

Normative Strength Values for Knee, Shoulder, Elbow and Ankle For Females Ages 9-73 as Determined by Isokinetic Testing

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ABSTRACT: Data were collected over a five year period from a sample of 1,282 females between the ages of 9-73 using a Cybex II Isokinetic Dynamometer. Peak torque at 60 degrees/second or 30 degrees/second in 5 reciprocal joint motions was obtained. The purpose of this testing was to develop normative strength data for a healthy female population. These norms can be used in the development of strength training and rehabilitation programs. In all cases of joint motion mean peak torque values increased with increasing age. The highest peak values occurred within the 19-30 year age group. Torque values progressively and incrementally decreased with further increase in age. Torque values in each age group consistently increased with increased weight, until reaching subjects weighing 220 pounds or more.

Isokinetic evaluation and exercise has increased greatly in recent years. This increased use has created a need for normative data.

Molnar and Alexander (1, 18, 19) published normative data on knee and elbow extension and flexion in children ages 7 - 15. Numerous studies (6,7,8,9,10,11, 12,13,14,15,16,17,20,21,22,23,25,26,27,28) have followed. The majority of these (6,10,11,12,14,15,20,21,23,25,26, 28) have focused on the knee. The remaining literature offered limited numbers of studies identifying normative data on other joints (1,7,8,16,21,25,27). A factor not accounted for in previous norms is the degenerative effects of aging on muscle tension development, estimated to be 20% between ages of 25 and 60.

The sparsity of information on females in general and specifically females over 30 years of age and the need for norms related to age and body weight for subjects in five reciprocal joint motions led to this study.

METHODOLOGY

The sample included 1282 females, ages 9 -73, who expressed a desire to be involved in a conditioning or strength training program.

A medical and injury history was taken from each individual. Subjects under 18 were required to have parental participation in the review of medical and injury history. Subjects over 35 were required to have a

physician release. Subjects with a previous injury history were required to obtain a physician release and to have completed treatment. Results of subjects who had completed therapy but continued to exhibit a significant bilateral strength imbalance were not included in this study. Additional data collected prior to testing included name, age, weight and training or conditioning status.

Subjects activity level ranged from sedentary to professional athletics. The groups were not divided or analyzed according to activity level due to the subjective nature of such categorization. All activity levels were analyzed together under the assumption that athletes would comprise the highest extreme of the range, while the sedentary population would generally comprise the lowest extreme of the range. All age groups included a range of athletes who were competing in some sport activity to sedentary individuals.

A Cybex II Dynamometer (Cybex, Division of Lumex, Inc., Ronkonkoma, NY. 1980) with dual channel recorder was used to measure peak torque. It was calibrated monthly as recommended by the manufacturer, using manufacturer's procedures (2). The testers were certified athletic trainers familiar with the Isolated Joint Testing and Exercise protocols (2). Each tester received a written protocol for administering the test and all were trained by one individual.

Each subject completed a five minute submaximal Fitron warm-up at 90RPM at 600 KPH or less. Upon completion the subject began a series of flexibility exercises. Each exercise was held for a count of ten and completed three times. Hamstrings, quadriceps, gastrocnemius, low back, anterior shoulder girdle and posterior shoulder girdle were stretched.

Standard testing procedures as outlined by Cybex were used for each joint tested (2). Each subject was given four to six submaximal trial repetitions and one to two maximal trial repetitions before testing. Each subject was allowed a brief rest (less than two minutes) prior to testing. Four voluntary maximum contractions, not corrected for gravity, were used to obtain peak torque output. Peak torque values for five reciprocal joint motions were collected. These included knee flexion/extension, shoulder flexion/extension, and elbow flexion/extension, tested at 60 degrees/second. Ankle inversion/eversion and plantar/dorsiflexion were tested at 30 degrees/second as suggested by the manufacturer (2). The testing was randomized so as to eliminate dependent ordering effect. Testing order assured that no muscle group was tested without rest

