Physical demands of tennis across the different court surfaces, performance levels, and sexes: a systematic review with meta-analysis

Sports Medicine

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Supplementary File 8. Complete overview of the quantitative synthesis (meta-analysis)

3.1 Duration of play

	Outcome (Description)	Studies included in the meta- analysis	Number of studies (n)	Number of outcomes (n)	Effect size (95%Cl)	Test for (Subgroup) Differences (p value)	95% PI _↓	l² (%)	Sensitivity analysis for ρ	Sensitivity analysis for imputed SDs +
			Match o	luration						
Male players	Match duration (min)	Filipcic et al. (2021)	7	8	M: 89.68	0.696	(65.67,	61.94	Very slight	M: 91.83
	(men/international hard	Hoppe et al. (2014)			(78.96,		122.48)		changes in	(78.99,
	+ clay surfaces/best of				101.86)				the estimates	106.76)
	3)	Hornery et al. (2007)							of the means	
		Mackie (2013)							and standard	
		/							errors.	

	Mendez-Villanueva et al. (2007)								
	Moreno-Perez et al. (2019)								
	Stare et al. (2015)								
	Yusoff and Krasilshchikov (2021)								
Match duration (min)	Filipcic et al. (2021)	5	5	M: 92.95‡	NA	(52.86,	88.10	Very slight	M: 96.48
(men/international hard surfaces/best of 3)	Hornery et al. (2007)			(73.11, 118 17)		163.42)		changes in the estimates	(69.78 <i>,</i> 133.41)
	Mackie (2013)			110.17)				of the means	133.41)
	Moreno-Perez et al. (2019)							and standard errors	
	Stare et al. (2015)							chors.	
Match duration (min)	Bergeron et al. (2007)	9	13	M: 77.98	0.876	(52.51,	84.65	Very slight	M: 77.98
(men/national hard +	Filipcic et al. (2021)			(69.16 <i>,</i> 87 91)		115.80)		changes in the estimates	(69.16, 87 91)
	Gallo-Salazar et al. (2019)			07.51				of the means	07.017
	Hoppe et al. (2014)							and standard errors.	
	Kilt and Arslan (2017)							chors.	
	Perri et al. (2016)								
	Ponzano et al. (2017)								
	Stare et al. (2015)								
	Torres-Luque et al. (2011)								
Match duration (min)	Bergeron et al. (2007)	7	11	M: 76.62	NA	(44.13,	88.90	Very slight	M: 76.62
men/national hard	Filipcic et al. (2021)			(64.56 <i>,</i> 90.93)		133.02)		changes in the estimates	(64.56 <i>,</i> 90.93)
	Gallo-Salazar et al. (2019)			56.56)				of the means	50.507
	Perri et al. (2016)							and standard errors.	
	Ponzano et al. (2017)								
	Stare et al. (2015)								
	Torres-Luque et al. (2011)								
Match duration (min)	Hoppe et al (2014)	3	3	M: 78.55	NA	(61.65,	0	Very slight	NA
(men/national clay surfaces/best of 3)	Kilt and Arslan (2017)			(70.34 <i>,</i> 87.72)		100.09)		changes in the estimates	
	Ponzano et al. (2017)			52				of the means and standard errors.	

