

Table 22. Mid-arm circumference in centimeters for females 20 years of age and older by race and ethnicity and age, by mean, standard error of the mean, and selected percentiles: United States 2003–2006

Race and ethnicity and age	Number examined	Mean	Standard error	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
All race and ethnicity groups <sup>1</sup>												
Centimeters												
20 years and over	4,195	31.9	0.15	24.3	25.7	26.5	27.9	31.0	35.1	37.4	39.2	42.0
20–29 years	685	30.3	0.30	23.5	24.2	25.1	26.2	29.0	33.1	35.8	37.6	41.4
30–39 years	652	31.9	0.29	24.7	25.8	26.9	27.9	30.7	35.3	37.9	39.5	41.3
40–49 years	773	32.7	0.28	24.9	26.2	27.1	28.7	31.7	35.9	38.2	40.1	42.4
50–59 years	585	32.8	0.23	25.6	26.3	27.4	28.6	32.0	35.9	38.5	40.0	42.3
60–69 years	683	33.0	0.20	25.5	27.0	27.8	29.0	32.1	36.1	37.9	39.5	43.7
70–79 years	452	31.3	0.28	24.4	25.8	26.7	27.9	30.6	34.1	35.9	37.3	39.5
80 years and over	365	29.2	0.23	22.7	23.8	24.9	26.1	28.9	32.0	33.5	34.5	36.0
Non-Hispanic white												
20 years and over	2,158	31.7	0.18	24.2	25.6	26.4	27.8	30.8	34.8	36.9	38.7	41.5
20–39 years	602	30.8	0.30	23.7	24.9	25.7	27.1	29.5	33.5	36.3	38.3	40.6
40–59 years	665	32.5	0.23	25.0	26.1	27.0	28.4	31.6	35.6	37.9	39.8	42.2
60 years and over	891	31.4	0.17	23.8	25.6	26.6	27.9	30.9	34.4	36.3	37.4	40.1
Non-Hispanic black												
20 years and over	925	34.4	0.25	25.3	26.8	28.2	29.9	33.9	38.0	40.5	42.3	45.6
20–39 years	319	33.6	0.38	24.6	26.0	27.1	28.8	33.0	37.5	40.0	41.5	44.6
40–59 years	347	35.3	0.31	26.1	27.8	29.6	31.0	34.7	39.2	41.4	43.1	45.8
60 years and over	259	34.2	0.45	25.7	26.8	28.3	30.1	34.1	37.3	39.7	41.3	45.3
Mexican American												
20 years and over	798	32.2	0.25	25.3	26.4	27.2	28.6	31.6	35.1	37.4	38.6	40.5
20–39 years	294	31.7	0.34	25.0	26.0	26.5	28.0	31.1	34.6	36.9	37.9	40.3
40–59 years	231	33.2	0.29	26.6	27.7	28.3	29.7	32.5	36.0	38.1	39.2	40.5
60 years and over	273	32.1	0.30	25.5	26.2	27.5	28.5	31.4	35.2	36.5	38.3	40.5

<sup>1</sup>Persons of other races and unknown race and ethnicity are included.

NOTE: Pregnant females were excluded.

**Table 23. Mid-arm circumference in centimeters for males 20 years of age and older by race and ethnicity and age, by mean, standard error of the mean, and selected percentiles: United States 2003–2006**

Race and ethnicity and age	Number examined	Mean	Standard error	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
Centimeters												
All race and ethnicity groups <sup>1</sup>												
20 years and over	4,349	34.1	0.11	27.5	29.0	29.9	31.2	33.8	36.6	38.2	39.5	41.4
20–29 years	791	33.7	0.23	26.7	28.1	29.4	30.6	33.1	36.4	38.2	39.3	41.8
30–39 years	726	34.6	0.17	28.6	29.7	30.4	31.6	34.1	36.8	38.4	39.8	41.9
40–49 years	751	35.1	0.20	28.7	30.2	31.0	32.5	34.7	37.5	38.9	40.2	42.2
50–59 years	570	34.2	0.20	27.9	29.4	30.1	31.3	33.9	36.6	38.3	39.4	41.4
60–69 years	652	34.0	0.23	27.7	29.4	30.1	31.1	33.7	36.4	37.9	39.1	40.6
70–79 years	534	32.5	0.19	26.2	27.8	28.6	30.0	32.3	34.7	36.2	37.5	38.8
80 years and over	325	29.9	0.15	24.4	25.8	26.5	27.6	29.9	31.8	32.8	34.3	35.4
Non-Hispanic white												
20 years and over	2,264	34.2	0.13	27.6	29.1	30.0	31.3	33.9	36.7	38.2	39.5	41.3
20–39 years	658	34.2	0.22	27.6	29.1	29.9	31.3	33.7	36.7	38.2	39.7	41.9
40–59 years	692	34.8	0.22	28.5	30.0	30.7	32.3	34.6	37.2	38.7	40.1	41.5
60 years and over	914	33.0	0.14	26.4	28.1	29.1	30.4	32.6	35.3	37.0	38.1	40.0
Non-Hispanic black												
20 years and over	908	35.0	0.21	28.0	29.3	30.0	31.6	34.4	37.9	39.7	41.5	44.4
20–39 years	351	35.5	0.31	28.3	29.1	30.5	31.8	35.0	38.2	40.8	42.5	45.4
40–59 years	298	35.1	0.29	28.6	29.6	30.1	31.8	34.4	37.9	39.5	41.3	43.6
60 years and over	259	33.3	0.25	25.2	27.4	28.7	30.4	33.2	36.1	37.9	39.0	40.7
Mexican American												
20 years and over	880	33.3	0.19	27.7	28.7	29.6	30.9	33.1	35.6	36.9	37.9	39.8
20–39 years	364	33.5	0.30	27.8	28.7	29.7	31.0	33.2	35.9	37.2	38.2	40.0
40–59 years	243	33.2	0.19	*	29.0	29.7	31.1	33.2	35.4	36.3	37.0	*
60 years and over	273	32.2	0.33	25.6	27.4	28.3	29.7	31.9	34.7	36.2	37.0	38.6

