Functional Movement Screen (FMS) predicts severe injuries in professional rugby union players

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The Functional Movement Screen

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Professional Rugby Union – High Injury Risk

- Full contact sport defined by repetitive bouts of short duration high intensity work during which players collide, sometimes while running at full speed.
- **81** injuries per 1000 match hours and 3 injuries per 1000 practice hours
(Williams et al., Sports Med 2013)

Need strategies that reduce injury risk

Screen to determine "high-risk" players

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Functional Movement Screen

– Cook et al., N Am J Sports Phys Ther 2006

Tests balance, strength and range of motion simultaneously; providing a holistic, integrative assessment of the players’ quality of movement.

FMS as an injury predictor

FMS predicts injury in

- American football players (Kiesel et al., N Am J Sports Phys Ther 2007)
- Female collegiate athletes (Chorba et al., N Am J Sports Phys Ther 2010)
- Military recruits (Lisman et al., Med Sci Sports Exerc 2013)
- General population (Letafatkar et al., Int J Sports Phys Ther 2014)

Review - **"moderate scientific evidence"** to support the use of FMS as a predictor of injury (Kraus et al., J Strength Cond Res, 2014)

Research Questions

- Can FMS predict severe injury in professional rugby players?
- What FMS score is the best predictor of injury risk?
- Is any individual or combination of component tests a better predictor of injury than the FMS composite score?
- Does FMS predict contact/non-contact injuries?

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Methods

- Professional rugby players (Stature 1.87 ± 0.08m, body mass 103.1 ± 13.1kg) completed FMS tests <u>prior</u> to the start of competition.
- 62 players completed 90 FMS tests over 4 preseason periods between 2011 and 2013.
- Injuries were recorded by team medical staff for 6 months (180 days) after each FMS test classified contact/non-contact.
- **<u>Severe Injury</u>** – exclusion >28 days
  (IRB Consensus Statement on Injury definitions, 2007)
- A receiver operated characteristic (ROC) curve and 2x2 contingency table were used to calculate odds and likelihood ratios, sensitivity and specificity.
- Survival analysis