Female players	Match duration (min) (women/international all surfaces/best of 3)	Fernandez-Fernandez et al. (2007) Fernandez-Fernandez et al. (2008) Mackie (2013) Morante and Brotherhood (2005) Sánchez-Pay et al. (2021)	5	9	M: 87.95‡ (71.72, 107.85)	0.77	(50.02, 154.65)	80.34	Very slight changes in the estimates of the means and standard errors.	NA
	Match duration (min) (women/international hard surfaces/best of 3)	Fernandez-Fernandez et al. (2007) Mackie (2013) Morante and Brotherhood (2005) Sánchez-Pay (2021)	4	5	M: 98.89‡ (75.74, 129.13)	NA	(55.54, 176.10)	66.83	Very slight changes in the estimates of the means and standard errors.	NA
	Match duration (min) (women/national hard surfaces/best of 3)	Galé-Ansodi (2017a) Perri et al. (2016) Stare et al. (2015) Torres-Luque et al. (2011)	4	5	M: 72.74‡ (48.66, 108.74)	NA	(27.88, 189.78)	88.85	Very slight changes in the estimates of the means and standard errors.	M: 75.88 (40.57, 141.91)
Male vs. female players	Match duration (min) (hard surfaces)	Perri et al. (2016) Stare et al. (2015) Torres-Luque et al. (2011)	3	4	MD: 8.8‡ (1.15, 16.4)	0.039	(1.65, 15.95)	0	Very slight changes in the estimates of the means and standard errors.	10.2 (-16.1, 36.5)
			Rally Du	ration						
Male players	Rally duration (s) (men international/hard + grass + clay surfaces)	Carboch et al. (2019) Filipcic et al. (2021) Hornery et al. (2007) Mackie (2013) Mendez-Villanueva et al. (2007) Morante and Brotherhood (2005) O'Donoghue and Ingram (2001) O'Donoghue and Liddle (1998) Stare et al. (2015) Takahashi et al. (2006) Yusoff & Krasilshchikov (2021)	11	21	M: 5.53 (4.87, 6.28)	0.00962	(3.29, 9.29)	88.16	Very slight changes in the estimates of the means and standard errors.	M: 5.65 (4.95, 6.45)
	Rally duration (s)	Carboch et al. (2019)	8	9	M: 5.63 (4.87, 6.51)	NA	(3.87, 8.21)	89.15	Very slight changes in	M: 5.74 (4.92, 6.69)

	(men international/hard	Filipcic et al. (2021)							the estimates	
	surfaces)	Hornery et al. (2007)							of the means	
		Mackie (2013)							errors.	
		Morante and Brotherhood (2005)								
		O'Donoghue and Ingram (2001)								
		Stare et al. (2015)								
		Takahashi et al. (2006)								
	Rally duration (s)	Carboch et al. (2019)	6	6	M: 7.09‡	NA	(5.99,	0	Very slight	NA
	(men international/clay surfaces)	Hornery et al. (2007)			(6.23, 8.06)		8.39)		changes in the estimates	
		Mendez-Villanueva et al. (2007)							of the means	
		O'Donoghue and Ingram (2001)							and standard errors.	
		O'Donoghue and Liddle (1998)								
		Takahashi et al. (2006)								
	Rally duration (s)	Carboch et al. (2019)	5	5	M: 4.27‡	NA	(1.82,	93.33	Very slight	NA
	(men international/grass	Morante and Brotherhood (2005)			(3.12, 5.85)		9.99)		changes in the estimates	
	surfaces)	O'Donoghue and Ingram (2001)							of the means	
		O'Donoghue and Liddle (1998)							and standard errors.	
		Takahashi et al. (2006)								
	Rally duration (s)	Filipcic et al. (2021)	6	8	M: 8.50‡	0.0809	(6.07,	69.98	Very slight	M: 8.86
	(men national/hard + clay surfaces)	Gallo-Salazar et al. (2019)			(7.22, 10.01)		11.90)		changes in the estimates	(7.51, 10.46)
		Kilit and Arslan (2017)							of the means	
		Kilit and Arslan (2018)							and standard errors.	
		Stare et al. (2015)								
		Torres-Luque et al. (2011)								
	Rally duration (s)	Filipcic et al. (2021)	5	6	M: 8.28‡	NA	(5.73,	71.51	Very slight	M: 8.86
	(men national/hard surfaces)	Gallo-Salazar et al. (2019)			(6.90, 9.95)		11.98)		changes in the estimates	(7.51, 10.46)
		Kilit and Arslan (2018)							of the means	
		Stare et al. (2015)							and standard errors.	
		Torres-Luque et al. (2011)								
Female players	Rally duration (s)	Carboch and Plachá (2018)	7	13	M: 6.36	0.0246	(3.67,	90.16	Very slight	NA
					(5.35, 7.56)		11.02)		changes in	