\* Figure does not meet standards of reliability or precision.

<sup>1</sup>Persons of other races and unknown race and ethnicity are included.

**Table 34. Maximal calf circumference in centimeters for females 20 years of age and older by race and ethnicity and age, by mean, standard error of the mean, and selected percentiles: United States 2003–2006**

Race and ethnicity and age	Number examined	Mean	Standard error	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
All race and ethnicity groups <sup>1</sup>												
Centimeters												
20 years and over . . . . .	4,133	38.3	0.13	31.8	33.0	33.8	35.0	37.5	40.9	43.0	44.7	47.1
20–29 years . . . . .	676	37.8	0.25	31.5	32.4	33.1	34.5	37.1	40.2	41.9	43.7	46.6
30–39 years . . . . .	648	38.7	0.23	32.2	33.6	34.1	35.3	38.0	41.2	43.4	45.3	47.2
40–49 years . . . . .	765	39.2	0.27	32.8	33.8	34.6	35.7	38.5	42.1	44.2	45.6	47.8
50–59 years . . . . .	578	38.7	0.24	32.3	33.4	34.3	35.5	37.7	41.3	43.1	44.3	47.4
60–69 years . . . . .	673	38.5	0.30	31.5	32.6	33.6	35.2	37.6	41.1	43.1	44.6	47.2
70–79 years . . . . .	437	36.8	0.27	31.1	32.1	32.9	33.9	36.2	39.0	40.6	42.0	44.7
80 years and over . . . . .	356	35.5	0.19	29.8	30.8	31.7	33.1	35.4	37.7	38.7	39.8	41.4
Non-Hispanic white												
20 years and over . . . . .	2,124	38.4	0.14	32.1	33.1	34.0	35.1	37.6	40.9	43.1	44.8	47.2
20–39 years . . . . .	595	38.4	0.23	32.2	33.0	33.9	35.0	37.7	40.5	42.8	44.6	47.1
40–59 years . . . . .	660	39.1	0.21	32.9	34.0	34.6	35.7	38.2	41.9	43.8	45.5	47.8
60 years and over . . . . .	869	37.5	0.17	31.2	32.3	33.1	34.4	36.8	39.8	41.5	43.1	45.6
Non-Hispanic black												
20 years and over . . . . .	912	39.6	0.17	32.1	33.6	34.9	36.1	39.1	42.5	44.6	46.2	48.6
20–39 years . . . . .	317	39.9	0.27	32.4	34.1	35.1	36.1	39.2	42.9	45.5	46.8	48.8
40–59 years . . . . .	341	39.9	0.25	32.6	34.1	35.3	36.5	39.5	42.6	44.5	45.2	48.6
60 years and over . . . . .	254	38.4	0.31	31.1	32.2	33.2	35.0	37.8	41.8	43.4	44.9	47.7
Mexican American												
20 years and over . . . . .	789	37.3	0.23	31.2	32.3	33.1	34.4	36.6	39.7	41.5	42.9	45.1
20–39 years . . . . .	293	37.4	0.30	31.2	32.2	33.1	34.3	36.6	39.9	41.7	43.0	45.1
40–59 years . . . . .	228	37.9	0.31	31.9	33.1	33.9	35.0	37.1	40.1	41.7	43.4	46.3
60 years and over . . . . .	268	35.6	0.21	30.1	30.9	31.6	33.0	35.2	37.7	39.0	40.4	42.4

<sup>1</sup>Persons of other races and unknown race and ethnicity are included.

NOTE: Pregnant females were excluded.