Results

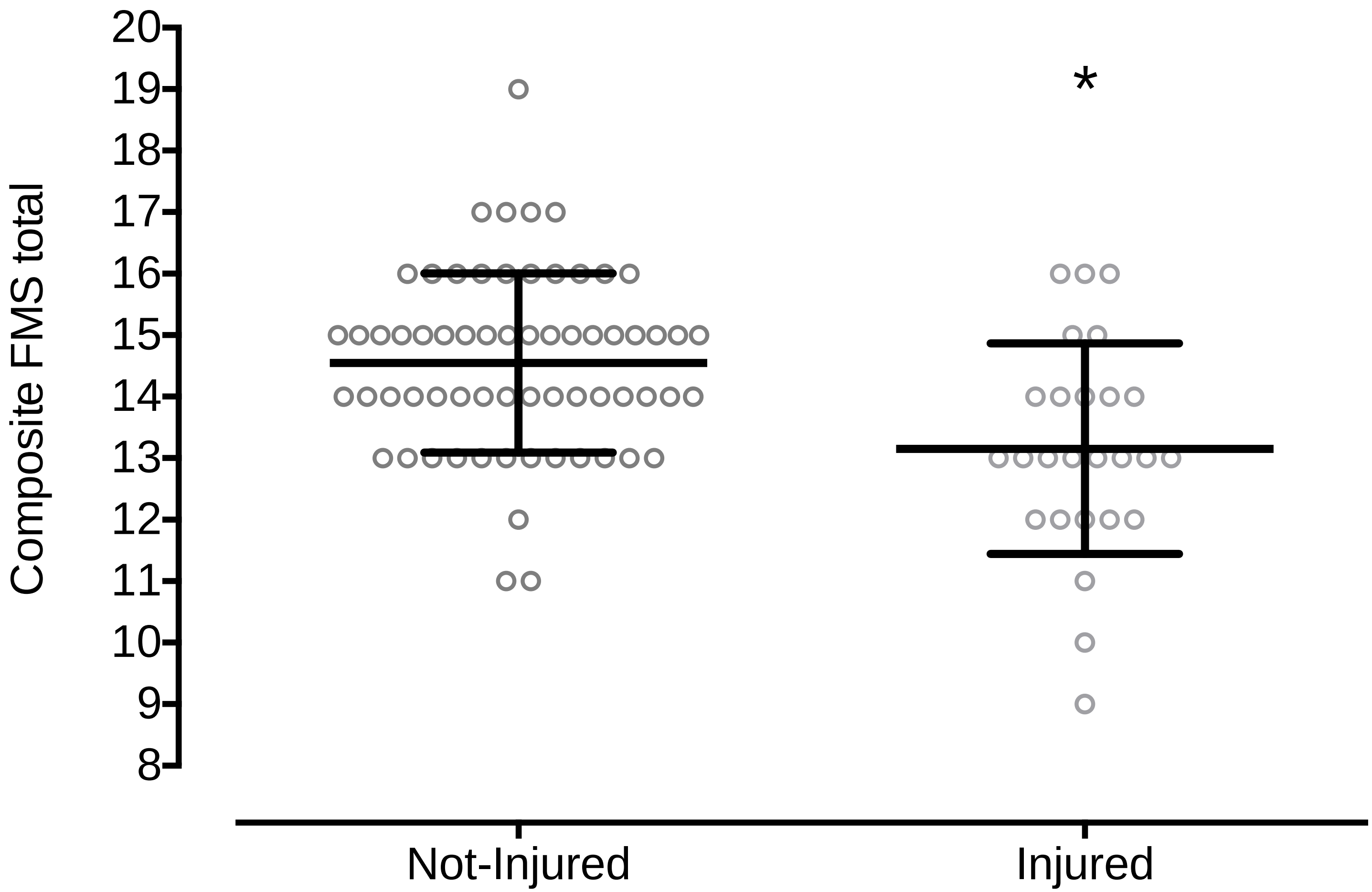

Figure 1 - Composite FMS scores of players not injured and players who suffered severe injury >28 days.

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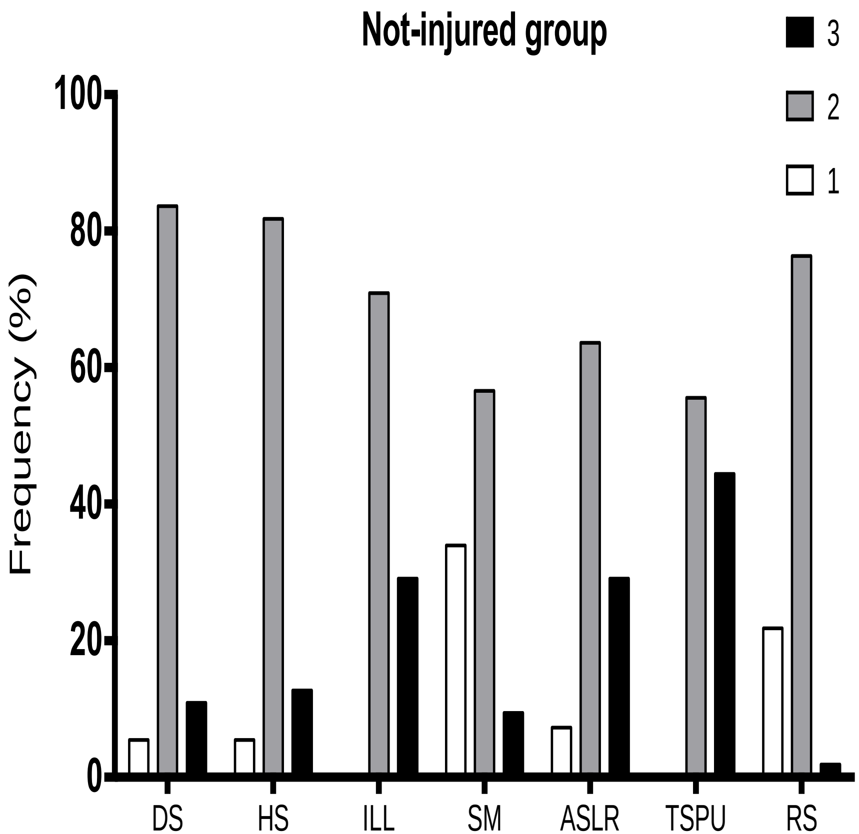
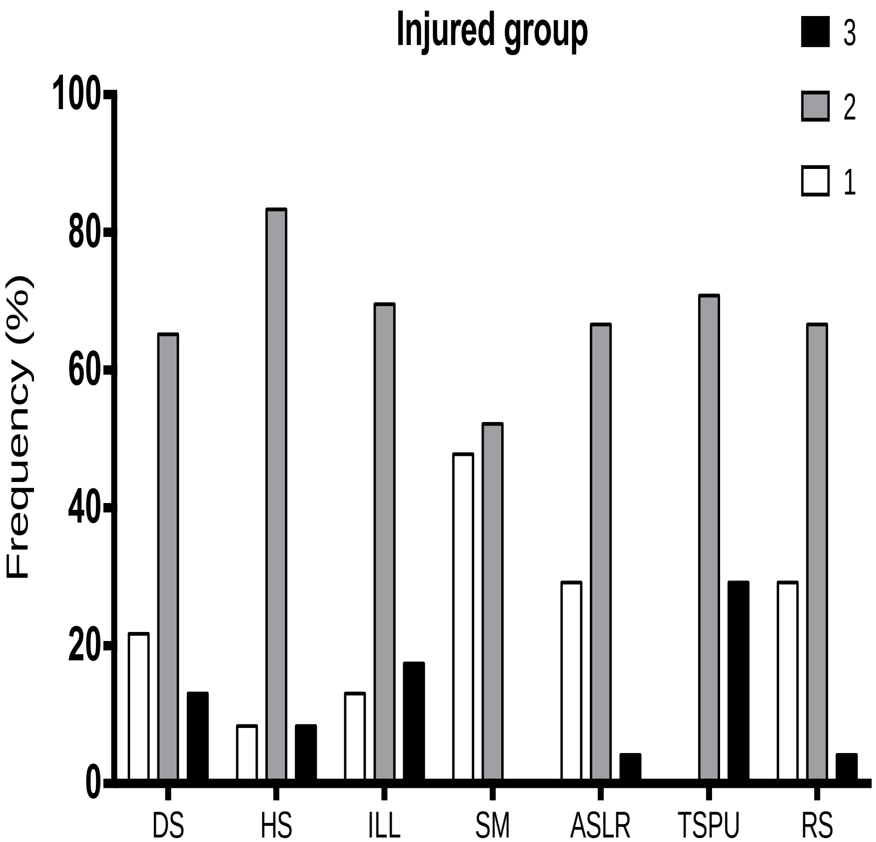
Results – Distribution of component test scores