	(women international/ hard + grass + clay surfaces)	Fernandez-Fernandez et al. (2007) Fernandez-Fernandez et al. (2008) Mackie (2013)							the estimates of the means and standard errors.	
		Morante and Brotherhood (2005)								
		O'Donoghue and Ingram (2001)								
		O'Donognue and Liddle (1998)								
	Rally duration (s) (women	Carboch and Plachá (2018)	5	7	M: 6.37‡ (5.01, 8.11)	NA	(3.27, 12.43)	92.96	Very slight changes in	NA
	international/hard	Fernandez-Fernandez et al. (2007)			(3.01, 0.11)		12.15)		the estimates	
	surfaces)	Mackie (2013)							of the means	
		Morante and Brotherhood (2005)							errors.	
		O'Donoghue and Ingram (2001)								
	Rally duration (s)	Fernandez-Fernandez et al. (2008)	3	3	M: 8.82‡	NA	(2.75,	0	Very slight	NA
	(women international/clay	O'Donoghue and Ingram (2001)			(5.18, 15.01)		28.34)		changes in the estimates	
	surfaces)	O'Donoghue and Liddle (1998)							of the means and standard	
	Rally duration (s)	Morante and Brotherhood (2005)	3	3	M: 5.67‡	NA	(3.89,	0	Very slight	NA
	(women	O'Donoghue and Ingram (2001)			(4.78, 6.73)		8.27)		changes in	
	surfaces)	O'Donoghue and Liddle (1998)							of the means and standard errors.	
Male vs. female	Rally duration (s)	Carboch et al. (2020)	5	11	MD: -0.475‡	0.41	(-3.28,	74.78	Very slight	NA
players	(international/hard + grass + clay surfaces)	Mackie (2013)			(-1.99, 1.04)		2.33)		changes in the estimates	
	gruss - cluy surfaces	Morante and Brotherhood (2005)							of the means	
		O'Donoghue and Ingram (2001)							and standard	
		O'Donoghue and Liddle (1998)							enors.	
	Rally duration (s)	Carboch et al. (2020)	4	6	MD: -0.399‡	0.498	(-3.86,	82.17	Very slight	NA
	(international/hard	Mackie (2013)			(-2.05, 1.26)		3.06)		changes in	
	surfaces	Morante and Brotherhood (2005)							of the means	
		O'Donoghue and Ingram (2001)							and standard	
	Rally duration (s)	Morante and Brotherhood (2005)	3	3	MD: -1.56‡	0.197	(-8.02,	87.29	Very slight	NA
	(international/grass surfaces)	O'Donoghue and Liddle (1998)			(-5.34, 2.22)		4.89)		changes in the estimates of the means	

		O'Donoghue and Ingram (2001)							and standard errors.	
			Effective pla	iying time						
Male players	Effective playing time (s)	Yusoff and Krasilshchikov (2021)	8	13	M: 18.55	0.563	(11.69,	90.49	Very slight	M: 18.88
	hard + grass + clay	Filipcic et al. (2021)			(15.83, 21.73)		29.43)		the estimates	(15.47, 23.04)
	surfaces)	Mackie (2013)							of the means	
		Mendez-Villanueva et al. (2007)							and standard errors.	
		Morante and Brotherhood (2005)								
		O'Donoghue and Liddle (1998)								
		Stare et al. (2015)								
		Whiteside and Reid (2017)								
	Effective playing time (s)	Filipcic et al. (2021)	5	8	M: 18.20‡	NA	(10.43,	92.45	Very slight	M: 16.72
	(men international/hard surfaces)	Mackie (2013)			(14.97, 22.13)		31.77)		changes in the estimates	(13.15 <i>,</i> 21.26)
	54.14565)	Morante and Brotherhood (2005)							of the means	
		Stare et al. (2015)							and standard errors	
		Whiteside and Reid (2017)							chois.	
	Effective playing time (s)	Filipcic et al. (2021)	6	8	M: 26.16	0.86	(18.4,	87.53	Very slight	M: 25.89
	(junior men national/hard + clav	Gallo-Salazar et al. (2019)			(23.28 <i>,</i> 29.41)		37.2)		changes in the estimates	(22.31 <i>,</i> 30.06)
	surfaces)	Kilit and Arslan (2017)			23.71)				of the means	50.007
		Kilit and Arslan (2018)							and standard	
		Stare et al. (2015)							enois.	
		Torres-Luques et al. (2011)								
	Effective playing time (s)	Filipcic et al. (2021)	5	6	M: 25.63	NA	(15.80,	90.69	Very slight	M: 25.17
	(junior men	Gallo-Salazar et al. (2019)			(21.38, 30.74)		41.59)		changes in	(19.47, 32 53)
	national/natu surfaces/	Kilit and Arslan (2018)			50.747				of the means	52.55)
		Torres-Luques et al. (2011)							and standard	
		Stare et al. (2015)							enois.	
Female players	Effective playing time (s)	Fernandez-Fernandez et al. (2007)	6	11	M: 20.04	0.469	(13.18,	88.62	Very slight	M: 19.57
	(women international/	Fernandez-Fernandez et al. (2008)			(17.25,		30.46)		changes in	(15.22,
	surfaces)	Mackie (2013)			23.271				of the means	23.101
		Morante and Brotherhood (2005)							and standard errors.	

