

Online Resource 1

SoF: a) Isometric and isotonic external and internal rotator strength values reported of the cases.

Study	LOE	Sport	Sample size	Age*	Gender F=female; M= male	Strength Dominant	Strength Non-Dominant	Weight	SMD (95%CI)
Cools et al., 2016. Observational study	3	Handball athletes and healthy controls	N=100	18-25	F=19	Isom ER Position (90/0) 0.91 (kg/f) (0.14) (SD)	Isom ER Position (90/0) 0.94 (kg/f) (0.12) (SD)	11.34 %	-0.23 (- 0.60. 0.14)
		Tennis	N=100	26-33	F=10	ECC ER Position (90/90) 2.1 (Nm kg) (0.5) (SD)	ECC ER Position (90/90) 2.0 (Nm kg) (0.6) (SD)	21.29 %	0.18 (- 0.19. 0.55)
		Volleyball	100	34-50	F=20	Isom ER Position (90/0) 1.9 (Kg/f) 0.4 (SD)	Isom ER Position (90/0) 1.9 (Kg/f) 0.4 (SD)	4.69%	0.00 (- 0.58. 0.58)
						ECC ER Position (90/90) 2.5 (Nm kg) 0.7 (SD)	ECC ER Position (90/90) 2.3 (Nm kg) 0.5 (SD)	21.09 %	0.33 (- 0.05. 0.70)
		Handball		18-25	M=22	Isom	Isom		

Study	LOE	Sport	Sample size	Age*	Gender F=female; M= male	Strength Dominant	Strength Non-Dominant	Weight	SMD (95%CI)
						ER Position (90/0) 1.6 (kg/f) 0.4 (SD)	ER Position (90/0) 1.5 (kg/f) 0.4 (SD)	4.25%	0.25 (- 0.36. 0.85)
						ECC ER Position (90/90) 2.2 (Nm kg) 0.5 (SD)	ECC ER Position (90/90) 2.0 (Nm kg) 0.6 (SD)	21.29 %	0.18 9- 0.19. 0.55)
		Tennis		26-33	M=11	Isom ER (90/0) 0.91 (kg/f) 0.14 (SD)	ER Position (90/0) 0.94 (kg/f) 0.12 (SD)	11.34 %	-0.23 (- 0.61. 0.15)
						ECC ER Position (90/90) 0.92 (kg/f) 0.22 (SD)	ECC ER Position (90/90) 0.94 (kg/f) 0.18 (SD)	8.01%	-0.10 (- 0.70. 0.51)
		Volleyball		34-50	M=	Isom ER Position (90/0) 0.87 (kg/f) 0.15 (SD)	Isom ER Position (90/0) 0.89 (kg/f) 0.19 (SD)	4.68%	-0.11 (- 0.69. 0.46)
						ECC ER Position (90/90) 1.02 (Nm kg) 0.20 (SD)	ECC ER Position (90/90) 1.11 (Nm kg) 0.16 (SD)	8.53%	-0.49 (- 1.07. 0.10)
Dos Santos De Andrade et al., 2010. Observational	3	Handball players female and males	27	23.0- 34	27	Ecc ER Position (90/0) 33.7 (Nm kg) 8.0 (SD)	ECC ER Position (90/0) 32.2 (Nm kg) 4.9 (SD)	5.47%	0.22 (- 0.31. 0.76)

Study	LOE	Sport	Sample size	Age*	Gender F=female; M= male	Strength Dominant	Strength Non-Dominant	Weight	SMD (95%CI)
Study	LOE		Sample size	Age, Mean/ (SD)	F Sample	Isom ER Position (90/0)	Isom ER Position (90/0)		SMD CL 95%
Riemann et al., 2010 Observational	3	Healthy volunteers	181 180	23.4 4.1 F	91 90	9.9 (kg/f) 3.0 (SD) 17.8 (kg/f) 5.2 (SD)	9.6 (kg/f) 4.1 (SD) 17.8 (kg/f) 5.2 (SD)	18.54 % 18.35 %	0.08 (- 0.2. 0.37) 0.00 (- 0.29. 0.29)
Peckitt et al., 2019 Observational cohort	3	Cricketers	36	20.- 28.0	4	155.0 (kg/f) 27.8 (SD)	147.2 (kg/f) 22.5 (SD)	N/A	N/A
Forthomme et al., 2018.	3		108	24 4		Ecc ER Position (90/90) 0.63 (Nm kg) 0.11 (SD)	Ecc ER Position (90/90) 0.61 (Nm kg) 0.13 (SD)	21.94 %	0.17 (- 0.10. 0.43)
Furness et al., 2018 Cohort.	2	Surfacing athletes	13	24.1 6.9	4	Isom ER (90/0) 1.81 (kg/f) 0.40 (SD)	Isom ER Position (90/0) 1.65 (kg/f) 0.34 (SD)	N/A	N/A