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Table 1a
Isokinetic Knee Extension in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)											
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
(Sample Size)	18		76		449		570		147		22	
(Torq. Range)	27.0-88.5		39.0-150.0		34.5-195.0		35.5-163.0		26.5-146.0		35.0-75.55	
0.0 - 59.9	*29.8	2.8										
60.0 - 69.9	*41.8	7.4	*39.0	0.0								
70.0 - 79.9	*41.5	5.0	*52.5	0.0								
80.0 - 89.9	63.3	16.7					*66.8	23.3	*33.5	0.0		
90.0 - 99.9	63.7	15.6	68.0	2.0	68.6	12.9	64.7	20.6	56.0	14.5		
100.0 - 109.9	*66.5	0.0	74.3	11.1	70.6	14.2	73.3	14.1	*64.7	10.5		
110.0 - 119.9			79.2	15.2	80.2	12.7	74.5	19.1	56.7	14.4	50.7	7.4
120.0 - 129.9			89.3	19.4	91.9	22.0	80.7	18.9	68.0	15.4	54.9	10.3
130.0 - 139.9			98.2	22.5	97.9	21.3	82.3	15.6	74.5	17.8	55.8	11.9
140.0 - 149.9			109.1	18.8	101.3	24.0	88.7	21.5	75.1	20.8	*67.0	0.0
150.0 - 159.9			130.9	19.2	111.5	25.4	96.6	20.8	79.4	20.5	*59.0	7.0
160.0 - 169.9			*122.5	6.0	119.0	31.2	97.4	24.1	79.5	14.2	*63.8	10.3
170.0 - 179.9			*88.2	10.2	120.1	20.9	108.9	21.9	*77.4	27.8		
180.0 - 189.9					113.1	26.6	86.3	16.5	86.4	4.2		
190.0 - 199.9			*149.0	0.0	*77.8	22.3	116.1	22.2	80.2	19.2		
200.0 - 209.9			*131.0	0.0	104.4	28.7	95.2	11.0	*86.0	0.0		
210.0 - 219.9			*131.5	0.0	*123.5	29.3	92.5	27.4	*70.5	0.0		
220.0 - 229.9					*100.8	40.8	*94.8	17.3				
230.0 - 239.9							*91.3	19.3				
240.0 - 249.9					*130.5	0.0	*109.5	0.0				
250.0 - 259.9					*125.5	0.0						
260.0+							*115.5	0.0	*82.0	0.0		

* = Less than 5 subjects

Table 1b
Isokinetic Knee Flexion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)											
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
(Sample Size)	18		76		449		570		147		22	
(Torq. Range)	16.5-61.0		27.0-103.5		25.0-138.0		15.0-129.0		13.0-107.0		20.5-54.5	
0.0 - 59.9	*17.3	.8										
60.0 - 69.9	*23.2	6.3	*27.0	0.0								
70.0 - 79.9	*29.8	2.3	*37.5	0.0								
80.0 - 89.9	43.6	11.4					*50.3	.3	*23.5	0.0		
90.0 - 99.9	37.8	6.4	42.0	9.0	45.1	8.2	39.5	10.4	35.5	8.0		
100.0 - 109.9	*44.0	0.0	47.2	8.2	48.8	13.1	49.4	9.1	*42.5	7.8		
110.0 - 119.9			50.2	13.7	50.4	10.9	49.5	11.2	36.7	10.8	30.7	6.1
120.0 - 129.9			56.0	8.6	59.0	14.2	52.5	12.6	44.1	11.2	36.3	6.5
130.0 - 139.9			58.6	12.9	64.0	14.3	52.4	11.3	48.4	10.2	42.4	5.9
140.0 - 149.9			72.5	14.0	63.6	16.5	58.9	14.5	50.8	11.1	*34.5	0.0
150.0 - 159.9			80.3	16.8	73.0	20.1	62.0	16.8	53.6	12.9	*41.0	13.0
160.0 - 169.9			*66.5	1.0	75.9	20.8	64.6	19.1	51.3	10.4	*41.5	11.5
170.0 - 179.9			*62.2	10.4	78.5	18.0	70.8	15.3	*55.6	20.8		
180.0 - 189.9					68.6	21.9	53.2	9.4	55.4	6.7		
190.0 - 199.9			*93.5	0.0	*43.7	11.0	74.6	20.8	54.0	12.8		
200.0 - 209.9			*90.5	0.0	63.9	16.2	54.7	9.5	*46.0	0.0		
210.0 - 219.9			*68.0	0.0	*77.0	13.7	60.5	16.7	*38.5	0.0		
220.0 - 229.9					*72.5	21.0	*62.0	4.0				
230.0 - 239.9							*52.0	14.9				
240.0 - 249.9					*83.0	0.0	*80.5	0.0				
250.0 - 259.9					*83.5	0.0						
260.0+							*66.0	0.0	*66.5	0.0		