		O'Donoghue and Liddle (1998)								
		Whiteside and Reid (2017)								
	Effective playing time (s)	Fernandez-Fernandez et al. (2007)	4	7	M: 20.02‡	NA	(10.40,	92.31	Very slight	M: 19.09
	(women international/hard	Mackie (2013)			(15.38, 26.07)		38.56)		changes in the estimates	(12.62, 28.88)
	surfaces)	Morante and Brotherhood (2005)			20.077				of the means	20.007
		Whiteside and Reid (2017)							and standard errors.	
Male vs. female	Effective playing time	Mackie (2013)	4	9	MD: -2.02‡	0.215	(-	82.64	Very slight	MD: -1.16
players	(%) (international/ hard +	Morante and Brotherhood (2005)			(-6.12, 2.08)		10.66, 6.63)		changes in the estimates	(-7.82, 5.49)
	grass + clay surfaces)	O'Donoghue and Liddle (1998)					0.007		of the means	
		Whiteside and Reid (2017)							and standard errors.	
	Effective playing time	Mackie (2013)	3	6	MD: -1.2‡	0.295	(-6.92,	46.30	Very slight	NA
	(%) (international/ hard	Morante and Brotherhood (2005)			(-4.89, 2.5)		4.53)		changes in the estimates	
	surfaces)	Whiteside and Reid (2017)							of the means	
									and standard	
									errors.	

3.2 Movement characteristics

	Outcome (Description)	Studies included in meta-analysis	Number of studies (n)	Number of outcomes (n)	Effect size (95%Cl)	Test for (Subgroup) Differences (p value)	95% PI ↓	l² (%)	Sensitivity analysis for ρ	Sensitivity analysis for imputed SDs +
		Distanc	e covered pe	r match						
Male players	Distance covered per	Cui et al. (2020a)	4	11	M:	0.533	(1243.35,	85.17	Very slight	M: 2382.11
	match (m)	Kovalchik and Reid (2017)			2292.29‡		4226.16)		changes in	(1567.46,
	(men/international hard +				(1767.40,				the estimates	3620.14)
	grass + clay surfaces/best	Maquirriain et al. (2016)			2973.07)				of the means	
	of 5)	Reid et al. (2016)							and standard errors.	
	Distance covered per	Cui et al. (2020a)	3	6	M:	NA	(1372.68,	26.78	Very slight	M: 2189.41
	match (m) (men/international hard	Kovalchik and Reid (2017)			2164.33‡ (1775.43,		3412.53)		changes in the estimates	(1401.48, 3420.32)
	surfaces/best of 5)	Reid et al. (2016)			2638.40)				of the means	