F=female; M= male; D= dominant; ND= non-dominant; ecc= eccentric; isom= isometric; ER= external rotation.
Age*= years in mean (SD); SD= standard deviation; D= dominant' ND= non-dominant.

Level of Evidence (LOE): OCEBM Levels of Evidence Working Group*. "The Oxford 2011 Levels of Evidence".
Oxford Centre for Evidence-Based Medicine. <http://www.cebm.net/index.aspx?o=5653> * OCEBM Table of Evidence.

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SoF: b) Eccentric external rotator strength of the cases.

Study	LOE	Sample size	Sport	Age*	S	AS	Study			Weight	SMD (95%CI)
							M	S	AS		
McDonough et al., 2014 Cohort	2	20	Rugby league	19.6 (1.77)	8	14	M=20	56.9	62.3	6.53%	0.27
								(Nm kg)	(Nm kg)	6.47%	(-0.60. 1.15)
								18.39	19.32		0.46
								(SD)	(SD)		(-0.42. 1.34)
								54.1	64.5		
Laudner, 2004 Observational study	3	22	Baseball league	22.9 3.45		11	M=22	-0.60	0.17	6.80%	0.13
								(Nm kg)	(Nm kg)		(-0.70. 0.97)
								6.16	4.90		
								(SD)	(SD)		
Heck et al., 2021. Cohort	2	15	Gymnasts	20.5 0.9	12	19	F=15	10.2	10.9	7.75%	0.19
								(Nm kg)	(Nm kg)		(-0.53. 0.92)
								2.9	3.9		
								(SD)	(SD)		
								9.8	10.2		
								(Nm kg)	(Nm kg)		
								2.2	3.5		

								(SD)	(SD)		
Forthomme et al., 2018 Cross sectional	3	108	Handball	24 4	51	57	M=108	0.62 (Nm kg) 0.10 (SD)	0.63 (Nm kg) 0.12 (SD)	11.12%	-0.09 (-0.47. 0.29)

S= symptomatic; AS= asymptomatic; ER= external rotators; ER= external rotators; N=Newton, N-M= Newton-meters, iso= isokinetic; ecc= eccentric, Age*= mean in years (SD); SD= standard deviation. Level of Evidence (LOE): OCEBM Levels of Evidence Working Group*. "The Oxford 2011 Levels of Evidence". Oxford Centre for Evidence-Based Medicine. <http://www.cebm.net/index.aspx?o=5653> * OCEBM Table of Evidence Working Group = Jeremy Howick, Iain Chalmers (James Lind Library), Paul Glasziou, Trish Greenhalgh, Carl Heneghan, Alessandro Liberati, Ivan Moschetti, Bob Phillips, Hazel Thornton, Olive Goddard, and Mary Hodgkinson.

SoF: c) IR and GIRD of the cases.

Study	LOE	Sample size	Sport	Age* Mean s and (SD) Age*	S	AS	IR Positio n Supine (90/90)	Means (SD) Degrees		Weight %	SM D (95 %CI)
								S Values expressed as means (SD)	AS Values expressed as means and (SD)		
Lala., B 2017. Prospective Observation al study.	3	36	Cricket professional league.	S= and AS= 23.56 (4.27) (SD)	8	23	D ND	51.30 (9.53) (SD) 58.11 (12.45) (SD)	51.48 (14.91) (SD) 64.09 (13.30) (SD)	8.94% 10.50%	-0.01 (0.82. 0.79) -0.44 (- 1.26- 0.37)
Rosa et al., 2019. Cross- sectional study	3	51	Members of the general public	S= 33.5 (10.1) (SD) AS= 27.4 (6.6) (SD)	2 5	28	IR	57.4 (12.4) (SD)	71.4 (14.7) (SD)	11.11%	-1.01 (- 1.58. - 0.44)
Lubiatowski 1 et al., 2018.	3	128	Professional handball	S= 25.0 (4.7)	8 7	41	IR	50.0 (15) (SD)	53.0 (13.0) (SD)	13.79% 12.86%	-0.21