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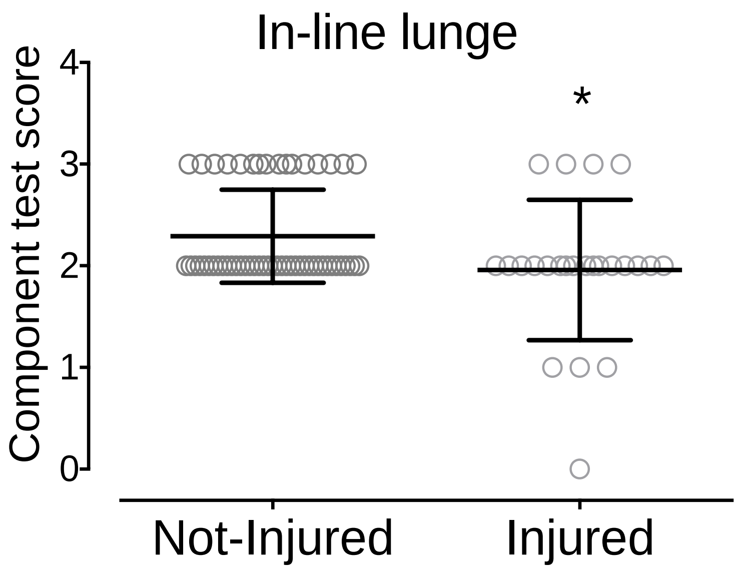
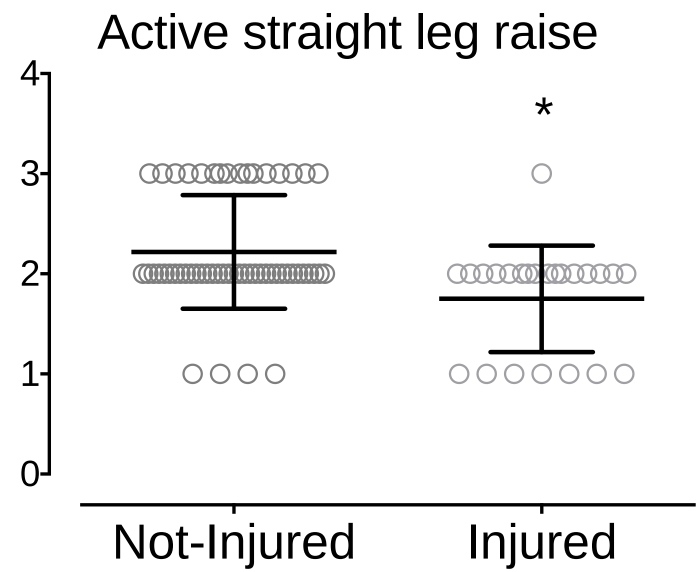
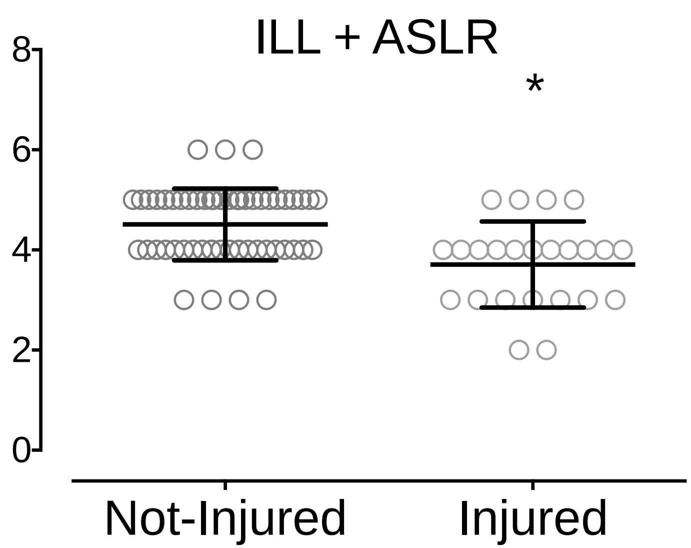
Results - FMS component tests







