

An interpretable machine learning framework for athlete motor profiling using multi-domain field assessments: a proof-of-concept study

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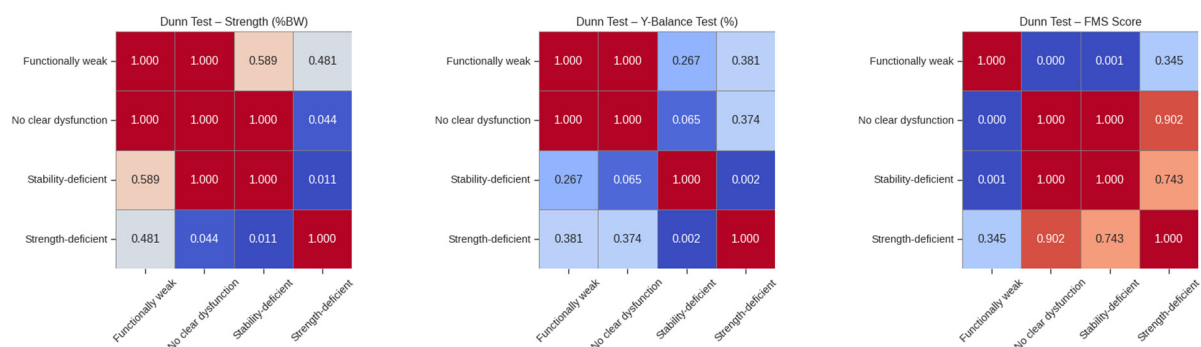


Figure S2 Decision Tree classifier – Functional profile.

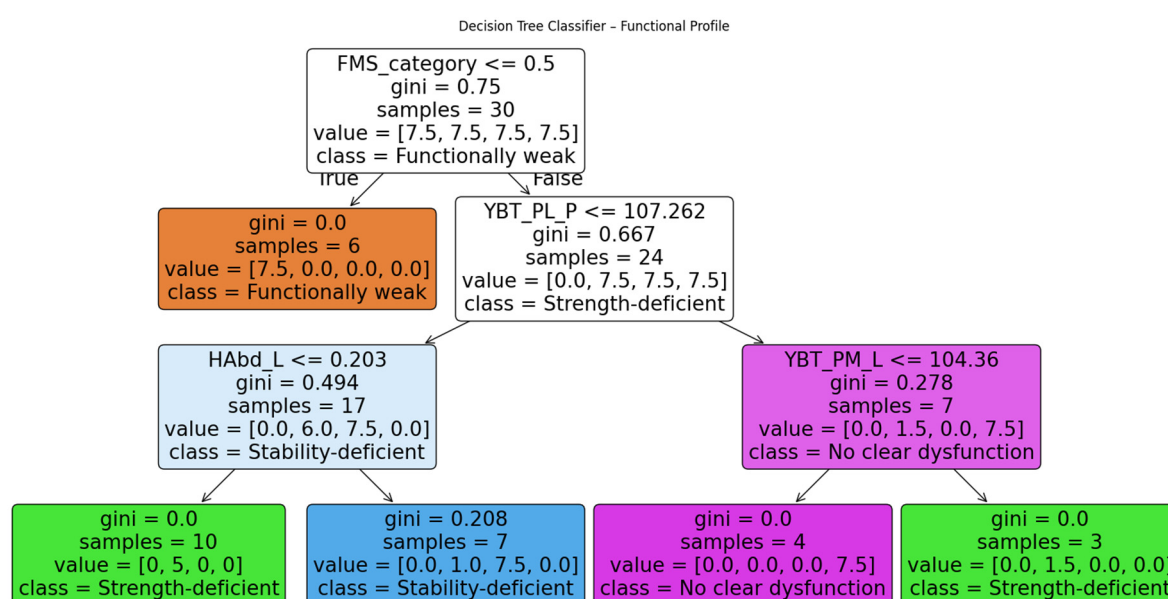


Figure S3 Distribution of Functional Movement Profiles by Sport Type

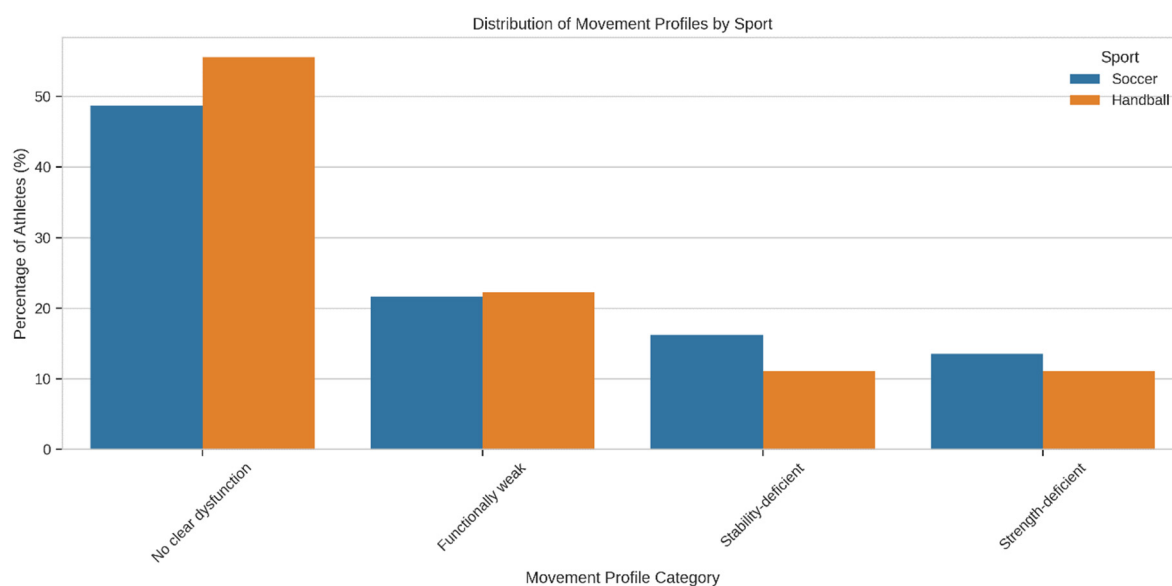


Figure S4. Comparison of Key Functional and Anthropometric Variables Between Soccer and Handball Athletes (box plots).

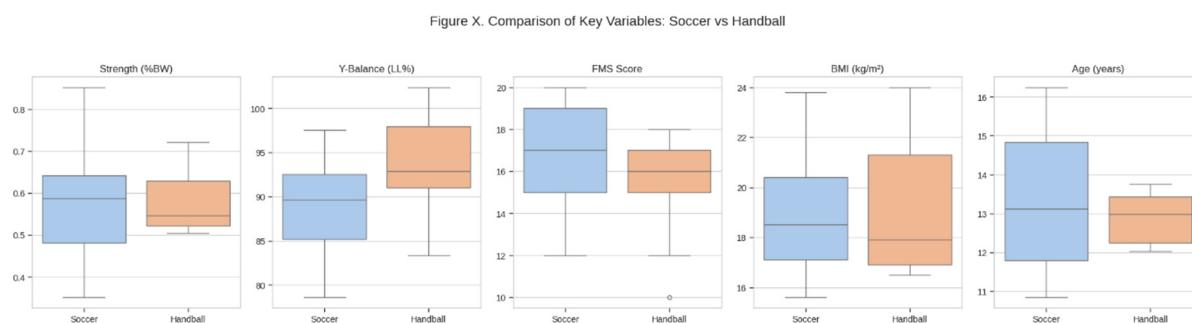


Table S1 A. Characteristics of the soccer players.

