

Investigating the reliability and sex differences of digit lengths, ratios, and hand measures in infants

Luisa Ernsten, Lisa M. Körner, Martin Heil, Gareth Richards, & Nora K. Schaal

Supplementary table 1 Summary and overview of the literature (in alphabetical order) underlying our research question and highlighting the available hand and digit measures. No claim is made to completeness.

Study	N (f/m)	Age	Measurement technique	Investigated hand/ digit measure	Sex differences	Effect size for sex difference
Aboul-Hagag et al., 2011	250 females, 250 males	≥ 18 years	direct, anthropometer, sliding caliper, ventral	hand length hand width hand index 2D 4D 2D:4D	m > f m > f m > f m > f m > f m < f	1.45 ^{a, b, f} -1.47 ^{a, b, e} 2.42 ^{a, b, f} -2.45 ^{a, b, e} 1.49 ^{a, b, e} -1.50 ^{a, b, f} 1.64 ^{a, b, e} -1.70 ^{a, b, f} 2.03 ^{a, b, e} -2.09 ^{a, b, f} 1.46 ^{a, b, e} -1.62 ^{a, b, f}
Dressler & Voracek, 2011	75 females, 75 males	mean age 25.9 years (<i>SD</i> = 9.2)	indirect, scans, digital Vernier caliper, ventral direct, digital Vernier caliper, ventral	indirect: 2D:3D 2D:4D 2D:5D 3D:4D 3D:5D 4D:5D direct: 2D:3D 2D:4D 2D:5D 3D:4D 3D:5D 4D:5D	indirect: n.s. m < f m < f m < f m < f m < f direct: n.s. n.s. m < f m < f m < f m < f ^f	indirect: 0.04 ^{b, e} -0.09 ^{b, f} 0.39 ^{b, f} -0.40 ^{b, e} 0.57 ^{b, e} -0.68 ^{b, f} 0.42 ^{b, f} -0.56 ^{b, e} 0.63 ^{b, e} -0.68 ^{b, f} 0.43 ^{b, e} -0.54 ^{b, f} direct: 0.04 ^{b, f} -0.20 ^{b, e} 0.18 ^{b, e} -0.24 ^{b, f} 0.33 ^{b, e} -0.55 ^{b, f} 0.38 ^{b, f} -0.47 ^{b, e} 0.52 ^{b, e} -0.60 ^{b, f} 0.26 ^{b, e} -0.48 ^{b, f}
Galis et al., 2010	158 females, 169 males	14-28 weeks of gestational age	indirect, radiography, ruler, ventral	2D:4D	m < f ^g	0.23 ^{a, c}

Knickmeyer et al., 2011	183 females, 181 males	0-2 years	indirect, photocopies, Vernier calipers, ventral	2D:4D	m < f ^g	0.13-0.33	
Krishan et al., 2011	100 females, 100 males	17-20 years	direct, sliding caliper, ventral and dorsal	hand length hand width hand index	m > f m > f m > f	1.69 ^{a, b, f} -1.72 ^{a, b, e} 2.05 ^{a, b, f} -2.10 ^{a, b, e} 0.43 ^{a, b, f} -0.50 ^{a, b, e}	
Kumar et al., 2017	Study I: 53 females, 51 males	Study I: 16-48 years	direct, Vernier calipers, dorsal	Study I: 2D:3D 2D:4D 2D:5D 3D:4D 3D:5D 4D:5D	Study I: n.s. n.s. m < f n.s. m < f m < f	Study I: 0.06 ^{b, f} -0.15 ^{b, e} 0.00 ^{b, f} -0.31 ^{b, e} 0.36 ^{b, e} -0.72 ^{b, f} 0.06 ^{b, f} -0.28 ^{b, e} 0.48 ^{b, e} -0.69 ^{b, f} 0.68 ^{b, e} -0.83 ^{b, f}	
	Study II: 68 females, 86 males	Study II: 17-28		Study II: 2D:3D 2D:4D 2D:5D 3D:4D 3D:5D 4D:5D	Study II: n.s. n.s. m < f n.s. m < f m < f	Study II: 0.06 ^{b, d, f} -0.18 ^{b, e} 0.00 ^{b, f} -0.15 ^{b, e} 0.42 ^{b, e} -0.48 ^{b, d} 0.00 ^{b, f} -0.05 ^{b, e} 0.37 ^{b, e} -0.50 ^{b, f} 0.38 ^{b, e} -0.57 ^{b, f}	
	Study III: 33 females, 31 males	Study III: 3-7.6 years		Study III: 2D:3D 2D:4D 2D:5D 3D:4D 3D:5D 4D:5D	Study III: n.s. n.s. n.s. n.s. m < f m < f	Study III: 0.33 ^{b, e, f} -0.39 ^{b, d} 0.07 ^{b, f} -0.16 ^{b, e} 0.25 ^{b, e} -0.53 ^{b, f} 0.13 ^{b, e} -0.29 ^{b, d, f} 0.44 ^{b, e} -0.70 ^{b, f} 0.46 ^{b, e} -0.63 ^{b, d}	
	Kyriakidis, 2021	80 females, 80 males	19-91 years	direct, electronic Vernier caliper, ventral	2D	m > f	
					3D	m > f	
					4D	m > f	
					5D	m > f	
					2D:3D	m < f	
					2D:4D	m < f	
					2D:5D	m < f	
					3D:4D	m < f ^f	
					3D:5D	n.s.	