									and standard	
	Distance covered per match (m)	Filipcic et al. (2021) Galé-Ansodi et al. (2017b)	8	12	M: 3313.59	0.886	(2247.86 <i>,</i> 4884.59)	85.55	errors. Very slight changes in	NA
	(men/national hard + clay surfaces/best of 3)	Gallo-Salazar et al. (2019) Hoppe et al. (2014)			(2870.06, 3825.67)				the estimates of the means and standard	
		Hoppe et al. (2016) Kilit and Arslan (2017)							enois.	
		Kilit and Arslan (2018) Perri et al. (2018)								
	Distance covered per match (m) (men/national hard surfaces/best of 3)	Filipcic et al. (2021) Galé-Ansodi et al. (2017b) Gallo-Salazar et al. (2019) Kilit and Arslan (2018) Perri et al. (2018)	5	8	M: 3200.72‡ (2322.31, 4411.40)	NA	(1363.13 <i>,</i> 7515.53)	92.65	Very slight changes in the estimates of the means and standard errors.	NA
	Distance covered per match (m) (men/national clay surfaces/best of 3)	Hoppe et al. (2014) Hoppe et al. (2016) Kilit and Arslan (2017) Kilit and Arslan (2018)	4	4	M: 3272.27‡ (3063.74, 3494.99	NA	(2940.46, 3641.51)	0	Very slight changes in the estimates of the means and standard errors.	NA
Female players	Distance covered per match (m) (women/international hard + grass + clay surfaces)	Cui et al. (2018) Kovalchik and Reid (2017) Reid et al. (2016)	3	7	M: 1249.13‡ (766.60, 2035.39)	NE	(383.24, 4071.43)	87.02	Very slight changes in the estimates of the means and standard errors.	M: 1304.77 (652.42, 2609.40)
	Distance covered per match (m) (women/national hard surfaces)	Galé-Ansodi et al. (2017a) Galé-Ansodi et al. (2017b) Perri et al. (2018)	3	4	M: 2966.77‡ (2268.63, 3879.76)	NA	(1473.06, 5975.13)	67.73	Very slight changes in the estimates of the means and standard errors.	NA
			Distance Covere	ed per Set						
Male players	Distance covered per set (m) (men/international all surfaces)	Cui et al. (2020a) Pereira et al. (2016a) Reid et al. (2016)	3	11	M: 606.97‡ (443.07, 831.51)	0.218	(278.55, 1322.62)	78.10	Very slight changes in the estimates of the means	NA

									and standard	
									errors.	
Female players	Distance covered per set	Cui et al. (2020a)	2	5	M: 573.6‡	NE	NE	84.70	Very slight	NA
	(m) (women/international all	Reid et al. (2016)			(372.7,				changes in	
	surfaces)				002.77				of the means	
									and standard	
			Distance covered	per point					enois.	
Male players	Distance covered per	Cui et al. (2020a)	6	16	M: 9.60	0.925	(5.56,	93.71	Very slight	M: 9.47
	point (m) (men/international bard +	Filipcic et al. (2021)			(7.56 <i>,</i> 12 19)		16.57)		changes in the estimates	(8.16, 10.99)
	grass + clay surfaces)	Kovalchik and Reid (2017)			12.15)				of the means	
		Martínez-Gallego et al. (2019)							and standard	
		Pereira et al. (2016)							enois.	
		Whiteside et al. (2015)								
	Distance covered per	Cui et al. (2020a)	5	10	M: 9.66‡	NA	(5.55,	94.50	Very slight	M: 9.53
	point (m) (men/international hard	Filipcic et al. (2021)			(7.59 <i>,</i> 12 30)		16.83)		changes in the estimates	(8.27, 11.00)
	surfaces)	Kovalchik and Reid (2017)			12.50)				of the means	
		Martínez-Gallego et al. (2019)							and standard	
		Whiteside et al. (2015)							chors.	
Female players	Distance covered per	Cui et al. (2018)	3	7	M: 8.22‡	NE	(1.70,	96.70	Very slight	9.36
	point (m) (women/international all	Kovalchik and Reid (2017)			(4.44 <i>,</i> 15.20)		39.79)		changes in the estimates	(5.25, 16.70)
	surfaces)	Reid et al. (2016)			10.120)				of the means	
									and standard errors.	
	Distance covered per	Cui et al. (2018)	3	5	M: 8.28‡	NE	(1.69,	96.67	Very slight	9.44
	point (m) (women/international	Kovalchik and Reid (2017)			(4.42 <i>,</i> 15 50)		40.52)		changes in the estimates	(4.78 18.63)
	hard surfaces)	Reid et al. (2016)			13.30)				of the means	
									and standard errors	
			Distance per m	inute					enois.	
Male players	Distance per minute	Fernández-Elias et al. (2020)	5	9	M: 48.22‡	NA	(41.46,	66.27	Very slight	NA
	(men/national hard surfaces)	Galé-Ansodi et al. (2017b)			(45.34 51.28)		56.08)		changes in the estimates	
		Galé-Ansodi et al. (2018)			02.20,				of the means	
		Gallo-Salazar et al. (2019)							and standard errors.	
									01015.	