* = Less than 5 subjects

Table 2a
Isokinetic Shoulder Extension in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)													
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60			
	(Sample Size)	(Torq. Range)	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
0.0 - 59.9	18	10.7-40.0	*12.0	1.3										
60.0 - 69.9			*17.8	2.7	*16.5	0.0								
70.0 - 79.9			*18.7	3.2	*22.0	0.0								
80.0 - 89.9			26.6	8.2										
90.0 - 99.9			23.8	.6	27.8	2.3	28.1	5.1	*26.8	3.3	*14.0	0.0		
100.0 - 109.9			*24.5	0.0	28.7	4.3	31.3	4.9	27.1	6.6	21.5	4.0		
110.0 - 119.9					32.2	9.2	34.0	8.4	28.0	4.6	*27.9	3.7		
120.0 - 129.9					36.7	7.4	37.0	8.3	31.8	7.9	25.8	6.7	22.9	3.8
130.0 - 139.9					41.5	9.7	39.5	8.4	33.6	8.4	30.5	6.9	27.8	3.4
140.0 - 149.9					48.3	10.7	39.5	9.5	33.3	6.1	32.5	5.8	29.3	3.2
150.0 - 159.9					51.4	10.3	43.2	9.8	34.8	6.2	31.8	8.4	*26.0	0.0
160.0 - 169.9					*40.0	1.0	46.9	13.3	38.5	7.3	33.0	7.2	*30.3	.3
170.0 - 179.9					*36.7	1.3	46.1	9.9	40.7	13.0	32.5	5.8	*35.0	1.0
180.0 - 189.9							48.9	18.0	46.5	10.1	34.4	13.0		
190.0 - 199.9					*64.5	0.0	*37.6	3.0	34.7	6.4	*37.5	3.6		
200.0 - 209.9					*46.5	0.0	39.2	9.6	41.8	8.9	29.6	12.1		
210.0 - 219.9					*49.0	0.0	*50.8	18.2	34.8	5.4	*34.5	0.0		
220.0 - 229.9							*47.8	2.3	39.8	9.8	*35.0	0.0		
230.0 - 239.9									*38.8	1.8				
240.0 - 249.9									*37.8	9.5				
250.0 - 259.9							*34.5	0.0	*42.0	0.0				
260.0+							*35.0	0.0						
									*41.0	0.0	*48.0	0.0		

* = Less than 5 subjects

Table 2b
Isokinetic Shoulder Flexion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)													
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60			
	(Sample Size)	(Torq. Range)	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
0.0 - 59.9	18	7.1-27.0	*8.8	1.7										
60.0 - 69.9			*14.5	1.1	*11.5	0.0								
70.0 - 79.9			*13.4	1.4	*16.0	0.0								
80.0 - 89.9			18.0	5.4										
90.0 - 99.9			17.8	1.4	19.3	.3	21.8	3.4	*21.8	1.3	*13.0	0.0		
100.0 - 109.9			*20.5	0.0	22.2	2.4	24.3	3.7	21.6	4.7	17.8	2.3		
110.0 - 119.9					23.0	5.6	25.4	4.0	22.8	3.2	*24.7	5.5		
120.0 - 129.9					25.8	3.6	27.1	5.0	24.1	4.7	21.6	6.0	18.8	3.8
130.0 - 139.9					28.1	5.4	29.0	4.7	25.8	5.8	23.3	4.8	19.7	5.9
140.0 - 149.9					31.3	3.9	29.9	6.1	26.0	4.8	23.6	3.6	23.1	3.0
150.0 - 159.9					34.3	5.2	31.8	6.1	26.4	4.8	23.8	4.3	*25.0	0.0
160.0 - 169.9					*31.3	1.3	34.3	7.9	29.4	5.4	25.8	8.2	*25.0	1.0
170.0 - 179.9					*27.8	.6	33.5	5.6	30.6	6.8	24.9	4.7	*26.8	1.3
180.0 - 189.9							36.3	8.1	32.6	7.3	27.0	9.4		
190.0 - 199.9					*46.0	0.0	*29.1	3.8	32.6	6.4	*30.3	4.8		
200.0 - 209.9					*35.5	0.0	31.9	5.7	28.6	6.6	22.6	9.4		
210.0 - 219.9					*34.0	0.0	*34.4	9.7	29.1	5.4	*27.0	0.0		
220.0 - 229.9							*37.3	.8	31.0	10.7	*28.0	0.0		
230.0 - 239.9									*28.5	.5				
240.0 - 249.9									*28.8	6.2				
250.0 - 259.9							*32.0	0.0	*35.5	0.0				
260.0+							*29.5	0.0						
									*35.5	0.0	*31.5	0.0		