				4D:5D	$m < f^e$	
Kyriakidis & Papaioannidou, 2008	60 females, 60 males	19-25 years	direct, electronic Vernier caliper, ventral	2D	$m > f$	$1.23^{a,b,f} - 1.24^{a,b,e}$
				3D	$m > f$	$1.56^{a,b,e} - 1.67^{a,b,f}$
				4D	$m > f$	$1.53^{a,b,f} - 1.60^{a,b,e}$
				5D	$m > f$	$1.38^{a,b,f} - 1.57^{a,b,e}$
				2D:3D	$m < f$	$0.62^{a,b,e} - 0.67^{a,b,f}$
				2D:4D	$m < f$	$0.63^{a,b,f} - 0.75^{a,b,e}$
				2D:5D	$m < f$	$0.62^{a,b,f} - 0.72^{a,b,e}$
				3D:4D	$m < f^e$	$0.16^{a,b,f} - 0.36^{a,b,e}$
				3D:5D	$m < f^e$	$0.16^{a,b,f} - 0.57^{a,b,e}$
				4D:5D	$m < f^e$	$0.09^{a,b,f} - 0.35^{a,b,e}$
Loehlin et al., 2009	400 females, 300 males	2/3 10-16 years, 1/3 ≥ 17 years	indirect, scans, computer program	rel2	$m < f$	$0.46^{b,f} - 0.66^{b,e}$
				rel3	$m < f$	$0.09^{b,f} - 0.22^{b,e}$
				rel4	$m > f$	$0.10^{b,f} - 0.18^{b,e}$
				rel5	$m > f$	$0.29^{b,f} - 0.33^{b,e}$
				2D:3D	$m < f$	$0.32^{b,f} - 0.42^{b,e}$
				2D:4D	$m < f$	$0.36^{b,f} - 0.58^{b,e}$
				2D:5D	$m < f$	$0.39^{b,f} - 0.50^{b,e}$
				3D:4D	$m < f$	$0.14^{b,f} - 0.33^{b,e}$
				3D:5D	$m < f$	$0.22^{b,f} - 0.27^{b,e}$
				4D:5D	$m < f$	$0.13^{b,e} - 0.17^{b,f}$
Manning, 2002 (Manning et al., 2000)	661 females, 567 males	children and adults	indirect, scans, Vernier calipers, ventral direct, Vernier calipers, ventral	D_{r-l}	n.s.	$0.04^{a,b}$
Manning, 2012	340 females, 340 males	2-18 years	direct, Vernier calipers, ventral	2D:3D	$m < f^g$	$0.17^{a,c,e} - 0.30^{a,c,f}$
				2D:4D	$m < f^g$	$0.26^{a,c,e} - 0.30^{a,c,f}$
				2D:5D	$m < f^g$	$0.32^{a,c,f} - 0.35^{a,c,e}$
				3D:4D	n.s. ^g	$0.03^{a,c,f} - 0.15^{a,c,e}$
				3D:5D	$m < f^{e,g}$	$0.14^{a,c,f} - 0.27^{a,c,e}$
				4D:5D	$m < f^{e,g}$	$0.11^{a,c,f} - 0.17^{a,c,e}$
Manning & Fink, 2018	Sample I: 340 females, 340 males (40 per age group)	Sample I: 2-18 years	Sample I: direct, Vernier calipers, ventral	Sample I: 2D 4D	Sample I: $m > f^g$ $m > f^g$	Sample I: $0.20^{a,c,e}$ $0.38^{a,c,e}$