Variable	Mean (SD)	Median (IQR)	Range	Normality p-value
Age	13.33 (1.59)	13.11 (11.79–14.84)	10.84 – 16.25	.0204
BMI	18.81 (2.12)	18.5 (17.1–20.4)	15.6 – 23.8	.1244
Mean_Strength	0.58 (.11)	0.59 (0.48–0.64)	0.35 – 0.85	.9234
Mean_Strength L	0.56 (.12)	0.56 (0.47–0.64)	0.33 – 0.86	.9187
Mean_Strength R	0.59 (.11)	0.61 (0.52–0.67)	0.36 – 0.85	.7895
Mean_YBT	89.15 (4.76)	89.64 (85.15–92.56)	78.57 – 97.52	.5463
Mean_YBT L	86.75 (5.25)	85.95 (83.89–91.22)	76.76 – 99.15	.714
Mean_YBT R	89.36 (5.16)	89.93 (84.91–93.15)	78.97 – 99.09	.6044
FMS_TOTAL	16.89 (2.48)	17.0 (15.0–19.0)	12.0 – 20.0	.0055

Table S1 B. Descriptive statistics (Mean [SD], Median [IQR], Range) for all strength, YBT, and FMS variable for soccer players.

Variable	Mean (SD)	Median (IQR)	Range
HAbd_L PEAK FORCE	0.20 (0.04)	0.20 (0.18–0.22)	0.12–0.29

HAbd_P PEAK FORCE	0.20 (0.04)	0.19 (0.17–0.21)	0.10–0.33
KE_L PEAK FORCE	0.69 (0.16)	0.68 (0.58–0.79)	0.37–1.03
KE_P PEAK FORCE	0.74 (0.17)	0.73 (0.62–0.86)	0.36–1.05
KF_L PEAK FORCE	0.42 (0.09)	0.40 (0.35–0.46)	0.25–0.62
KF_P PEAK FORCE	0.42 (0.09)	0.44 (0.36–0.48)	0.22–0.67
AP_L PEAK FORCE	0.93 (0.28)	0.89 (0.74–1.14)	0.36–1.62
AP_P PEAK FORCE	1.01 (0.33)	1.02 (0.75–1.21)	0.42–1.70
YBT_ANT_L_Normalized	66.32 (6.17)	66.29 (62.84–69.80)	50.35–85.47
YBT_ANT_R_Normalized	65.66 (4.72)	65.17 (62.12–70.00)	57.84–74.91
YBT_PM_L_Normalized	100.27 (7.13)	100.00 (96.81–104.81)	81.23–116.67
YBT_PM_R_Normalized	101.22 (6.80)	100.76 (96.42–105.90)	89.36–114.10
YBT_PL_L_Normalized	100.21 (7.92)	101.45 (95.08–105.19)	79.57–118.91
YBT_PL_R_Normalized	101.20 (8.23)	102.65 (96.84–108.17)	76.34–114.23
YBT_COMPOSITE_R	89.36 (5.16)	89.93 (84.91–93.15)	78.97–99.09

YBT_COMPOSITE_L	86.75 (5.25)	85.95 (83.89–91.22)	76.76–99.15
FMS_TOTAL	16.89 (2.48)	17.00 (15.00–19.00)	12.00–20.00

Table S2: Random Forest Per-Class Classification Metrics with 95% Bootstrapped Confidence Intervals

Profile	Precision (95% CI)	Recall (95% CI)	F1-score (95% CI)
Functionally Weak	1.000 (1.000–1.000)	1.000 (1.000–1.000)	1.000 (1.000–1.000)
Strength-deficient	0.666 (0.249–1.000)	0.805 (0.333–1.000)	0.709 (0.286–1.000)
Stability-deficient	0.741 (0.000–1.000)	0.501 (0.000–1.000)	0.572 (0.000–0.909)
No clear dysfunction	0.797 (0.600–0.952)	0.837 (0.643–1.000)	0.812 (0.647–0.938)