		Perri et al. (2018)								
Female players	Distance per minute	Galé-Ansodi et al. (2017a)	4	5	M: 45.44‡	NA	(35.76,	87.74	Very slight	NA
. ,	(women/national hard	Galé-Ansodi et al. (2017b)			(41.52,		57.73)		changes in	
	surfaces)	Galé-Ansodi et al. (2018)			49.72)				of the means	
		Perri et al. (2018)							and standard	
Malays fomale	Distance per minute (m)	Galé-Ansodi et al. (2017h)	3	4	MD: 2 36‡	0.0111	(1 50	0	errors. Very slight	NA
players	(national/hard surfaces)	Galé-Ansodi et al. (2018)			(1.38,	0.0111	3.22)	0	changes in	
picyere		Perri et al. (2018)			3.34)				the estimates	
									and standard	
									errors.	
Mala players	Peak running speed (m/s)	Fernández-Elias et al. (2020)	Peak Running S	peed 5	M: 5.46±	ΝΔ	(2.95	81.83	Very slight	M: 5.81
iviale players	(men/international/hard	Filincic et al. (2021)	-	5	(4.04,	NA .	10.12)	01.05	changes in	(4.91, 6.89)
	surfaces)	Kovalchik and Reid (2017)			7.38)				the estimates	
		Whiteside et al. (2015)							and standard	
							10 - 50		errors.	
	Peak running speed (m/s) (men/national/hard + clav	Filipcic et al. (2021)	6	7	M: 4.82 (4.28.	0.11	(3.58 <i>,</i> 6.49)	92.82	Very slight changes in	NA
	surfaces)	Galé-Ansodi et al. (2017b)			5.43)				the estimates	
		Galé-Ansodi et al. (2018)							of the means and standard	
		Gallo-Salazar et al. (2019)							errors.	
		Hoppe et al. (2014)								
		Hoppe et al. (2016)								
	Peak running speed (m/s)	Filipcic et al. (2021)	4	5	M: 5.06‡	NA	(3.32	94.45	Very slight	NA
	surfaces)	Galé-Ansodi et al. (2017b)			(4.27 <i>,</i> 5.99)		7.71)		the estimates	
		Galé-Ansodi et al. (2018)							of the means	
		Gallo-Salazar et al. (2019)							errors.	
Female players	Peak running speed (m/s)	Galé-Ansodi et al. (2017a)	3	3	M: 4.18‡	NA	(3.36,	64.94	Very slight	NA
	(women/national/hard surfaces)	Galé-Ansodi et al. (2017b)			(3.83 <i>,</i> 4.55)		5.20)		changes in the estimates	
	54.14665)	Galé-Ansodi et al. (2018)							of the means	
									and standard errors.	
			Average Running	Speed						
Male players	Average running speed	Filipcic et al. (2021)	3	4	M: 2.07‡	NA	(0.05,	98.45	Very slight	M: 1.99
	(m/s)						90.22)		changes in	(0.47 <i>,</i> 8.35)

