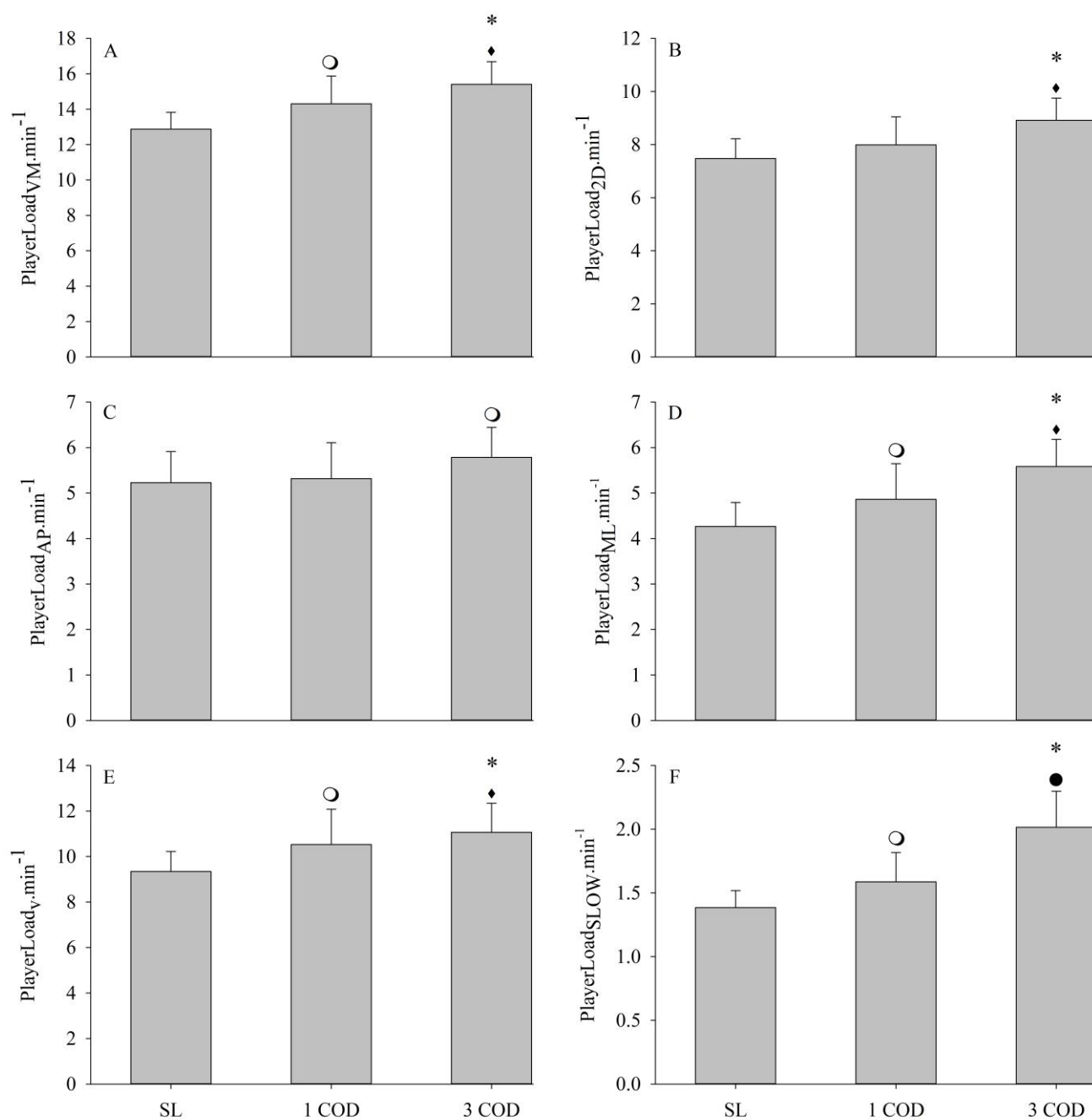
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**Figure 1.** Design of 3 experimental protocols used to determine how the addition of changes in direction influence all PlayerLoad variables when controlling for total distance covered. One repetition of each drill involved a 60 m running effort completed in 15 seconds; drill A was a 60 m straight line effort, drill B was a 60 m shuttle run with 1 change of direction (1 COD), and drill C was a 60 m effort with 3 changes in direction (3 COD). The participants had 15 seconds to walk a 5 m ‘out-and-back’ recovery between each repetition.