	Sample II: 42,843 females, 46,402 males	Sample II: 18-30 years	Sample II: self-measurement, ruler, ventral	2D:4D Sample II: 2D 4D 2D:4D	m < f Sample II: m > f ^g m > f ^g m < f	0.26 ^{a, c, e} Sample II: 0.45 ^{a, c, e} 0.49 ^{a, c, e} 0.21 ^{a, c, e}
McIntyre et al., 2005	56 females, 68 males	1 month-18 years	indirect, radiography, computer program	2D 3D 4D 2D:4D 3D:4D	m > f m > f m > f m < f ^g m < f ^g	0.35 ^{a, c, f} 0.44 ^{a, c, f}
McIntyre et al., 2006	537 females, 523 males	2-10 years	indirect, radiography, computer program	2D:4D 3D:4D	m < f m < f	0.24 ^{a, b, f} 0.61 ^{a, b, f}
McFadden & Shubel, 2002	62 females, 60 males	heterosexual males $M=19.0$, heterosexual females $M=19.1$, homosexual males $M=22.0$, homosexual females $M=20.7$ years	indirect, scans, computer program	2D:3D 2D:4D 2D:5D 3D:4D 3D:5D 4D:5D	m < f m < f m < f m < f m < f n.s.	0.49 ^{b, f} -0.50 ^{b, e} 0.74 ^{b, f} -0.85 ^{b, e} 0.68 ^{b, f} -0.76 ^{b, e} 0.54 ^{b, f} -0.72 ^{b, e} 0.39 ^{b, f} -0.51 ^{b, e} 0.13 ^{b, e, f}
Raziye et al., 2016	27 females, 23 males	20-40 weeks of gestational age	indirect, mammography and radiography, digital caliper	2D 3D 4D 5D 2D:4D hand length hand width hand index	n.s. n.s. n.s. n.s. n.s. n.s. n.s. n.s. n.s.	
Richards et al., 2019	54 females, 52 males	<i>median</i> = 27.18 h after birth	indirect, scans, Vernier calipers, ventral	2D:4D D_{r-l}	m < f ^f n.s.	0.21 ^{a, b, e} – 0.57 ^{a, b, f} 0.30 ^{a, b}
Stenstrom et al., 2011	235 females, 178 males	17-44 years	direct, digital calipers, ventral	2D:4D rel2	m < f m < f	0.30 ^{b, e} 0.31 ^{b, e}

Wong & Hines, 2016	70 females, 56 males	three age groups: 20-26 months, 27-33 months, 34-40 months	indirect, scans, ventral, in pixel using a computer program	2D:4D	m < f	0.61 ^c
-----------------------	-------------------------	--	--	-------	-------	-------------------

Note: n.s. – not significant, ^a Computed from test statistic, ^b Comparison of group means, ^c Main effect of factor sex, ^d Mean of right and left hand, ^e right hand, ^f left hand, ^g age effects.

Supplementary table 2 Intra-class correlations and 95% confident intervals of digit length measurements of two independent examiners.

			<i>ICC</i>	95% CI	
				upper	lower
<i>2D</i>	pre	right	.97	.96	.98
		left	.96	.95	.97
	post	right	.96	.95	.97
		left	.95	.95	.96
<i>3D</i>	pre	right	.97	.96	.98
		left	.97	.96	.98
	post	right	.97	.96	.97
		left	.95	.95	.96
<i>4D</i>	pre	right	.96	.95	.98
		left	.97	.97	.98
	post	right	.96	.96	.97
		left	.94	.93	.95
<i>5D</i>	pre	right	.97	.95	.98
		left	.95	.93	.97
	post	right	.96	.95	.96
		left	.95	.94	.95

Supplementary table 3 Intra-class correlations and 95% confident intervals of hand length and width measurements of two independent examiners.