Study	LO E	Sampl e size	Sport	Age* Mean s and (SD) Age*	S	A S	IR Positio n Supine (90/90)	Means (SD) Degrees		Weig ht %	SM D (95 %CI)
								S Values expressed as means (SD)	AS as means (SD)		
Cross sectional			Player and asymptoma- tic control group	(SD) AS= 25.0 (1.0) (SD)	5 7 4 9	41 41		37.0 (12.0) (SD) 49.0 (13) (SD)	53.0 (12.0) 52.0 (14.0) (SD)	13.79%	(- 0.58. 0.16) -1.32 (- 1.76.- 0.88) -0.22
Moreno- Perez et al., 2015 Analytical Cross sectional Study.	3	47	Tennis	S=25.6 (3.0) (SD) AS= 27.2 (4.3) (SD)	1 9	28	D	40.6 (11.6) (SD)	49.3 (11.3) (SD)	10.71%	-0.77 (- 1.37.- 0.16)
							ND	52.5 (10.6) (SD)	62.6 (11.0) (SD)	10.61%	-0.92 (- 1.53.- 0.30)
Marcondes et al., 2013 Analytical cross- sectional	3	49	Tennis	S= 25.9 (4.1) (SD) AS= 26.5 (3.6) (SD)	2 7	22	D	49.2 (5.6) (SD)	58.0 (7.7) (SD)	10.50%	-1.31 (1.93. -0.69)
							ND	65.4 (11.1) (SD)	64.1 (4.8) (SD)		0.14 (- 0.42. 0.71)
								Degrees Means (SD)			
Moreno- Perez et al., 2015 Observation al cross- sectional	3	47	Tennis professional players.	S= 25.6 (3.0) (SD) AS= 22.2 (4.3) (SD)	1 9	28	GIRD	11.9 (10.5) (SD)	13.3 (8.6) (SD)	20.20%	-0.14 (- 0.72. 0.44)
Lala, 2017 Prospective observation al study	3	36	Professional Cricketers	S and AS= 23.56 (4.27) (SD)	9	23	GIRD	7.78 (12.70) (SD)	12.61 (13.16) (SD)	11.42%	-0.36 (- 1.14. 0.41)

Study	LOE	Sample size	Sport	Age* Mean s and (SD) Age*	S	AS	IR Positio n Supine (90/90)	Means (SD) Degrees		Weight %	SMD (95 %CI)
								S Values expressed as means (SD)	AS as means (SD)		
Lubiatowski 1 et al., 2018 Cross sectional	3	128	Professional handball players and asymptomatic control	S=25 (4.7) (SD) AS=25 (1.0) (SD)	36	41	GIRD	6.0 (11) (SD)	5 (10) (SD)	34.25%	0.09 (- 0.35. 0.54)
								7 (11) (SD)	5 (10) (SD)	34.13%	-0.19 (- 0.64. 0.26)
								4 (11) (SD)	6 (10) (SD)		

IR= internal, GIRD= gleno humeral internal range deficit, age*= Age*= mean in years (SD); SD= standard deviation
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SoF: d) ER:IR strength ratios of the cases.

Author	Ratio ER: IR Values expressed as means (SD)		Isometri c	DCR Isotonic	Sport/ Healthy individua ls	No Participan ts	Pre- seaso n	Post seaso n
	D	ND						
Riemann et al., 2010	0.87 (0.21)	0.88 (0.25)	X		Members of the general public	M=181		
Riemann et al., 2010	0.86 (0.37)	0.85 (0.30)	X		Members of the general public	F=181		
Peckitt and McCaig 2019	0.87 (0.21)	0.92 (0.27)	X		Elite cricketers	M=18	X	
Peckitt and McCaig 2019	0.82 (0.17)	0.81 (0.24)	X		Elite cricketers.	M=18		X
Forthomme et al., 2018.	0.73 (0.12)	0.81 (0.13)		X Conn Er/conn IR at 60°/s	Hand ball players	M=108		
Forthomme et al., 2018.	1.20 (0.30)	1.30 (0.35)		X Mixed ratio Ecc ER/Con n IR at 60°/s.	Handball players.	M=108		
Author	Asymptomat ic	Symptomati c	Isometri c	Isotonic	Discipline			
McDonough et al., (L)	1.84 (0.5)	1.71 (0.26)		X	Rugby	M=20		
McDonough et al., 2014(R)	1.97 (0.29)	1.69 (0.44)		X	Rugby	M=20		
Maestroni et al.,	0.9 (0.2)	0.7 (0.2)	X		Members of the general public	67		