**Figure 2.** Differences in PlayerLoad variables when controlling for distance covered and adding change of direction tasks in junior rugby league players. Data are presented as mean  $\pm$  SD.

SL = Straight line running at 140m/min; 1 COD = 140 m/min with 1 x 180° change of direction;  
 3 COD = 140 m/min with 3 x 180° changes of direction.

\*Large effect size difference from SL; ●Large effect size difference from 1 COD; ○Moderate effect size difference from SL; ♦Moderate effect size difference from 1 COD.

**Table 1.** Relationships between measures of collision, PlayerLoad (PL), and locomotor activity during professional rugby league match-play.

$R^2$ (r)	Collision		PL						Walking & running	
	Collision-PL <sub>VM</sub> .min <sup>-1</sup>	Number of Collisions.min <sup>-1</sup>	PL <sub>VM</sub> .min <sup>-1</sup>	PL <sub>2D</sub> .min <sup>-1</sup>	PL <sub>AP</sub> .min <sup>-1</sup>	PL <sub>ML</sub> .min <sup>-1</sup>	PL <sub>V</sub> .min <sup>-1</sup>	PL <sub>SLOW</sub> .min <sup>-1</sup>	Total distance.min <sup>-1</sup>	Distance <2 m.sec <sup>-1</sup> .min <sup>-1</sup>
Collision-PL <sub>VM</sub> .min <sup>-1</sup>	1.00 (1.00)									
Number of Collisions.min <sup>-1</sup>	0.93 (0.97)	1.00 (1.00)								
PL <sub>VM</sub> .min <sup>-1</sup>	0.33 (0.58)	0.30 (0.55)	1.00 (1.00)							
PL <sub>2D</sub> .min <sup>-1</sup>	0.40 (0.63)	0.37 (0.61)	0.96 (0.98)	1.00 (1.00)						
PL <sub>AP</sub> .min <sup>-1</sup>	0.35 (0.59)	0.34 (0.59)	0.91 (0.95)	0.97 (0.98)	1.00 (1.00)					
PL <sub>ML</sub> .min <sup>-1</sup>	0.42 (0.65)	0.38 (0.62)	0.91 (0.95)	0.93 (0.97)	0.82 (0.91)	1.00 (1.00)				
PL <sub>V</sub> .min <sup>-1</sup>	0.23 (0.48)	0.20 (0.45)	0.95 (0.98)	0.83 (0.91)	0.78 (0.88)	0.80 (0.89)	1.00 (1.00)			
PL <sub>SLOW</sub> .min <sup>-1</sup>	0.25 (0.50)	0.22 (0.47)	0.62 (0.79)	0.60 (0.77)	0.57 (0.76)	0.56 (0.75)	0.58 (0.76)	1.00 (1.00)		
Total distance.min <sup>-1</sup>	0.09 (0.30)	0.09 (0.30)	0.62 (0.79)	0.57 (0.76)	0.56 (0.73)	0.53 (0.73)	0.62 (0.79)	0.32 (0.57)	1.00 (1.00)	
Distance <2 m.sec <sup>-1</sup> .min <sup>-1</sup>	0.09 (-0.31)	0.12 (-0.34)	0.01 (-0.12)	0.02 (-0.15)	0.02 (-0.16)	0.03 (-0.16)	0.01 (-0.08)	0.07 (0.26)	0.05 (0.23)	1.00 (1.00)

Coloured shading represents a correlation (r) that is:

