

Title: Head Acceleration Event Exposure during Elite Men's and Women's Rugby Union Training

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Authors: Samuel Hudson^{1,2}, James Tooby³, Gregory Roe³, Thomas Sawczuk^{3,4}, Dario Cazzola^{1,2}, Matt Cross^{3,5}, Ben Jones^{3,5,6,7,8}, Simon Kemp^{9,10}, Sarah Whitehead³, Keith Stokes^{1,2,9}

Affiliations:

¹ Centre for Health and Injury and Illness Prevention in Sport, University of Bath, United Kingdom

² UK Collaborating Centre on Injury and Illness Prevention in Sport (UKCCIIIS), University of Bath, United Kingdom

³ Carnegie Applied Rugby Research (CARR) centre, Carnegie School of Sport, Leeds Beckett University, Leeds, UK.

⁴ Obesity Institute, Leeds Beckett University, Leeds, UK.

⁵ Premiership Rugby, London, UK.

⁶ Division of Physiological Sciences, Department of Human Biology, Faculty of Health Sciences, University of Cape Town, Cape Town, South Africa

⁷ School of Behavioural and Health Sciences, Faculty of Health Sciences, Australian Catholic University, Brisbane, QLD, Australia

⁸ Rugby Football League, Etihad Campus, Manchester, United Kingdom

⁹ Rugby Football Union, Twickenham, UK.

¹⁰ Department of Epidemiology and Population Health, London School of Hygiene and Tropical Medicine, London, UK

Corresponding author: Samuel Hudson, sjh241@bath.ac.uk

Level of Contact	HAE Count					Players Sampled (<i>n</i>)	Player Exposures (<i>n</i>)	Minutes of Player Exposure	HAE Incidence (<i>per player minute & 95% CI</i>)					
	≥5 <i>g</i>	≥10 <i>g</i>	≥15 <i>g</i>	≥20 <i>g</i>	≥25 <i>g</i>				≥5 <i>g</i>	≥10 <i>g</i>	≥15 <i>g</i>	≥20 <i>g</i>	≥25 <i>g</i>	
Men's Forwards														
Full Contact	1469	977	474	227	104	138	1895	8392	0.20 (0.16 - 0.26)	0.12 (0.10 - 0.16)	0.06 (0.05 - 0.08)	0.03 (0.02 - 0.04)	0.02 (0.01 - 0.03)	
Live Backs Units	-	-	-	-	-	-	-	-	-	-	-	-	-	
Live Lineout	881	602	289	129	57	135	855	3027	0.32 (0.26 - 0.40)	0.21 (0.17 - 0.29)	0.11 (0.08 - 0.15)	0.05 (0.04 - 0.09)	0.03 (0.02 - 0.05)	
Live Scrum	67	34	14	6	5	124	744	2544	0.02 (0.02 - 0.04)	0.01 (0.01 - 0.02)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)	
Team Full Contact	521	341	171	92	42	70	2820	296	0.20 (0.17 - 0.26)	0.13 (0.10 - 0.17)	0.07 (0.05 - 0.09)	0.04 (0.03 - 0.06)	0.02 (0.01 - 0.04)	
Controlled Contact	2677	1600	724	341	161	146	3197	25724	0.09 (0.08 - 0.10)	0.05 (0.05 - 0.06)	0.02 (0.02 - 0.03)	0.01 (0.01 - 0.01)	0.01 (0.00 - 0.01)	
Live Breakdown	92	58	30	15	8	28	122	68	0.79 (0.60 - 1.02)	0.54 (0.38 - 0.76)	0.34 (0.20 - 0.53)	0.17 (0.08 - 0.29)	0.08 (0.03 - 0.20)	
Live Tackle Drill	158	81	39	14	10	66	213	629	0.28 (0.22 - 0.37)	0.14 (0.10 - 0.19)	0.07 (0.05 - 0.12)	0.03 (0.01 - 0.05)	0.02 (0.01 - 0.03)	
Team Shoulder On	2016	1203	547	255	119	138	1849	21817	0.09 (0.07 - 0.10)	0.05 (0.04 - 0.06)	0.02 (0.02 - 0.03)	0.01 (0.01 - 0.01)	0.01 (0.00 - 0.01)	
Wrestling	20	14	7	4	3	5	11	23	0.63 (0.16 - 1.39)	0.44 (0.03 - 0.91)	0.22 (0.00 - 0.44)	0.13 (0.00 - 0.31)	0.09 (0.00 - 0.19)	
Breakdown Bags (Opposed)	95	51	21	10	1	91	252	759	0.16 (0.12 - 0.21)	0.08 (0.05 - 0.11)	0.04 (0.02 - 0.07)	0.02 (0.01 - 0.03)	0.00 (0.00 - 0.02)	
Breakdown Bags (Unopposed)	21	10	3	1	0	44	91	258	0.09 (0.05 - 0.16)	0.05 (0.02 - 0.12)	0.02 (0.00 - 0.09)	0.02 (0.00 - 0.07)	0.00 (NA)	
Lineout vs Pads	52	40	20	10	6	28	100	299	0.21 (0.13 - 0.36)	0.17 (0.10 - 0.30)	0.07 (0.04 - 0.12)	0.03 (0.01 - 0.05)	0.02 (0.01 - 0.04)	
Sled Scrum	2	1	0	0	0	44	73	324	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Tackle Bags Drill	161	104	42	23	12	94	212	462	0.36 (0.28 - 0.46)	0.23 (0.17 - 0.32)	0.10 (0.06 - 0.18)	0.06 (0.03 - 0.12)	0.02 (0.01 - 0.04)	
Team vs Pads	60	38	15	9	2	83	1174	317	0.05 (0.03 - 0.07)	0.03 (0.02 - 0.05)	0.01 (0.01 - 0.02)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)	

Men's Backs														
Non Contact		143	76	43	15	4	131	994	5100	0.03 (0.02 - 0.05)	0.01 (0.01 - 0.02)	0.01 (0.01 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)
	Unopposed Backs Units	-	-	-	-	-	-	-	-	-	-	-	-	-
	Unopposed Lineout	108	61	39	14	4	124	621	3593	0.03 (0.02 - 0.04)	0.14 (0.01 - 0.22)	0.01 (0.01 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)
	Passing	8	3	1	1	0	32	138	432	0.01 (0.01 - 0.03)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (NA)
	Team Unopposed Organisation	27	12	3	0	0	78	246	1112	0.03 (0.01 - 0.06)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.02)	0.00 (NA)	0.00 (NA)
Men's Backs														
Full Contact		183	125	53	25	14	40	156	1648	0.16 (0.09 - 0.41)	0.10 (0.06 - 0.26)	0.03 (0.02 - 0.04)	0.01 (0.01 - 0.02)	0.01 (0.00 - 0.01)
	Live Backs Units	23	20	7	2	2	10	13	30	0.89 (0.40 - 1.60)	0.73 (0.34 - 1.23)	0.21 (0.07 - 0.49)	0.06 (0.03 - 0.11)	0.06 (0.00 - 0.22)
	Live Lineout	-	-	-	-	-	-	-	-	-	-	-	-	-
	Live Scrum	-	-	-	-	-	-	-	-	-	-	-	-	-
	Team Full Contact	160	1105	46	23	12	38	143	1617	0.09 (0.07 - 0.13)	0.06 (0.04 - 0.07)	0.02 (0.01 - 0.04)	0.01 (0.01 - 0.02)	0.01 (0.00 - 0.01)
Controlled Contact		836	482	225	122	61	90	1320	10975	0.11 (0.08 - 0.20)	0.07 (0.05 - 0.12)	0.03 (0.02 - 0.05)	0.02 (0.01 - 0.03)	0.01 (0.00 - 0.02)
	Live Breakdown	67	47	17	9	5	15	37	114	0.51 (0.32 - 0.77)	0.37 (0.25 - 0.53)	0.11 (0.06 - 0.18)	0.06 (0.03 - 0.11)	0.04 (0.02 - 0.08)
	Live Tackle Drill	81	54	24	14	8	35	83	253	0.27 (0.18 - 0.38)	0.19 (0.12 - 0.32)	0.09 (0.05 - 0.18)	0.06 (0.03 - 0.16)	0.03 (0.00 - 0.11)
	Team Shoulder On	562	312	152	85	43	87	799	9519	0.09 (0.06 - 0.20)	0.05 (0.03 - 0.11)	0.03 (0.02 - 0.05)	0.02 (0.01 - 0.03)	0.01 (0.00 - 0.03)
	Wrestling	-	-	-	-	-	-	-	-	-	-	-	-	-
	Breakdown Bags (Opposed)	47	30	14	5	3	50	129	292	0.14 (0.08 - 0.27)	0.10 (0.05 - 0.25)	0.07 (0.02 - 0.20)	0.04 (0.01 - 0.10)	0.01 (0.00 - 0.04)
	Breakdown Bags (Unopposed)	13	7	3	1	0	21	34	91	0.13 (0.05 - 0.26)	0.05 (0.01 - 0.14)	0.02 (0.00 - 0.07)	0.00 (0.00 - 0.02)	0.00 (NA)
	Lineout vs Pads	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sled Scrum	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tackle Bags Drill	55	29	12	6	2	53	110	232	0.26 (0.18 - 0.40)	0.15 (0.10 - 0.22)	0.08 (0.03 - 0.15)	0.03 (0.01 - 0.11)	0.02 (0.00 - 0.08)

Table 1: HAE Incidence (per player minute & 95% CI) by Level of Contact														
Level of Contact	HAE Count					Players Sampled (n)	Player Exposures (n)	Minutes of Player Exposure	HAE Incidence (<i>per player minute & 95% CI</i>)					95% CI
	≥5 g	≥10 g	≥15 g	≥20 g	≥25 g				≥5 g	≥10 g	≥15 g	≥20 g	≥25 g	
Women's Forwards														
Full Contact	193	111	48	19	12	67	219	1733	0.10 (0.08 - 0.14)	0.06 (0.04 - 0.08)	0.03 (0.02 - 0.04)	0.01 (0.00 - 0.02)	0.01 (0.00 - 0.01)	
Live Backs Units	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Live Lineout	51	28	14	4	3	48	476	348	0.12 (0.09 - 0.18)	0.05 (0.03 - 0.08)	0.03 (0.02 - 0.05)	0.01 (0.00 - 0.02)	0.01 (0.00 - 0.02)	
Live Scrum	4	0	0	0	0	42	522	95	0.00 (0.00 - 0.01)	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Team Full Contact	138	83	34	15	9	32	46	735	0.22 (0.14 - 0.34)	0.15 (0.09 - 0.28)	0.06 (0.03 - 0.12)	0.03 (0.01 - 0.07)	0.02 (0.00 - 0.06)	
Controlled Contact	463	250	89	36	14	88	1273	9969	0.05 (0.04 - 0.06)	0.03 (0.02 - 0.03)	0.01 (0.01 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	
Live Breakdown	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Live Tackle Drill	84	54	16	8	0	64	159	799	0.14 (0.11 - 0.20)	0.09 (0.07 - 0.14)	0.02 (0.01 - 0.04)	0.01 (0.01 - 0.03)	0.00 (NA)	
Team Shoulder On	298	152	61	24	12	72	802	7718	0.04 (0.03 - 0.05)	0.02 (0.02 - 0.03)	0.01 (0.01 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	
Wrestling	2	0	0	0	0	2	2	7	0.29 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Men's Sevens														
Team vs Pads	11	3	3	2	0	37	108	414	0.03 (0.01 - 0.06)	0.01 (0.00 - 0.01)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)	0.00 (NA)	
Non Contact	112	46	20	10	6	66	598	4613	0.02 (0.01 - 0.03)	0.01 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	
Unopposed Backs Units	86	35	16	8	5	63	391	3743	0.02 (0.01 - 0.03)	0.01 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	
Unopposed Lineout	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Passing	9	3	0	0	0	21	98	339	0.02 (0.00 - 0.04)	0.00 (0.00 - 0.01)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Team Unopposed Organisation	17	8	4	2	1	39	129	590	0.02 (0.01 - 0.04)	0.01 (0.00 - 0.03)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	

Men's Backs	Breakdown Bags (Opposed)	29	16	5	2	1	39	78	348	0.07 (0.04 - 0.11)	0.04 (0.03 - 0.07)	0.02 (0.00 - 0.03)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.02)
	Breakdown Bags (Unopposed)	2	0	0	0	0	30	41	176	0.01 (0.00 - 0.03)	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)
	Lineout vs Pads	7	3	1	0	0	25	33	149	0.06 (0.02 - 0.14)	0.02 (0.00 - 0.08)	0.00 (0.00 - 0.02)	0.00 (NA)	0.00 (NA)
	Sled Scrum	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tackle Bags Drill	25	17	1	1	1	36	96	297	0.09 (0.06 - 0.15)	0.07 (0.04 - 0.11)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)
	Team vs Pads	16	8	5	1	0	42	62	476	0.04 (0.01 - 0.08)	0.03 (0.01 - 0.08)	0.02 (0.00 - 0.06)	0.00 (0.00 - 0.00)	0.00 (NA)
	Non Contact	45	27	12	7	4	157	377	4187	0.01 (0.01 - 0.01)	0.01 (0.00 - 0.01)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
	Unopposed Backs Units	-	-	-	-	-	-	-	-	-	-	-	-	-
	Unopposed Lineout	17	10	5	3	1	58	135	1755	0.01 (0.00 - 0.02)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)
	Passing	4	3	0	0	0	33	49	257	0.02 (0.00 - 0.04)	0.01 (0.00 - 0.04)	0.00 (NA)	0.00 (NA)	0.00 (NA)
Team Unopposed Organisation	24	13	7	4	3	66	193	2175	0.01 (0.01 - 0.03)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	
Women's Backs														
Women's Backs	Full Contact	29	15	10	3	1	16	33	586	0.05 (0.03 - 0.11)	0.03 (0.01 - 0.09)	0.03 (0.01 - 0.09)	0.02 (0.00 - 0.08)	0.02 (0.00 - 0.05)
	Live Backs Units	5	1	1	0	0	7	7	61	0.08 (0.02 - 0.18)	0.02 (0.00 - 0.03)	0.02 (0.00 - 0.05)	0.00 (NA)	0.00 (NA)
	Live Lineout	-	-	-	-	-	-	-	-	-	-	-	-	-
	Live Scrum	-	-	-	-	-	-	-	-	-	-	-	-	-
	Team Full Contact	24	14	9	3	1	16	26	524	0.05 (0.03 - 0.10)	0.03 (0.01 - 0.09)	0.03 (0.01 - 0.08)	0.02 (0.00 - 0.08)	0.02 (0.00 - 0.05)
	Controlled Contact	115	59	26	6	3	54	452	3416	0.05 (0.03 - 0.07)	0.03 (0.02 - 0.04)	0.01 (0.01 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.00)
	Live Breakdown	-	-	-	-	-	-	-	-	-	-	-	-	-
	Live Tackle Drill	46	21	10	0	0	37	83	383	0.10 (0.06 - 0.14)	0.05 (0.03 - 0.07)	0.02 (0.01 - 0.04)	0.00 (NA)	0.00 (NA)
	Team Shoulder On	52	26	13	6	3	42	275	2594	0.03 (0.02 - 0.05)	0.02 (0.01 - 0.04)	0.01 (0.00 - 0.02)	0.00 (0.00 - 0.01)	0.00 (0.00 - 0.01)

Wrestling	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Breakdown Bags (Opposed)	11	10	3	0	0	24	50	211	0.06 (0.03 - 0.10)	0.06 (0.03 - 0.10)	0.02 (0.00 - 0.06)	0.00 (NA)	0.00 (NA)	
Breakdown Bags (Unopposed)	0	0	0	0	0	2	2	10	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Lineout vs Pads	-	-	-	-	-	-	-	-	-	-	-	-	-	
Sled Scrum	-	-	-	-	-	-	-	-	-	-	-	-	-	
Tackle Bags Drill	6	2	0	0	0	18	29	89	0.11 (0.02 - 0.40)	0.08 (0.00 - 0.41)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Team vs Pads	0	0	0	0	0	8	13	130	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Non Contact	39	27	18	12	5	38	178	1988	0.04 (0.02 - 0.08)	0.02 (0.01 - 0.05)	0.01 (0.00 - 0.04)	0.01 (0.00 - 0.03)	0.00 (0.00 - 0.01)	
Unopposed Backs Units	29	24	16	12	5	33	80	820	0.05 (0.02 - 0.09)	0.03 (0.01 - 0.07)	0.01 (0.00 - 0.05)	0.01 (0.00 - 0.04)	0.01 (0.00 - 0.02)	
Unopposed Lineout	-	-	-	-	-	-	-	-	-	-	-	-	-	
Passing	2	0	0	0	0	7	15	79	0.03 (0.00 - 0.14)	0.00 (NA)	0.00 (NA)	0.00 (NA)	0.00 (NA)	
Team Unopposed Organisation	8	3	2	0	0	30	83	1089	0.01 (0.01 - 0.03)	0.00 (0.00 - 0.00)	0.00 (0.00 - 0.00)	0.00 (NA)	0.00 (NA)	

Table S1: Exposure data and average HAE incidence per player minute (CI: 95%) for men's and women's forwards and backs during each level of contact training and drill type at different PLA thresholds.

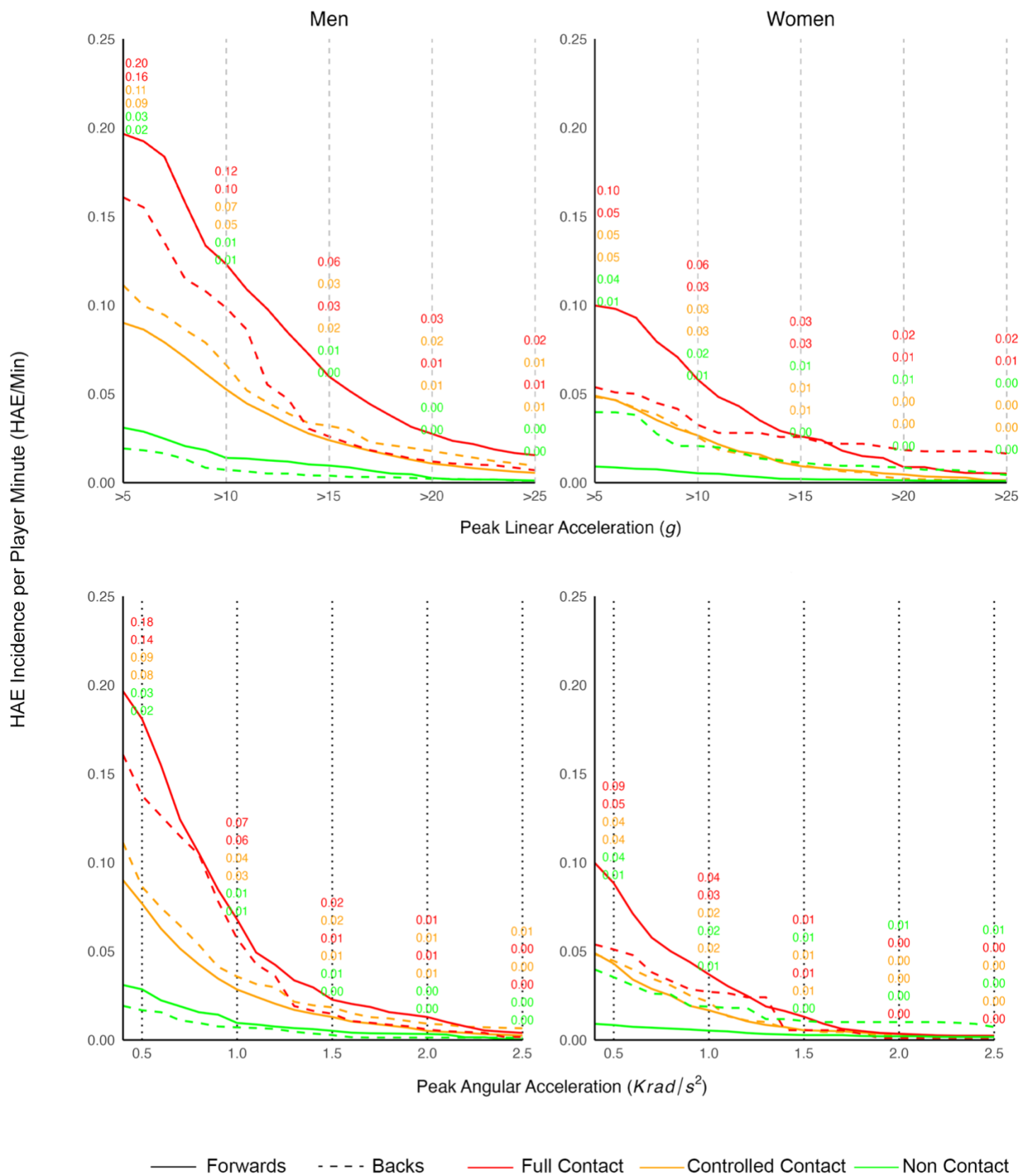


Figure S1: HAE incidence per player minute for men's and