**Table 35. Maximal calf circumference in centimeters for males 20 years of age and older by race and ethnicity and age, by mean, standard error of the mean, and selected percentiles: United States 2003–2006**

Race and ethnicity and age	Number examined	Mean	Standard error	Percentile								
				5th	10th	15th	25th	50th	75th	85th	90th	95th
All race and ethnicity groups <sup>1</sup>												
20 years and over	4,303	39.5	0.09	33.6	34.7	35.6	36.9	39.2	41.9	43.4	44.4	46.4
20–29 years	779	39.4	0.19	33.5	34.7	35.4	36.7	38.7	41.3	43.4	45.1	47.3
30–39 years	714	39.8	0.17	34.1	34.9	35.8	36.9	39.5	42.2	43.5	44.5	46.5
40–49 years	748	40.3	0.16	34.7	35.9	36.5	37.8	40.0	42.7	44.2	44.9	46.7
50–59 years	568	39.8	0.20	33.7	34.9	35.9	37.2	39.6	42.0	43.4	44.6	46.0
60–69 years	648	39.2	0.18	33.4	34.5	35.7	36.9	39.1	41.7	42.8	43.6	44.8
70–79 years	530	38.0	0.22	32.3	33.7	34.2	35.5	37.7	40.2	41.3	42.5	44.2
80 years and over	316	36.1	0.16	31.1	32.3	32.8	34.0	36.0	38.0	39.3	40.0	41.0
Non-Hispanic white												
20 years and over	2,245	39.8	0.11	33.9	35.0	35.9	37.1	39.4	42.1	43.5	44.5	46.6
20–39 years	648	39.8	0.17	34.2	35.1	35.9	37.0	39.4	42.0	43.6	44.8	47.4
40–59 years	691	40.4	0.19	34.4	35.9	36.7	38.0	40.1	42.6	44.2	44.9	46.6
60 years and over	906	38.6	0.14	32.7	33.8	34.6	36.1	38.3	40.8	42.2	43.1	44.5
Non-Hispanic black												
20 years and over	900	39.7	0.18	33.5	34.6	35.5	36.7	39.4	42.1	44.0	45.5	47.2
20–39 years	348	40.2	0.27	33.8	35.0	35.9	37.0	39.7	42.6	45.0	46.4	48.0
40–59 years	299	39.8	0.23	33.5	35.1	36.0	37.1	39.5	41.8	43.8	44.6	46.8
60 years and over	253	38.0	0.23	32.1	33.7	34.4	35.3	37.8	40.4	41.6	42.9	44.6
Mexican American												
20 years and over	865	37.9	0.18	32.7	33.5	34.5	35.6	37.7	39.9	41.2	42.2	43.4
20–39 years	355	38.1	0.26	33.0	33.6	34.6	35.6	37.8	40.0	41.8	42.7	44.2
40–59 years	240	37.9	0.20	32.5	34.3	34.9	35.8	37.9	39.6	40.7	41.6	42.6
60 years and over	270	36.5	0.25	30.8	32.0	32.7	34.3	36.3	38.7	39.8	40.6	42.4

<sup>1</sup>Persons of other races and unknown race and ethnicity are included.

Table 3  
Consolidated grip strength reference values for males

Age range (years)	Source references	Total subjects (n)	Left (lb) mean (95% CI)	Left (kg) mean (95% CI)	Right (lb) mean (95% CI)	Right (kg) mean (95% CI)
20-24	[5,7-9,11,16]	134	104.6 (85.5-123.6)	47.4 (38.8-56.1)	117.6 (99.6-135.6)	53.3 (45.2-61.5)
25-29	[5,7,10,16]	149	110.2 (90.5-129.9)	50.0 (41.1-58.9)	119.0 (97.7-140.3)	53.9 (44.3-63.6)
30-34	[5,7,10,16]	120	108.4 (89.1-127.6)	49.2 (40.4-57.9)	116.4 (97.2-135.6)	52.8 (44.1-61.5)
35-39	[5,7,10,16]	117	113.7 (97.1-130.8)	51.6 (44.0-59.3)	117.6 (97.0-138.1)	53.3 (44.0-62.6)
40-44	[5,7,10,16]	111	109.7 (93.7-125.8)	49.8 (42.5-57.1)	119.4 (103.9-135.0)	54.1 (47.1-61.2)
45-49	[5,7,10,16]	110	107.4 (88.9-126.0)	48.7 (40.3-57.2)	111.1 (93.7-128.5)	50.4 (42.5-58.3)
50-54	[5,7,10,16]	100	99.7 (86.8-112.7)	45.2 (39.4-51.1)	111.4 (97.4-125.4)	50.6 (44.2-56.9)
55-59	[5,7,10,16]	100	90.4 (74.3-106.6)	41.0 (33.7-48.4)	97.2 (80.9-113.4)	44.1 (36.7-51.4)
60-64	[5,7,8,10,16]	120	85.4 (73.7-97.1)	38.7 (33.4-44.0)	92.0 (81.1-103.0)	41.7 (36.8-46.7)
65-69	[5,7,8,16]	82	84.3 (70.6-97.9)	38.2 (32.0-44.4)	91.9 (78.1-105.7)	41.7 (35.4-47.9)
70-74	[5,7-9,11,16]	120	79.9 (66.9-92.9)	36.2 (30.3-42.1)	84.3 (70.5-98.0)	38.2 (32.0-44.5)
75+	[5,7-9,11,15,16]	217	65.6 (54.7-76.4)	29.8 (24.8-34.7)	61.7 (52.2-68.4)	28.0 (22.7-31.0)