Author	Ratio ER: IR Values expressed as means (SD)		Isometri c	DCR Isotonic	Sport/ Healthy individua ls	No Participan ts	Pre- seaso n	Post seaso n
	D	ND						
Marcondes et al., (D)	0.82 (0.1)	0.74 (0.2)	X		Tennis	49		
Marcondes et al (ND)	0.99 (0.1)	0.98 (0.1)	X		Tennis	49		
Forthomm me et al	0.74 (0.12)	0.73 (0.12)		Conn ER at 60°/s X	Handball	108		
Forthomm e et al.,	0.79 (0.16)	0.77 (0.13)		Conn ER at 60°/s X	Handball	108		
Forthomm et al.,	1.21 (0.33)	1.19 (0.28)		Conn ER at 60°/s	Handball	108		
Skazalski et al	1.35 (0.18)	1.63 (0.53)		Conn ER at 60 °/s	Volleyball	81		

F=female; M= male; D= dominant; ND= non-dominant; ecc= eccentric; isom= isometric; ER= external rotation.

Age*= years in mean (SD); SD= standard deviation; D= dominant' ND= non-dominant, ER:IR = internal versus external ratio.

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SoF: e) IR; ER; TROM; GIRD; TAMD of the cases.

Authors	IR ROM Means (SD)		GIRD Means (SD)	ER Means (SD)		ERG Means (SD)	TROM Means (SD)	TAMD Means (SD)		Discipline
	D	ND	(ND-D)	D	ND	(ND-D)	D	(ND-D)	ND	
Peckitt et al.,	185.4 (41.9) (SD)	172.1 (46.3) (SD)	-13.3	155.0 (27.8) (SD)	147.2 (22.5) (SD)	-7.8	177.8 (13.5) (SD)	183.0 (14.4)	5.6	Cricket (Pre-season)
Peckitt et al.,	172.8 (46.3) (SD)	169.1 (52.6) (SD)	-3.1	139.2 (32.7) (SD)	128.8 (27.3) (SD)	11.2	197.8 (16.9) (SD)	197.0 (10.3) (SD)	-0.2	In season)
Lala, 2017	51.30 (9.53) (SD)	58.11 (12.45) (SD)	7.78 (12.70) (SD)	121.60 (18.10) (SD)	114 (20) (SD)	0 (-6-4) (SD)	172.90 (19.65) (SD)	178 (26) (SD)		Cricket S
Lala et al., 2017	51.48 (14.91) (SD)	64.09 (13.30) (SD)	12.61 (13.16) (SD)	122.0 (19) (SD)	120 (25) (SD)	-2 (-16: -8) (SD)	173.09 (20.38)	184.91 (19.53)		Cricket AS
Marcondes et al., 2013	49.2 (8.6) (SD)	65.4 (11.1) (SD)	8.8	107.1 (7.7) (SD)	90.5 (3.3) (SD)	-16.6	156.3	155.9	-0.4	Tennis S
Marcondes et al., 2013	58.0 (7.7) (SD)	64.1 (4.8) (SD)	6.1	97.3 (4.6) (SD)	91.8 (2.9) (SD)	-5.5	155.3	155.9	0.6	Tennis AS
Moreno-Perez et al., 2015	40.6 (11.6) (SD)	49.3 (11.3) (SD)	8.7							Tennis S
Moreno-Perez et al., 2015	51.5 (10.6) (SD)	62.6 (11.0) (SD)	13.3							Tennis As