Differences in FMS scores between injured and not-injured players appear to be due to differences in ASLR and ILL scores

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Results

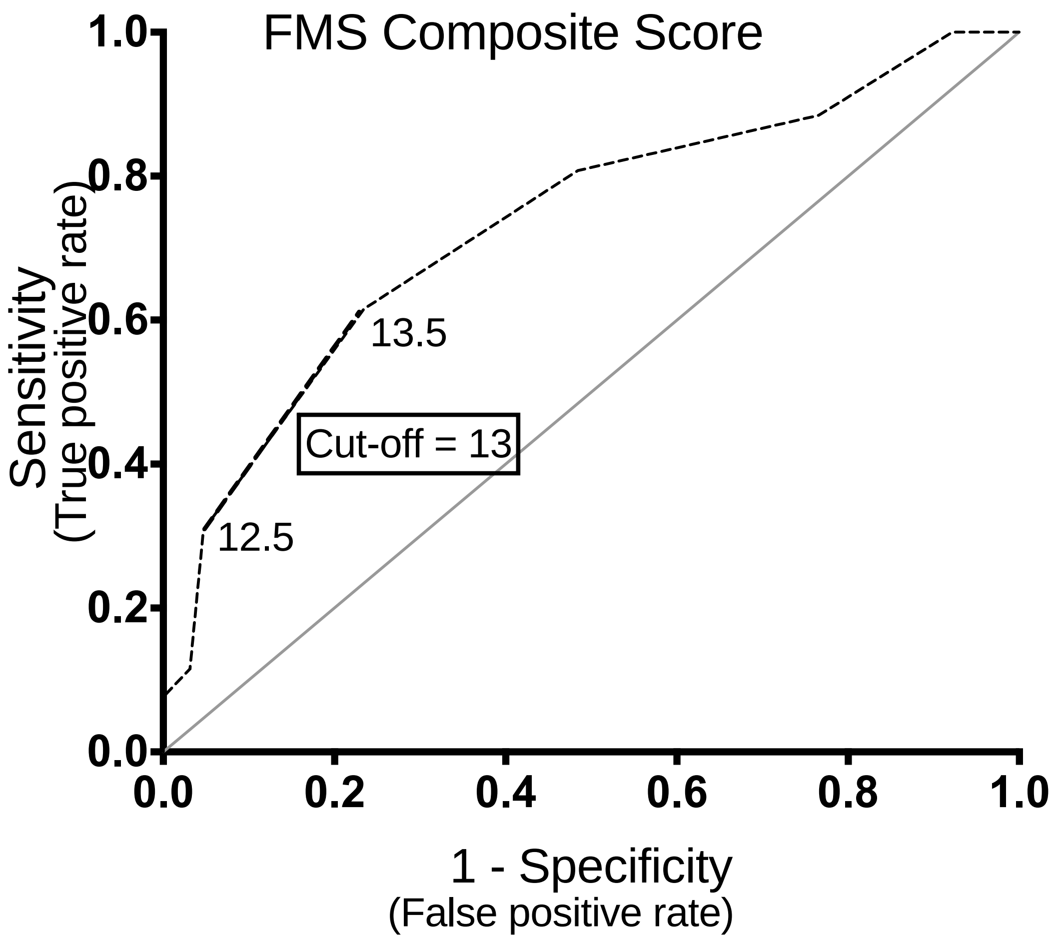

Figure 2 - ROC curves for the FMS composite test relating to injured or non-injured status.

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Results – All injuries

2 x 2 contingency table for FMS score of ≤ 13

	Severe Injured	Non-Severe Injured
FMS ≤ 13	16 True Positives	15 False Positives
FMS ≥ 14	10 False Negatives	49 True Negatives

Sensitivity 0.61
(95% CI = 0.41 to 0.80)
61%
61% of players with FMS ≤ 13 will sustain severe injury

Specificity 0.77
(95% CI = 0.64 to 0.86)
77%
77% of players with FMS > 13 will not sustain severe injury

Odds Ratio = 5.2
(95% CI = 2.0-13.9)
Players with FMS ≤ 13 are 5.2 times more likely to sustain a severe injury

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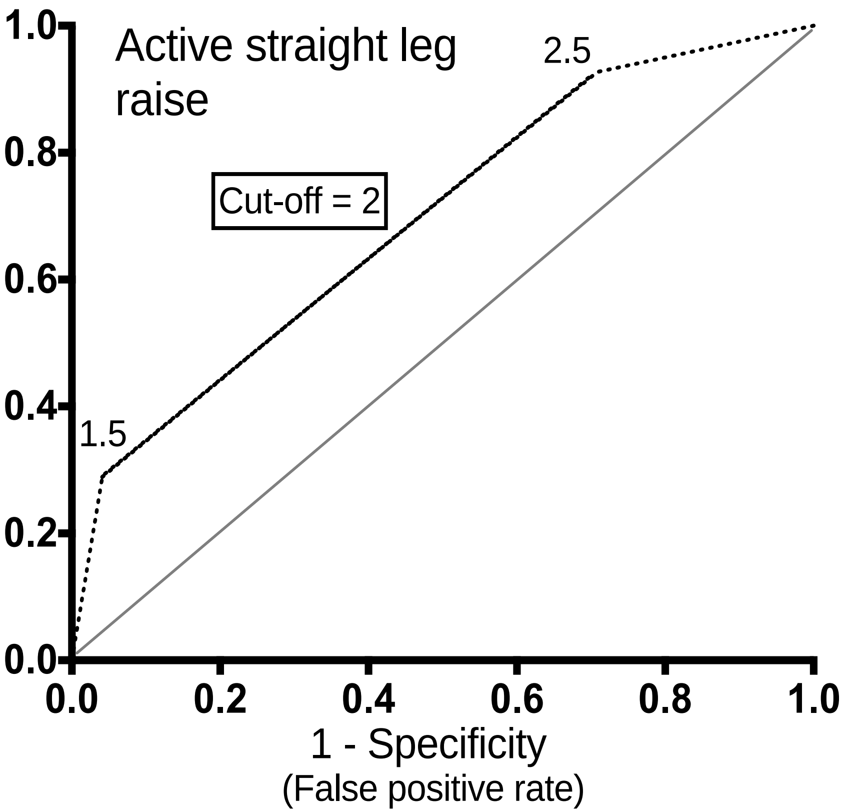
Results