Table 4  
Consolidated grip strength reference values for females

Age range (years)	Source references	Total subjects (n)	Left (lb) mean (95% CI)	Left (kg) mean (95% CI)	Right (lb) mean (95% CI)	Right (kg) mean (95% CI)
20-24	[5,7-9,11,16]	133	61.4 (51.0-71.8)	27.9 (23.1-32.6)	67.4 (58.9-75.8)	30.6 (26.7-34.4)
25-29	[5-7,10,16]	142	68.0 (59.9-76.0)	30.8 (27.2-34.5)	74.5 (65.1-83.9)	33.8 (29.5-38.1)
30-34	[5-7,10,16]	141	70.0 (64.0-75.9)	31.8 (29.0-34.4)	74.5 (63.8-85.1)	33.8 (28.9-38.6)
35-39	[5-7,10,16]	142	66.5 (56.9-76.1)	30.2 (25.8-34.5)	73.1 (63.0-83.3)	33.2 (28.6-37.8)
40-44	[5-7,10,16]	133	64.5 (54.0-74.9)	29.3 (24.5-34.0)	72.3 (61.7-82.9)	32.8 (28.0-37.6)
45-49	[5-7,10,16]	133	67.8 (56.8-78.8)	30.8 (25.8-35.7)	74.8 (63.7-85.9)	33.9 (28.9-39.0)
50-54	[5-7,10,16]	116	63.4 (52.9-73.9)	28.8 (24.0-33.5)	68.2 (58.8-77.5)	30.9 (26.7-35.2)
55-59	[5-7,10,14,16]	123	60.0 (54.3-65.1)	27.2 (24.6-29.5)	66.0 (58.1-74.0)	29.9 (26.4-33.6)
60-64	[5,7,8,10,12,16]	132	50.6 (41.0-60.1)	23.0 (18.6-27.3)	57.1 (48.9-65.3)	25.9 (22.2-29.6)
65-69	[5,7,8,11-13,16]	118	50.4 (43.1-57.7)	22.9 (19.6-26.2)	56.5 (49.6-63.4)	25.6 (22.5-28.8)
70-74	[5,7-9,11-13,16]	166	49.5 (42.1-56.8)	22.5 (19.1-25.8)	53.4 (45.6-61.3)	24.2 (20.7-27.8)
75+	[5,7-9,11-13,15,16]	361	36.1 (32.3-40.0)	16.4 (14.7-18.1)	39.5 (35.3-43.9)	18.0 (16.0-19.9)

**Table 2. Results of Meta-Analysis of Grip Strength Data Obtained from Men 75 or More Years of Age**

Age Group (yrs)	Side	Studies/Subjects	Homogeneity Q (p)	Strength (lb) Mean (95% CI)	Strength (kg) Mean (95% CI)
75-79	Left	6/114	2.011 (.848)	68.5 (56.4-80.6)	31.1 (25.6-36.6)
	Right	6/114	1.136 (.951)	72.7 (59.7-85.7)	33.0 (27.1-38.9)
80-84	Left	6/107	2.646 (.754)	59.6 (49.0-70.2)	27.0 (22.2-31.8)
	Right	6/107	1.724 (.886)	66.4 (53.6-79.1)	30.1 (24.3-35.9)
85-89	Left	5/35	.739 (.946)	55.3 (45.1-65.5)	25.1 (20.5-29.7)
	Right	5/35	.940 (.919)	56.9 (50.3-63.5)	25.8 (22.8-28.8)
90-99	Left	4/14	.342 (.952)	41.6 (38.3-44.8)	18.9 (17.4-20.3)
	Right	4/14	.630 (.889)	41.5 (31.1-51.9)	18.8 (14.1-23.5)

**Table 3. Results of Meta-Analysis of Grip Strength Data Obtained from Women 75 or More Years of Age**

Age Group (yrs)	Side	Studies/Subjects	Homogeneity Q (p)	Strength (lb) Mean (95% CI)	Strength (kg) Mean (95% CI)
75-79	Left	7/207	1.168 (.978)	42.5 (35.5-49.4)	19.3 (16.1-22.4)
	Right	7/207	1.618 (.951)	47.6 (40.9-54.2)	21.6 (18.6-24.6)
80-84	Left	7/166	1.685 (.946)	37.6 (31.9-43.3)	17.1 (14.5-19.6)
	Right	7/166	1.900 (.929)	38.2 (32.6-43.8)	17.3 (14.8-19.9)
85-89	Left	5/75	1.719 (.787)	34.6 (26.9-42.3)	15.7 (12.2-19.2)
	Right	5/75	.956 (.916)	37.7 (28.3-47.1)	17.1 (12.8-21.4)
90-99	Left	3/21	.225 (.894)	32.6 (24.6-40.5)	14.8 (11.2-18.4)
	Right	3/21	.408 (.815)	33.6 (25.3-42.0)	15.2 (11.5-19.1)

Table 7: Strength Reference Values for Men Presented by Muscle Action, Decade, and Side