women's forwards and backs in contact training at different PLA and PAA magnitude thresholds.

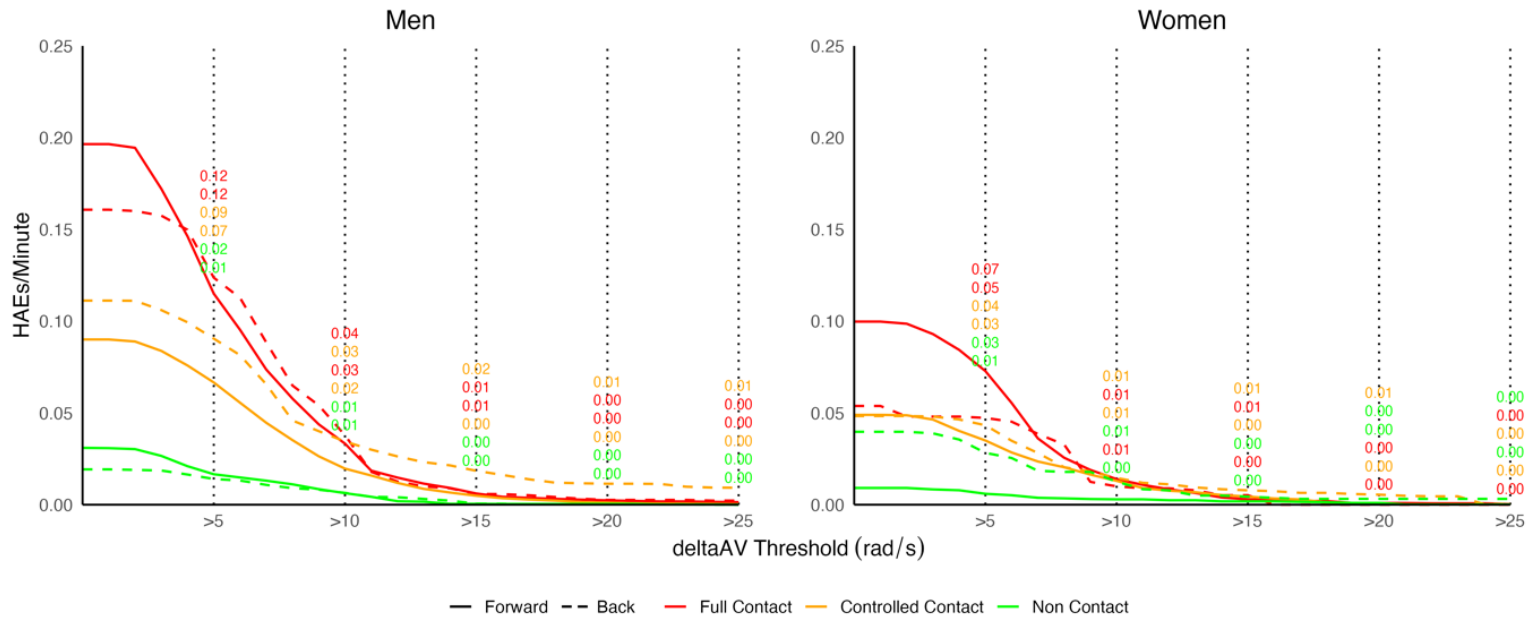


Figure S2: HAE incidence per player minute for men's and women's forwards and backs in contact training at different delta angular velocity magnitude thresholds.