Authors	IR ROM Means (SD)		GIRD Means (SD)	ER Means (SD)		ERG Means (SD)	TROM Means (SD)	TAMD Means (SD)		Discipline
	D	ND	(ND-D)	D	ND	(ND-D)	D	(ND-D)	ND	
Rosa et al., 2019	71.4 (14.7) (SD)				102.6 (15.3) (SD)			174.0		(AS)
Author	IR Means (SD)	GIRD Means (SD)	ER Means (SD)	ERG Means (SD)	TAM Means (SD)	TAMD Means (SD)	Symptoms	Discipline		
Lubiatowski et al., 2018	50 (15) (SD)	6 (11) (SD)	88 (21) (SD)	3 (11) (SD)	138 (32) (SD)	4 (14) (SD)	Shoulder pain	Handball (S)		
Lubiatowski et al., 2018	53.0 (12.0) (SD)	5 (10) (SD)	94 (15) (SD)	5 (10) (SD)	146 (24) (SD)	1 (18) (SD)	Shoulder pain	Handball (AS)		
Lubiatowski et al., 2018 S	37 (12) (SD)	7 (11) (SD)	76 (26) (SD)	1 (17) (SD)	110 (34) (SD)	6 (20) (SD)	Internal impingement	Handball (AS)		
Lubiatowski et al., 2018	53 (12) (SD)	5 (10) (SD)	94 (14) (SD)	4 (10) (SD)	148 (22) (SD)	1 (11) (SD)	Internal impingement	Handball (AS)		
Lubiatowski et al., 2018 S	49 (13) (SD)	4 (11) (SD)	94 (16) (SD)	7 (7) (SD)	14 (26) (SD)	-3 (9) (SD)	Partial rotator cuff tear	Handball (AS)		
Lubiatowski et al., 2018	52 (14) (SD)	6 (10) (SD)	9 (18) (SD)	3 (12) (SD)	143 (28) (SD)	3 (13) (SD)	Partial rotator cuff tear	Handball (AS)		

F=female; M= male; D= dominant; ND= non-dominant; ecc= eccentric; isom= isometric; ER= external rotation. Age*= years in mean (SD); SD= standard deviation; D= dominant' ND= non-dominant. IR=internal rotation, TROM= total range of motion, GIRD, gleno humeral internal motion deficit, TAMD, total arch of motion deficit.

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SoF: f) Studies investigating pectoralis minor (PM) muscle of the cases and the controls.

Authors	Sport/ Members of the general public	PML (pectoralis minor muscle length) (Kendall position)	PMI (pectoralis minor muscle index) (Borstad position)	Novel testing position	Symptomatic (S) Asymptomatic (AS) Dominant (D) Non-dominant (ND)	Other variables
Lala, 2017	Cricket	X			S and AS	TROM, ER, GIRD
Olivier et al., 2020	Cricket	X			D and ND	TAROM, ER, GIRD
Olivier et al., 20148	Cricket	X			S and AS	ER, IR, TROM
De Souza, 2019	Swimming				AS	
Bhati et al., 2007	Competitive sportsmen				S	Pectoralis minor enthesi
Morais and Cruz, 2016	Overhead athletes				S	Scapula dyskinesia
Grimes et al., 2020	Soc		X		S and AS	Scapula dyskinesia Scapula assistance test (SAT)
Kim et al., 2020	Office workers			X		Shortness of PM
Reeser et al., 2010	Athletes			X		Scapula dyskinesia, GIRD, ER, IR strength
Finley et al., 2017	Soc		X		S and AS	Resting and activated length of PM during arm elevation
Ebaugh et al., 2018	Soc			X	S and AS	Resting and activated length of Pm during scapular plane elevation
Bond, 2016	Soc	X	X		S and AS	Difference between PM Length testing and PMI testing. Scapula dyskinesia.
Yeşilyaprak et al., 2016.	Soc		X		S and AS	Upper trapezius length and scapula dyskinesia test (SDT)
Lee et al., 2015	Soc		X		AS	Serratus anterior muscle strength,

						posterior capsule tightness and scapula dyskinesia
Turgut and Baltaci, 2018	Soc	X			S and AS	Scapula dyskinesia in elevation and posterior capsule tightness.
Navarro-Ledesma et al., 2019	Soc	X			S and AS	Scapula dyskinesia and posterior shoulder tightness And acromio-humeral distance (AHD)
Muhle et al., 2020	Soc		X		S and AS	Strength of lower trapezius
Struyf et al., 2014	Soc		X		S and AS	Intra -and inter -rater reliability
Sebastian et al., 2017	Soc	X			S and AS	Scapula backwards test (SBT)
Harrington et al., 2014	Swimming		X		S and AS and D and ND	IR, ER and joint position test JPS
Rosa et al., 2019	Soc		X		S and AS	Gleno-humeral (GHJ) and ER
Lee et al., 2020	Soc		X		S and AS	Scapular reposition test (SRT) VAS (Pain) and isometric elevation strength

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