Functional Profile Summary Statistics										
	Mean_S trength	Mean _YBT	Mean_Str ength_Z	Mean_ YBT_Z	FMS_T OTAL	FMS_c ategory	n_Red _flag	n_Yello w_flag	n_Gree n_flag	n_T otal
Functionally weak	0.56	88.96	-0.15	-0.04	13.38	Low	0	4	4	8
Strength-deficient	0.45	93.45	-1.13	0.92	16.40	Medium	0	1	4	5
Stability-deficient	0.65	84.34	0.66	-1.02	18.67	Medium	0	0	6	6
No clear dysfunction	0.59	89.63	0.16	0.10	18.00	Medium	1	3	14	18

Functional Profile Summary with Flag Percentages										
	Mean_S trength	Mean _YBT	Mean_Str ength_Z	Mean_ YBT_Z	FMS_T OTAL	FMS_c ategory	n_Red _flag	n_Yello w_flag	n_Gree n_flag	n_T otal
Functionally weak	0.56	88.96	-0.15	-0.04	13.38	Low	0 (0.0%)	4 (50.0%)	4 (50.0%)	8
Strength-deficient	0.45	93.45	-1.13	0.92	16.40	Medium	0 (0.0%)	1 (20.0%)	4 (80.0%)	5
Stability-deficient	0.65	84.34	0.66	-1.02	18.67	Medium	0 (0.0%)	0 (0.0%)	6 (100.0%)	6
No clear dysfunction	0.59	89.63	0.16	0.10	18.00	Medium	1 (5.6%)	3 (16.7%)	14 (77.8%)	18

	FMS _TO TAL	Mean_Streng th	Mean_YB T	flag_fm s	flag_strengt h	flag_yb t	Total_Flag_Sco re	Flag_Catego ry
0	19	0.55	94.24	0	0	0	0	Green flag
1	16	0.45	93.45	0	1	0	1	Green flag
2	14	0.42	87.80	1	1	0	2	Yellow flag
3	18	0.42	92.56	0	1	0	1	Green flag
4	17	0.43	93.98	0	1	0	1	Green flag
5	13	0.48	88.55	1	1	0	2	Yellow flag
6	18	0.60	95.32	0	0	0	0	Green flag
7	20	0.54	97.40	0	0	0	0	Green flag
8	16	0.46	94.97	0	1	0	1	Green flag
9	18	0.35	85.60	0	1	1	2	Yellow flag
10	15	0.48	92.29	1	1	0	2	Yellow flag
11	19	0.56	90.91	0	0	0	0	Green flag
12	15	0.35	84.53	1	1	1	3	Red flag
13	13	0.61	93.26	1	0	0	1	Green flag
14	14	0.56	79.44	1	0	1	2	Yellow flag
15	15	0.69	87.37	1	0	0	1	Green flag
16	13	0.51	88.65	1	1	0	2	Yellow flag
17	12	0.71	90.68	1	0	0	1	Green flag
18	19	0.85	97.52	0	0	0	0	Green flag
19	15	0.64	93.38	1	0	0	1	Green flag
20	14	0.62	91.23	1	0	0	1	Green flag
21	14	0.57	92.04	1	0	0	1	Green flag
22	15	0.67	89.97	1	0	0	1	Green flag
23	19	0.73	84.85	0	0	1	1	Green flag

	FMS _TO TAL	Mean_Streng th	Mean_YB T	flag_fm s	flag_strengt h	flag_yb t	Total_Flag_Sco re	Flag_Catego ry
24	19	0.68	86.83	0	0	1	1	Green flag
25	19	0.74	85.15	0	0	1	1	Green flag
26	16	0.64	87.15	0	0	1	1	Green flag
27	18	0.54	83.85	0	0	1	1	Green flag
28	17	0.51	78.57	0	1	1	2	Yellow flag
29	19	0.48	82.28	0	1	1	2	Yellow flag
30	20	0.63	88.33	0	0	0	0	Green flag
31	17	0.62	83.68	0	0	1	1	Green flag
32	19	0.62	84.60	0	0	1	1	Green flag
33	20	0.74	91.91	0	0	0	0	Green flag
34	20	0.66	83.93	0	0	1	1	Green flag
35	20	0.59	92.46	0	0	0	0	Green flag
36	20	0.62	89.64	0	0	0	0	Green flag