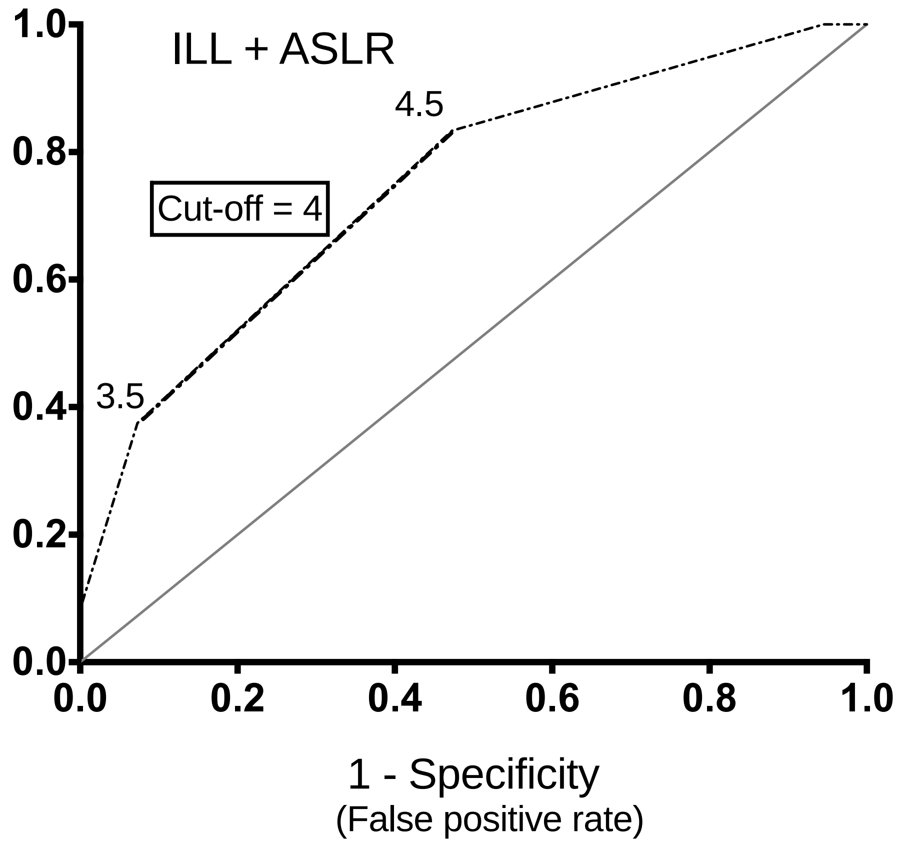


Figure 3 - ROC curves for the FMS composite test relating to injured or non-injured status.

Other component tests **"no better than chance"** at predicting severe injury

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Results – Active straight leg raise and in-line lunge

ASLR score ≤ 2 predicts injuries

Sensitivity 0.96 **96%**

(95%CI = 0.92 to 43)

Specificity 0.29 **29%**

(95%CI = 0.18 to 0.43)

Odds ratio 9.4

(95% CI = 1.2 to 76)

	Severe Injured	Non-Severe Injured
ASLR ≤ 2	23 True Positives	39 False Positives
ASLR ≥ 3	1 False Negatives	16 True Negatives

ILL + ASLR score ≤ 4 predicts injuries

Sensitivity 0.83 **83%**

(95%CI = 0.63 to 0.95)

Specificity 0.53 **53%**

(95%CI = 0.39 to 0.66)

Odds ratio 5.6

(95% CI = 1.7 to 18)

Non-Contact and Contact Injuries

	Contact Injuries			Non-contact injuries		
	Injured	Not injured	Effect size	Injured	Not injured	Effect size
	N=14	N=76		N=12	N=78	
FMS Composite Score	**13.1 ± 2.0***	**14.3 ± 1.5**	**medium**	**13.3 ± 1.4**	**14.3 ± 1.7**	**medium**
Deep Squat	**1.6 ± 0.8***	**2.1 ± 0.4**	large	2.1 ± 0.5	2.0 ± 0.5	small
Hurdle Step	2.1 ± 0.3	2.1 ± 0.4	trivial	1.9 ± 0.5	2.1 ± 0.4	small
In-Line Lunge	**1.8 ± 0.7***	**2.3 ± 0.5**	large	2.1 ± 0.7	2.2 ± 0.5	trivial
Shoulder Mobility	1.5 ± 0.7	1.6 ± 0.7	trivial	1.4 ± 0.5	1.7 ± 0.7	small
Active Straight Leg Raise	**1.8 ± 0.6***	**2.1 ± 0.6**	**medium**	**1.8 ± 0.5***	**2.1 ± 0.6**	**medium**
Trunk Stability Push Up	2.2 ± 0.4	2.4 ± 0.6	small	2.4 ± 0.5	2.4 ± 0.6	trivial
Rotary Stability	1.9 ± 0.5	1.8 ± 0.5	small	1.6 ± 0.5	1.8 ± 0.5	medium

Results – Non-contact injuries

FMS composite score ≤ 14 predicts non-contact injuries

Sensitivity 0.83
(95%CI = 0.52 to 0.98)

83%

Specificity 0.46
(95%CI = 0.35 to 0.58)

46%

Odds ratio 4.3
(95% CI = 0.9 to 21)

ASLR was **"no better than chance"** at predicting severe non-contact injury

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Results – Contact Injuries

	FMS Composite Score ≤ 13	Deep Squat + In-line lunge	Deep Squat + In-line lunge + Active straight leg raise
Sensitivity (95%CI)	0.71 (0.42 to 0.92)	0.92 (0.62 to 1.0)	0.83 (0.52 to 0.98)
Specificity (95%CI)	0.72 (0.61 to 0.82)	0.37 (0.26 to 0.50)	0.52 (0.40 to 0.65)
Odds Ratio (95%CI)	6.5 (1.8 to 23.0)	6.5 (0.8 to 54)	5.5 (1.1 to 27)
X^2 Test	p = 0.003	P = 0.049	p = 0.023

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How does FMS predict contact injuries?