Muscle Action	Decade	Side (n)	Force (N)			Force/Wt (%)					
			$\bar{X}$	SD	SD	$\bar{X}$	SD	SD			
Wrist extension	20-29	Non (16)	171.1	23.6	21.7	2.7	246.3	43.9	31.4	6.4	
		Dom (16)	184.3	27.6	23.3	2.5	258.4	61.0	32.7	6.8	
	30-39	Non (13)	172.5	39.9	22.0	4.5	237.2	69.6	30.5	9.1	
		Dom (13)	169.5	41.5	21.8	5.1	249.2	60.2	31.9	7.7	
	40-49	Non (15)	178.6	32.2	21.5	4.5	244.9	43.1	29.1	4.2	
		Dom (15)	185.1	38.1	22.0	3.6	245.5	37.5	29.8	5.8	
	50-59	Non (22)	144.7	35.9	16.9	2.6	222.5	47.5	26.1	4.7	
		Dom (21)	148.9	35.0	17.9	4.1	240.4	57.6	28.2	5.7	
	60-69	Non (18)	125.8	24.4	16.0	3.7	195.8	44.7	24.9	6.4	
		Dom (18)	138.3	29.9	17.5	4.0	203.0	45.1	25.5	5.6	
	70-79	Non (22)	126.5	22.1	16.9	3.4	187.9	33.7	25.0	4.5	
		Dom (22)	130.1	22.3	17.3	2.8	191.8	31.5	25.6	5.0	
	Elbow flexion	20-29	Non (16)	278.5	47.8	35.5	6.9	388.4	81.5	49.6	8.7
			Dom (16)	285.0	38.2	36.4	5.9	372.6	89.6	47.3	8.8
		30-39	Non (13)	281.2	54.3	36.1	7.4	362.7	58.5	43.9	9.9
			Dom (13)	268.5	47.1	34.6	7.4	376.1	63.7	45.3	9.0
		40-49	Non (15)	268.5	29.7	32.5	5.2	311.0	63.3	36.7	7.1
			Dom (15)	268.5	33.6	33.3	3.5	311.0	63.3	36.7	7.1
50-59		Non (22)	258.2	49.6	31.6	5.6	323.2	90.8	36.9	13.5	
		Dom (21)	256.9	38.5	33.8	4.9	323.2	90.8	36.9	13.5	
60-69		Non (18)	243.6	42.7	30.8	5.1	272.7	51.2	34.8	9.4	
		Dom (17)	259.4	43.9	32.6	5.7	269.0	76.9	33.8	10.4	
70-79		Non (22)	237.5	38.1	31.4	4.3	246.0	47.6	32.7	6.1	
		Dom (22)	237.3	39.9	32.2	4.8	240.0	47.3	32.1	7.2	
Elbow extension		20-29	Non (16)	244.5	39.5	31.1	5.0	578.6	94.7	74.0	14.9
			Dom (16)	243.1	50.5	30.8	5.1	575.2	82.8	73.7	12.3
		30-39	Non (13)	214.3	50.8	27.6	7.2	572.5	76.5	73.8	11.0
			Dom (13)	214.3	50.8	27.6	7.2	572.5	76.5	73.8	11.0
		40-49	Non (15)	214.1	36.7	25.8	5.5	588.9	72.5	70.5	10.2
			Dom (15)	209.9	33.4	25.3	5.2	583.0	73.7	69.8	9.4
	50-59	Non (22)	186.1	38.5	21.9	3.7	467.7	103.1	55.1	11.2	
		Dom (22)	196.9	37.2	23.3	4.5	470.9	92.3	55.7	11.1	
	60-69	Non (18)	164.7	32.6	20.7	3.5	376.5	67.3	47.7	8.7	
		Dom (18)	168.5	41.6	21.1	4.2	386.9	94.3	48.9	12.4	
	70-79	Non (22)	169.5	36.8	22.4	4.0	365.9	76.9	48.4	8.8	
		Dom (22)	163.2	35.3	21.5	3.6	360.3	72.6	47.7	8.4	
	Shoulder lateral rotation	20-29	Non (16)	205.0	33.5	26.0	3.9	206.7	41.4	26.5	6.2
			Dom (16)	206.8	39.6	26.3	4.9	211.7	39.7	27.0	5.4
		30-39	Non (13)	181.1	48.9	23.1	6.1	225.9	58.1	28.9	6.7
			Dom (13)	185.2	43.0	24.0	4.7	223.6	47.7	28.5	5.2
		40-49	Non (15)	175.7	23.6	21.1	3.6	194.2	37.3	22.4	5.9
			Dom (15)	189.9	36.9	22.9	5.2	190.7	43.3	23.2	6.5
50-59		Non (18)	152.3	36.4	17.8	2.6	203.1	58.6	24.0	6.8	
		Dom (22)	166.7	42.7	19.6	4.4	195.2	61.9	23.1	7.1	
60-69		Non (17)	134.3	28.6	17.2	4.9	167.6	47.6	21.4	5.8	
		Dom (17)	150.4	36.5	19.0	5.0	169.1	49.0	21.4	6.4	
70-79		Non (22)	134.1	30.0	17.9	4.2	182.1	39.2	21.5	5.0	
		Dom (22)	140.1	29.0	18.8	4.5	187.4	38.7	22.2	4.6	
Shoulder extension		20-29	Non (16)	385.1	68.2	48.8	7.5	318.8	61.2	40.2	5.8
			Dom (16)	396.5	75.2	50.1	7.8	321.2	84.7	40.2	7.9
		30-39	Non (13)	376.4	93.5	48.1	10.8	333.3	54.3	42.7	6.3
			Dom (13)	402.5	88.3	51.8	12.2	329.1	66.6	42.0	7.6
		40-49	Non (15)	409.4	71.6	49.3	10.1	321.4	66.9	38.4	8.0
			Dom (15)	400.1	78.6	48.0	10.3	311.1	41.1	37.3	5.7
	50-59	Non (22)	303.4	54.3	35.9	6.5	303.6	69.8	35.7	7.9	
		Dom (22)	332.1	60.0	39.1	5.9	308.9	74.7	36.2	7.8	
	60-69	Non (17)	272.2	55.2	34.4	7.1	261.4	67.1	33.1	8.6	
		Dom (17)	270.9	59.7	34.2	7.2	258.9	49.4	32.8	6.8	
	70-79	Non (22)	259.4	53.1	34.2	6.5	246.0	42.6	32.8	6.2	
		Dom (22)	276.0	45.6	36.3	6.4	250.8	42.7	33.6	7.2	

\*Knee extension force met or surpassed 650N and was recorded as 650N for 6 men in their 20s, 4 men in their 30s, 7 men in their 40s, and 3 men in their 50s. Reference values for these decades, therefore, may be depressed.

Table 8: Strength Reference Values for Women Presented by Muscle Action, Decade, and Side

Muscle Action	Decade	Side (n)	Force (N)			Force/Wt (%)			Muscle Action	Decade	Side (n)	Force (N)			Force/Wt (%)		
			$\bar{X}$	SD	SD	$\bar{X}$	SD	SD				$\bar{X}$	SD	SD	$\bar{X}$	SD	SD
Wrist extension	20-29	Non (22)	94.4	19.0	16.3	2.8	21.2	23.4	Shoulder abduction	20-29	Non (22)	135.3	28.8	26.5	4.0		
		Dom (22)	99.6	16.8	17.2	2.1	153.2	28.8			26.5	4.0					
	30-39	Non (23)	98.0	19.8	15.4	2.7	135.5	28.4	21.2	30-39	Non (23)	135.5	28.4	21.2	3.7		
		Dom (23)	104.6	17.6	16.5	3.0	138.5	28.2	21.8		3.4						
	40-49	Non (21)	99.4	21.2	16.4	3.9	129.1	26.2	21.4	40-49	Non (21)	129.1	26.2	21.4	5.1		
		Dom (21)	102.1	17.5	16.9	3.5	139.0	33.1	22.8		4.5						
	50-59	Non (21)	98.5	17.2	15.8	2.6	137.2	24.7	22.0	50-59	Non (21)	134.9	28.9	21.5	4.1		
		Dom (21)	99.7	18.4	16.1	3.2	137.2	24.7	22.0		4.1						
	60-69	Non (18)	85.2	19.8	13.9	3.6	103.7	16.1	17.1	60-69	Non (18)	103.7	16.1	17.1	3.9		
		Dom (17)	83.2	17.7	13.8	3.4	112.1	25.1	18.4		4.9						
	70-79	Non (20)	61.4	17.8	10.8	3.6	101.6	21.3	17.8	70-79	Non (20)	101.6	21.3	17.8	4.6		
		Dom (20)	69.8	17.6	12.4	4.1	96.9	21.9	16.7		4.2						
Elbow flexion	20-29	Non (22)	152.5	21.8	26.5	3.4	273.3	45.5	47.4	20-29	Non (22)	273.3	45.5	47.4	7.1		
		Dom (22)	154.9	20.7	26.8	2.6	294.9	51.1	51.4		9.2						
	30-39	Non (23)	163.8	31.8	25.1	3.3	252.9	53.3	41.3	30-39	Non (23)	252.9	53.3	41.3	12.1		
		Dom (23)	163.8	28.1	25.7	3.0	248.7	75.5	38.6		8.6						
	40-49	Non (21)	156.9	25.3	26.0	5.1	247.1	51.3	41.1	40-49	Non (21)	247.1	51.3	41.1	11.3		
		Dom (21)	151.3	21.7	25.0	4.4	240.1	48.7	39.1		10.5						
	50-59	Non (21)	156.3	22.4	25.2	4.4	230.5	57.3	37.8	50-59	Non (21)	230.5	57.3	37.8	10.7		
		Dom (21)	134.2	19.0	22.0	4.4	235.7	74.9	38.9		15.2						
	60-69	Non (18)	130.5	21.6	21.4	4.4	166.2	36.1	26.7	60-69	Non (18)	166.2	36.1	26.7	9.2		
		Dom (18)	130.3	28.7	22.7	5.0	166.2	48.7	29.1		9.9						
	70-79	Non (20)	129.9	27.0	22.6	4.9	166.2	48.7	29.1	70-79	Non (20)	166.2	48.7	29.1	9.9		
		Dom (20)	115.2	22.5	20.0	3.7	166.2	97.7	80.5		14.0						
Elbow extension	20-29	Non (22)	116.2	20.2	20.2	3.2	467.3	122.6	63.8	20-29	Non (22)	467.3	122.6	63.8	15.0		