	(men/international hard	Martinez-Gallego et al. (2019)			(0.57,				the estimates	
	surfaces)	Reid et al. (2016)			7.62)				of the means and standard errors.	
	Average running speed	Filipcic et al. (2021)	8	10	M: 1.13	0.0473	(0.16,	99.81	Very slight	NA
	(m/s) (men/national hard + clav	Galé-Ansodi et al. (2017b)			(0.63 <i>,</i> 2.04)		7.85)		changes in the estimates	
	surfaces)	Galé-Ansodi et al. (2018)			- ,				of the means	
		Gallo-Salazar et al. (2019)							and standard errors.	
		Hoppe et al. (2014)								
		Hoppe et al. (2016)								
		Kilit and Arslan (2017)								
		Kilit and Arslan (2018)								
	Average running speed	Filipcic et al. (2021)	5	6	M: 1.50‡	NA	(0.16,	99.79	Very slight	NA
	(m/s) (men/national hard	Galé-Ansodi et al. (2017b)			(0.58 <i>,</i> 3.90)		14.47)		changes in the estimates	
	surfaces)	Galé-Ansodi et al. (2018)			0.00)				of the means	
		Gallo-Salazar et al. (2019)							and standard errors.	
		Kilit and Arslan (2018)								
	Average running speed	Hoppe et al. (2014)	4	4	M:0.70‡	NA	(0.7, 0.7)	0	Very slight	NA
	(m/s) (men/national clay	Hoppe et al. (2016)			(0.7, 0.7)				changes in the estimates	
	surfaces)	Kilit and Arslan (2017)							of the means	
		Kilit and Arslan (2018)							and standard errors.	
Female players	Average running speed	Galé-Ansodi et al. (2017a)	3	3	M: 2.89‡	NA	(2.44,	30.77	Very slight	NA
	(m/s) (women/national hard	Galé-Ansodi et al. (2017b)			(2.69, 3.11)		3.43)		changes in the estimates	
	surfaces)	Galé-Ansodi et al. (2018)			,				of the means and standard errors.	

3.3 Stroke characteristics

Outcome	Studies included in meta-analysis	Number	Number	Effect	Test for	95% PI	l ²	Sensitivity	Sensitivity
(Description)		of	of	size	(Subgroup)	Ŧ	(%)	analysis	analysis
				(95%CI)	Differences			for ρ	for

			studies (n)	outcomes (n)		(p value)				imputed SDs ⊦
			Strokes per ral	lly						
Male players	Strokes per rally (men/international/all surfaces)	Carboch et al. (2019)	8	14	M: 4.11‡	0.716	(2.47,	82.66	Very slight	M: 4.10
		Filipcic et al. (2021)			(3.41, 4.95)		6.85)		the estimates of the means and standard errors.	(3.24, 5.19)
		Hornery et al. (2007)								
		Kovalchik and Reid (2017)								
		Mendez-Villanueva et al. (2007)								
		Stare et al. (2015)								
		Takahashi et al. (2006)								
		Yusoff & Krasilshchikov (2021)								
	Strokes per rally	Carboch et al. (2019)	6	7	M: 4.24‡	NA	(2.41, 7.47)	89.21	Very slight	M: 4.29
	(men/international/hard surfaces)	Filipcic et al. (2021)			(3.43, 5.25)				changes in the	(3.13, 5.89)
		Hornery et al. (2007)							estimates of	
		Kovalchik and Reid (2017)							the means and standard	
		Takahashi et al. (2006)							errors.	
		Stare et al. (2015)								
	Strokes per rally (men/international/clay	Carboch et al. (2019)	4	4	M: 4.76‡	NA	(2.47, 9.18)	48.36	Very slight changes in the	NA
		Hornery et al. (2007)			(3.41 <i>,</i> 6.66)					
		Mendez-Villanueva et al. (2007)			,				estimates of	
		Takahashi et al. (2006)							the means and standard	
									errors.	
	Strokes per rally	Gallo-Salazar et al. (2019)	5	7	M: 4.92‡	0.328	(1.72 <i>,</i> 14 10)	99.01	Very slight	M: 4.88
	+ clay surfaces)	Kilit and Arslan (2017)			7.50)		14.10)		the	(2.00, 0.05)
		Kilit and Arslan (2018)							estimates of	
		Stare et al. (2015)							and standard	
		Torres-Luque et al. (2011)							errors.	
	Strokes per rally (men juniors/national/hard surfaces)	Gallo-Salazar et al. (2019)	4	5	M: 4.63‡ (2.63 <i>,</i> 8.15)	NA	(1.19,	99.26	Very slight	M: 4.44 (1.63, 12.11)
		Kilit and Arslan (2018)					18.02)		the	
		Stare et al. (2015)			•				estimates of	
		Torres-Luque et al. (2011)							the means	