Model 1: Disadvantageous tackle positions

Poor tackle technique = ↑ Risk of injury (Burger et al., 2015)

Dysfunctional movement patterns (low-FMS) may make it more difficult for players to get into the "ideal" tackle position

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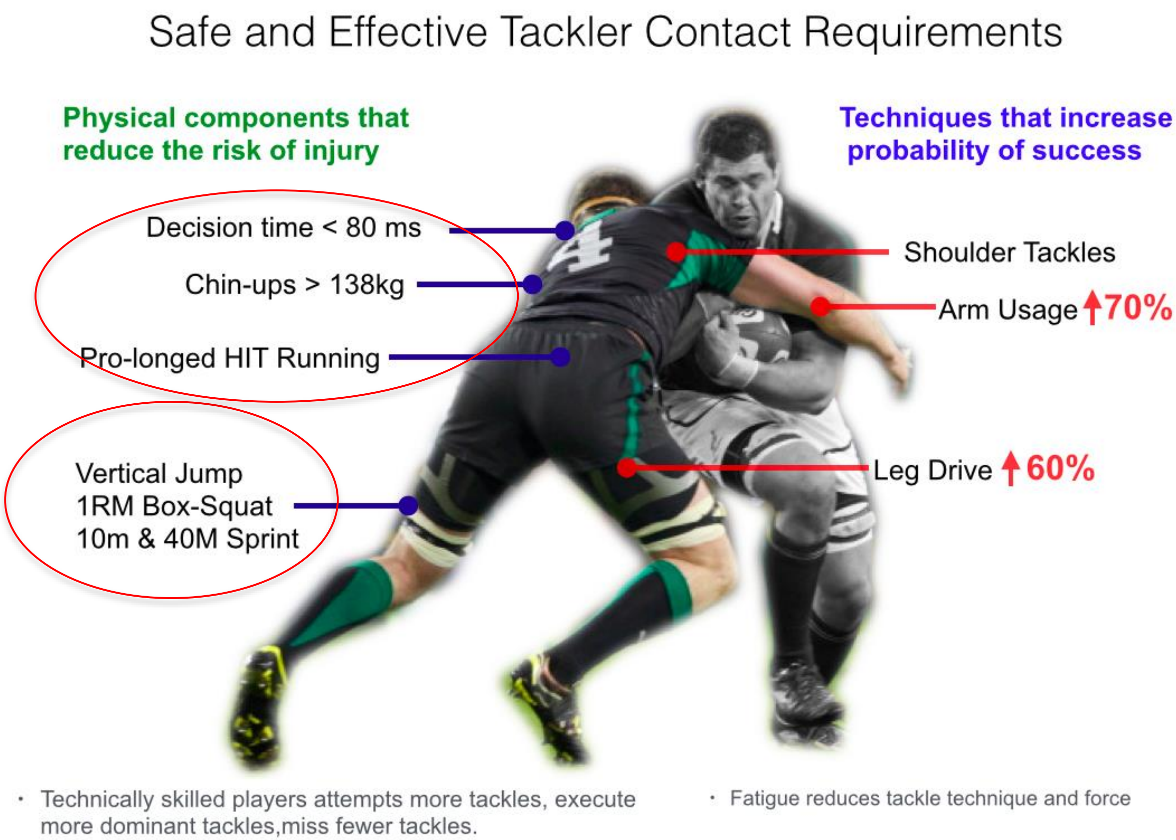
How does FMS predict contact injuries?