		Dom (22)	116.7	33.8	18.4	3.2	408.3	128.8	63.3		15.5						
	30-39	Non (23)	112.3	26.6	18.5	4.4	380.6	86.5	62.6	30-39	Non (23)	380.6	86.5	62.6	14.3		
		Dom (23)	109.7	21.8	18.1	4.1	362.7	60.0	59.7		10.4						
	40-49	Non (21)	106.7	20.8	17.5	3.7	318.7	72.6	51.2	40-49	Non (21)	318.7	72.6	51.2	12.4		
		Dom (21)	111.2	19.1	17.9	3.4	347.7	75.8	53.7		12.8						
	50-59	Non (18)	95.3	18.2	15.5	2.8	273.6	80.0	44.6	50-59	Non (18)	273.6	80.0	44.6	13.6		
		Dom (18)	92.9	20.6	14.8	3.2	204.7	43.9	35.8		9.1						
	60-69	Non (20)	88.6	16.5	15.5	3.1	210.1	45.6	36.6	60-69	Non (20)	210.1	45.6	36.6	8.8		
		Dom (20)	89.0	17.8	15.6	3.2	132.9	29.6	22.9		4.2						
	70-79	Non (22)	97.0	19.3	16.8	3.1	139.9	27.0	24.3	70-79	Non (22)	139.9	27.0	24.3	4.6		
		Dom (22)	108.4	18.8	18.8	3.0	115.5	36.5	18.7		6.0						
Shoulder lateral rotation	20-29	Non (23)	105.5	23.2	16.6	3.2	119.0	38.3	19.2	20-29	Non (23)	119.0	38.3	19.2	6.3		
		Dom (23)	115.4	23.1	18.2	3.6	124.8	43.2	20.6		5.0						
	30-39	Non (21)	113.6	24.4	18.8	4.4	115.1	21.6	18.8	30-39	Non (21)	115.1	21.6	18.8	4.6		
		Dom (21)	115.6	23.2	19.1	4.3	116.2	30.5	18.9		5.4						
	40-49	Non (21)	107.9	19.0	17.4	3.5	98.7	24.6	16.3	40-49	Non (21)	98.7	24.6	16.3	4.5		
		Dom (21)	86.5	22.0	14.1	3.5	103.3	26.7	17.1		4.9						
	50-59	Non (18)	87.2	19.5	14.4	4.2	91.8	28.9	16.1	50-59	Non (18)	91.8	28.9	16.1	5.4		
		Dom (18)	81.8	10.8	13.6	3.2	92.1	27.2	16.2		5.4						
	60-69	Non (19)	79.3	16.2	13.9	3.5	189.9	45.7	32.7	60-69	Non (19)	189.9	45.7	32.7	5.9		
		Dom (19)	192.2	37.9	33.2	5.2	193.5	37.6	33.7		6.7						
	70-79	Non (22)	205.6	39.2	35.5	5.2	211.1	54.6	33.1	70-79	Non (22)	211.1	54.6	33.1	8.2		
		Dom (22)	207.4	48.0	32.6	6.8	212.3	58.9	35.5		7.5						
Shoulder extension	20-29	Non (23)	202.0	44.7	33.2	7.4	218.4	37.6	36.0	20-29	Non (23)	218.4	37.6	36.0	6.6		
		Dom (23)	210.9	41.1	34.6	6.4	207.4	35.1	33.4		6.4						
	30-39	Non (21)	191.0	47.2	30.5	6.7	154.2	33.9	26.7	30-39	Non (21)	154.2	33.9	26.7	6.5		
		Dom (21)	180.9	34.7	26.4	6.7	172.3	43.8	28.2		7.7						
	40-49	Non (18)	154.1	37.5	25.3	7.2	147.1	28.5	25.8	40-49	Non (18)	147.1	28.5	25.8	5.9		
		Dom (18)	136.5	26.8	23.9	5.7	152.7	34.4	26.7		6.7						
	50-59	Non (20)	143.9	34.9	24.9	5.9				50-59	Non (20)						
		Dom (20)															

\*Knee extension force met or surpassed 650N and was recorded as 650N for one woman in her 30s. Reference values for this decade, therefore, may be depressed.