			ICC	95% CI	
				upper	lower
<i>Hand length</i>	pre	right	.96	.93	.97
		left	.94	.89	.96
	post	right	.95	.93	.96
		left	.93	.92	.95
<i>Hand width</i>	pre	right	.86	.78	.92
		left	.96	.92	.97
	post	right	.94	.93	.95
		left	.95	.94	.96

Supplementary table 4 Test-retest reliability of pre and post scans for boys, girls, and overall.

		Boys			Girls			Overall		
		<i>r</i>	<i>p</i>	<i>N</i>	<i>r</i>	<i>p</i>	<i>N</i>	<i>r</i>	<i>p</i>	<i>N</i>
2D	right	.77	<.001	66	.86	<.001	64	.81	<.001	130
	left	.78	<.001	66	.84	<.001	64	.81	<.001	130
	averaged	.84	<.001	66	.92	<.001	64	.88	<.001	130
3D	right	.81	<.001	66	.90	<.001	64	.85	<.001	130
	left	.83	<.001	66	.87	<.001	64	.85	<.001	130
	averaged	.88	<.001	66	.94	<.001	64	.91	<.001	130
4D	right	.80	<.001	66	.72	<.001	64	.77	<.001	130
	left	.88	<.001	66	.84	<.001	64	.87	<.001	130
	averaged	.91	<.001	66	.86	<.001	64	.89	<.001	130
5D	right	.68	<.001	66	.74	<.001	64	.72	<.001	130
	left	.86	<.001	66	.82	<.001	64	.85	<.001	130
	averaged	.84	<.001	66	.88	<.001	64	.87	<.001	130
2D:4D	right	.58	<.001	66	.37	.002	64	.50	<.001	130
	left	.55	<.001	66	.68	<.001	64	.63	<.001	130
	averaged	.65	<.001	66	.68	<.001	64	.67	<.001	130
2D:5D	right	.42	<.001	66	.54	<.001	64	.49	<.001	130
	left	.62	<.001	66	.59	<.001	64	.63	<.001	130
	averaged	.62	<.001	66	.67	<.001	64	.67	<.001	130
3D:4D	right	.62	<.001	66	.37	.003	64	.52	<.001	130
	left	.56	<.001	66	.50	<.001	64	.53	<.001	130
	averaged	.71	<.001	66	.56	<.001	64	.66	<.001	130
3D:5D	right	.49	<.001	66	.65	<.001	64	.59	<.001	130
	left	.69	<.001	66	.62	<.001	64	.67	<.001	130
	averaged	.69	<.001	66	.75	<.001	64	.74	<.001	130
4D:5D	right	.54	<.001	66	.70	<.001	64	.64	<.001	130
	left	.68	<.001	66	.65	<.001	64	.67	<.001	130
	averaged	.69	<.001	66	.80	<.001	64	.75	<.001	130
rel2	right	.46	<.001	66	.43	<.001	64	.46	<.001	130
	left	.56	<.001	66	.63	<.001	64	.61	<.001	130
	averaged	.60	<.001	66	.65	<.001	64	.64	<.001	130
rel3	right	.56	<.001	66	.62	<.001	64	.60	<.001	130
	left	.66	<.001	66	.55	<.001	64	.61	<.001	130
	averaged	.73	<.001	66	.72	<.001	64	.73	<.001	130
rel4	right	.70	<.001	66	.42	<.001	64	.57	<.001	130
	left	.54	<.001	66	.66	<.001	64	.61	<.001	130
	averaged	.70	<.001	66	.70	<.001	64	.71	<.001	130
rel5	right	.45	<.001	66	.65	<.001	64	.56	<.001	130
	left	.69	<.001	66	.61	<.001	64	.67	<.001	130
	averaged	.67	<.001	66	.74	<.001	64	.72	<.001	130
<i>D_{r-l}</i>		.40	.001	66	.33	.008	64	.36	<.001	130