Model 2: Fatigue

Fatigue is a risk factor for injury

- Highest injury incidence in final quarter of matches (Brooks et al, 2005, Br J Sports Med)
- Well-developed physical characteristics prevent injury



Dysfunctional movement patterns (Low-FMS) may be **inefficient**, and ↑ rate of fatigue

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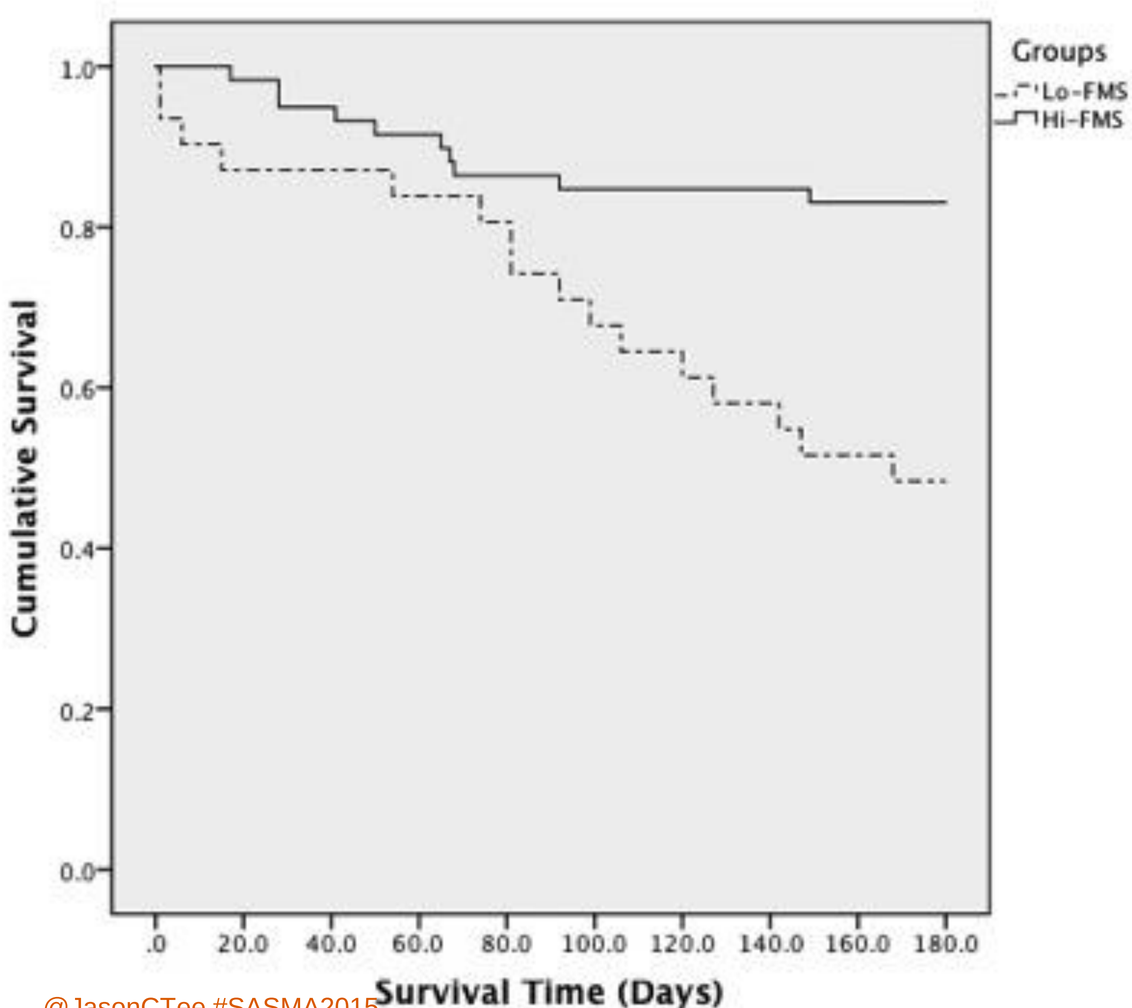
Survival analysis

High-FMS (≥14) vs. Low-FMS (≤13)



Mean survival time is **<u>31 days</u>** greater for High-FMS vs. Low-FMS groups (160 ± 6 vs. 129 ± 11 days)

Significant difference in survival time for **<u>contact,</u>** but not for **<u>non-contact</u>** injuries

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Conclusion

FMS is a **predictor** of severe contact and non-contact injury in professional rugby union players.

ASLR **≤ 2** predicts injury with a sensitivity of 96%

An FMS score of **≤ 13** predicts severe injury with the **highest specificity**.

FMS will assist in the management of players, improving team performance and reducing cost of injury

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Implications

- Professional rugby union players should perform regular FMS screens.
- Players who attain low FMS scores should be placed on exercise programs to correct their movement dysfunction.

Future research

FMS scores can be improved by corrective training programs (Kiesel et al., Scand J Med Sci Sports 2011)

Determine whether corrective training programs improve player’s resilience and reduces the time spent off the field due to injury

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Thank you for listening!

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