# The Senior Fitness Test items: a brief overview

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Table 1: Normal range of scores for men, with scoring above this range would be considered

defined as the middle 50% of the population. Those for their age and those below the range as

## Normal Range of Scores - Men

	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Chair stand (no. of stands)	14 - 19	12 - 18	12 - 17	11 - 17	10 - 15	8 - 14	7 - 12
Arm Curl (no. of reps)	16 - 22	15 - 21	14 - 21	13 - 19	13 - 19	11 - 17	10 - 14
6-Min Walk (no. of yds)	610 - 735	560 - 700	545 - 680	470 - 640	445 - 605	380 - 570	305 - 500
2-Min Step (no. of steps)	87 - 115	86 - 116	80 - 110	73 - 109	71 - 103	59 - 91	52 - 86
Chair Sit-&-Reach (inches +/-)	-2.5 - +4.0	-3.0 - +3.0	-3.5 - +2.5	-4.0 - +2.0	-5.5 - +1.5	-5.5 - +0.5	-6.5 - -0.5
Back Scratch (inches +/-)	-8.5 - +0.0	-7.5 - -1.0	-8.0 - -1.0	-9.0 - -2.0	-9.5 - -2.0	-10.0 - -3.0	-10.5 - -4.0
8-Ft Up-&-Go (seconds)	5.6 - 3.8	5.7 - 4.3	6.0 - 4.2	7.2 - 4.6	7.6 - 5.2	8.9 - 5.3	10.0 - 6.2

Table 2: Normal range of scores for women, with scoring above this range would be considered

defined as the middle 50% of the population. Those for their age and those below the range as

## Normal Range of Scores - Women

	60-64	65-69	70-74	75-79	80-84	85-89	90-94
Chair stand (no. of stands)	12 - 17	11 - 16	10 - 15	10 - 15	9 - 14	8 - 13	4 - 11
Arm Curl (no. of reps)	13 - 19	12 - 18	12 - 17	11 - 17	10 - 16	10 - 15	8 - 13
6-Min Walk (no. of yds)	545 - 660	500 - 635	480 - 615	430 - 585	385 - 540	340 - 510	275 - 440
2-Min Step (no. of steps)	75 - 107	73 - 107	68 - 101	68 - 100	60 - 91	55 - 85	44 - 72
Chair Sit-&-Reach (inches +/-)	-0.5 - +5.0	-0.5 - +4.5	-1.0 - +4.0	-1.5 - +3.5	-2.0 - +3.0	-2.5 - +2.5	-4.5 - +1.0
Back Scratch (inches +/-)	-3.0 - +1.5	-3.5 - +1.5	-4.0 - +1.0	-5.0 - +0.5	-5.5 - +0.0	-7.0 - -1.0	-8.0 - -1.0
8-Ft Up-&-Go (seconds)	6.0 - 4.4	6.4 - 4.8	7.1 - 4.9	7.4 - 5.2	8.7 - 5.7	9.6 - 6.2	11.5 - 7.3

countered in the meta-analysis suggests that all individuals of 60 or more years should not be considered together. The homogeneity of data from individuals in the 60- to 69-yr. and 80- to 89-yr. age groups supports their consolidation regardless of sex or test specifics. Although performance data of the 70-79 yr. age group remained heterogeneous, sex and test specifics (analysis not reported) did not provide an explanation. As the upper limits of the 95% confidence interval for performance of the 70- to 79-yr. group (12.6 sec.) fell between that of the younger (11.4 sec.) and older (14.8 sec.) groups, it may provide a rough estimate of normal performance.

TABLE 2  
SUMMARY OF FINAL DESCRIPTIVE META-ANALYSIS OF SIT-TO-STAND TIMES\*

Age (yr.)	n		Sit-to-Stand (sec.)		Homogeneity	p
	Studies/Groups	Total Sample	M	95% CI	Q	
60-99	14/37	20617	12.1	12.1-12.1	20972	<.001
60-69	6/6	4184	11.4	11.4-11.4	6.126	
70-79	8/12	8450	12.6	12.6-12.6	1199	<.001
80-89	6/10	344	12.7	10.7-14.8	4.012	

\*Excludes some data from two studies (see Table 1).

The homogeneity of some data notwithstanding, the inconsistency in the procedures used for the 5-repetition STS test is disconcerting. Chair height, which is known to affect STS performance (Schenkman, Hughes, Samsa, & Studenski, 1996), was often not described or when described ranged from 43.0 to 47.0 cm. Granting that the chairs in diverse settings may differ, a minimal range of heights should be used for testing. A narrow range, e.g., 43.0 to 46.0 cm, is suggested as reflective of most standard chairs encountered in home and institutional settings. The 5-repetition STS test should definitely be performed without the use of the upper limbs as their use has a considerable influence on the ability to stand from sitting (Eriksson & Bohannon, 2003). Further, as the 5-repetition STS test is used to quantify muscle performance, it follows that instructions should require that subjects perform the task as quickly as possible. As the intent is to quantify work against gravity, it makes sense to stop timing with completion of the fifth stand rather than with a return to sitting after the fifth stand.

As with all meta-analyses, this one has limitations. In spite of a thorough search, some studies may have been missed. Of the studies included, key determinants of performance may not have been available or were overlooked. The decision to exclude data from specific groups may not have been appropriate. Still, the summary provided acknowledges these facts. So the data presented provides more guidance in interpreting performance than was available before. Normative data obtained from a well defined, diverse,