									and standard	
									errors.	
Female players	Strokes per rally	Carboch et al. (2018)	4	5	M: 3.86‡	0.0415	(1.52 <i>,</i> 9.80)	71.62	Very slight	M: 3.26 (1 31 8 16)
	+ clay surfaces)	Fernandez-Fernandez et al. (2007)			6.22)		5.007		the	(1.51, 0.10)
		Fernandez-Fernandez et al. (2008)							estimates of	
		Kovalchik and Reid (2017)							the means	
									errors.	
			First Serve Speed	1						
Male players	First Serve Speed (km/h) (men/international all surfaces)	Brown (2021)	6	19	M: 182.42	0.099	(171.20,	95.25	Very slight	M: 183.01
		Cui et al. (2020a)			(178.06, 186.89)		194.38)		changes in the	(177.88, 188.30)
		Fitzpatrick et al. (2019)							estimates of	
		Hornery et al. (2007)							the means and standard errors.	
		Kovalchik and Reid (2017)								
		Reid et al. (2016)								
	First Serve Speed (km/h)	Cui et al. (2020a)	4	11	M:	NA	(169.20,	84.91	Very slight	M: 182.73,
	(men/international hard surfaces)	Hornery et al. (2007)			181.93‡ (176.58, 187.44)		195.61)		changes in	(174.86, 190.96)
		Kovalchik and Reid (2017)							estimates of	
		Reid et al. (2016)							the means	
									and standard errors.	
	First Serve Speed (km/h)	Cui et al. (2020a)	3	7	M:	NA	(153.79,	84.73	Very slight	NA
	(men/international clay surfaces)	Fitzpatrick et al. (2019)			180.02‡ (168.87, 191.92)		210.73)		changes in	
		Hornery et al. (2007)							estimates of	
									the means	
									and standard errors	
Female players	First Serve Speed (km/h)	Brown (2021)	4	5	M:	NE	(143.69,	94.60	Very slight	M:156.87
	(women/international all surfaces)	Fitzpatrick et al. (2019)			156.13‡		169.64)		changes in	(150.01 <i>,</i>
		Kovalchik and Reid (2017)			161.00)				estimates of	104.05)
		Reid et al. (2016)							the means	
		/							and standard errors.	
			Second Serve Spe	ed						

Male players	Second Serve Speed (km/h) (men/international all surfaces)	Brown (2021) Cui et al. (2020a) Hornery et al. (2007) Reid et al. (2016)	4	16	M: 148.86‡ (135.03, 164.10)	0.268	(121.76, 181.99)	97.42	Very slight changes in the estimates of the means and standard errors.	NA
	Second Serve Speed (km/h) (men/international hard surfaces)	Cui et al. (2020a) Hornery et al. (2007) Reid et al. (2016)	3	10	M: 146.38‡ (125.32, 170.97)	NA	(99.92, 214.44)	95.84	Very slight changes in the estimates of the means and standard errors.	NA
Female players	Second Serve Speed (km/h) (women/international all surfaces)	Brown (2021) Reid et al. (2016)	2	2	M: 133.68‡ (106.56, 167.69)	NE	NE	95.39	Very slight changes in the estimates of the means and standard errors.	NA

M: mean, MD: Mean Difference, SD: Standard Deviation, 95%CI: 95% Confidence Interval, 95%PI: 95% Prediction Interval. NA: Not applicable. NE: Not estimable.

All outcomes were transformed to a logscale and then back transformed via exponentiating the values. This was done to ensure that no implausible (i.e., negative) estimates were obtained. The prediction interval indicates the heterogeneity in the data and the range of potential values that could be possible in future studies.

Different correlational values (0, 0.2, 0.4, 0.6, 1.0) for ρ were used for sensitivity analyses. For the main analysis a value of ρ = 0.8 was used. ‡ A low number of studies leads to a low number of degrees of freedom (df). The confidence in these results is low. This is the case if df < 4.

 \downarrow Please note that the estimate for the 95% PI is not very accurate in the case of < 10 studies.

• Sensitivity analysis was performed by removal of all studies with imputed SDs.