* = Less than 5 subjects

Table 3a
Isokinetic Elbow Extension in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)											
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
(Sample Size)	18		76		449		570		147		22	
(Torq. Range)	5.4-20.3		9.8-44.5		9.0-53.5		8.2-45.0		7.0-46.0		7.5-20.4	
0.0 - 59.9	*7.1	1.7										
60.0 - 69.9	*8.5	1.7	*9.8	0.0								
70.0 - 79.9	*10.7	.7	*9.9	0.0								
80.0 - 89.9	14.5	3.6					*14.6	3.2	*12.5	0.0		
90.0 - 99.9	16.0	1.2	16.9	1.8	16.5	4.7	14.3	4.6	15.0	.7		
100.0 - 109.9	*10.9	0.0	18.7	4.4	18.5	3.3	15.6	3.2	*15.3	1.7		
110.0 - 119.9			18.3	4.2	19.1	4.5	17.2	3.9	15.5	3.9	13.0	3.0
120.0 - 129.9			22.1	4.6	21.4	5.4	18.8	4.8	16.1	3.3	14.9	4.0
130.0 - 139.9			23.0	5.6	23.2	6.1	18.8	3.7	18.1	3.7	14.5	1.6
140.0 - 149.9			27.4	6.5	22.8	6.6	20.5	5.2	19.1	4.5	*14.9	0.0
150.0 - 159.9			31.1	7.3	26.4	7.2	22.1	5.6	19.6	6.4	*15.2	.3
160.0 - 169.9			*19.7	5.0	28.2	9.3	23.3	7.6	19.4	3.6	*20.1	.1
170.0 - 179.9			*25.9	3.2	28.8	6.7	28.2	6.7	22.7	9.2		
180.0 - 189.9					28.9	12.5	21.6	4.5	*20.6	2.5		
190.0 - 199.9			*44.5	0.0	*24.9	2.6	26.5	6.1	20.7	2.8		
200.0 - 209.9			*26.0	0.0	24.1	6.9	20.6	2.5	*17.9	0.0		
210.0 - 219.9			*32.0	0.0	*33.1	12.6	24.7	6.7	*23.5	0.0		
220.0 - 229.9					*31.2	7.3	*24.3	3.3				
230.0 - 239.9							*19.3	5.8				
240.0 - 249.9					*17.3	0.0	*23.5	0.0				
250.0 - 259.9					*20.6	0.0						
260.0+							*25.0	0.0	*21.9	0.0		

* = Less than 5 subjects

Table 3b
Isokinetic Elbow Flexion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)											
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
(Sample Size)	18		76		449		570		147		22	
(Torq. Range)	6.5-18.5		9.9-37.0		9.0-49.5		7.7-40.0		4.5-37.5		7.2-19.7	
0.0 - 59.9	*7.3	.8										
60.0 - 69.9	*8.9	.9	*9.9	0.0								
70.0 - 79.9	*9.3	1.7	*11.8	0.0								
80.0 - 89.9	14.1	3.1					*14.7	4.1	*10.3	0.0		
90.0 - 99.9	13.6	1.0	16.0	.5	16.5	4.0	15.6	6.0	13.1	1.1		
100.0 - 109.9	*12.4	0.0	17.0	2.9	17.7	3.5	16.3	2.7	*14.0	.9		
110.0 - 119.9			16.8	3.4	18.2	3.3	17.3	3.8	14.2	3.7	11.4	2.4
120.0 - 129.9			20.6	2.6	20.9	5.3	18.3	3.9	15.8	3.2	15.7	3.6
130.0 - 139.9			20.6	4.8	22.3	5.3	18.5	3.0	17.3	4.3	15.5	1.8
140.0 - 149.9			24.0	5.3	21.9	5.9	19.7	4.2	17.9	3.4	*13.1	0.0
150.0 - 159.9			26.6	7.3	24.3	5.8	21.4	4.5	18.7	5.2	*17.1	.8
160.0 - 169.9			*19.9	1.1	26.5	8.2	21.9	6.1	20.0	3.6	*18.8	.7
170.0 - 179.9			*22.7	5.2	26.9	5.1	24.2	6.1	20.6	6.3		
180.0 - 189.9					26.3	10.4	19.4	3.1	*21.3	2.8		
190.0 - 199.9			*32.5	0.0	*20.5	2.4	22.7	4.5	20.4	4.1		
200.0 - 209.9			*29.0	0.0	22.5	4.9	19.0	3.4	*14.9	0.0		
210.0 - 219.9			*37.0	0.0	*27.4	7.3	22.9	6.4	*19.0	0.0		
220.0 - 229.9					*31.1	6.0	*25.4	1.1				
230.0 - 239.9							*18.5	2.4				
240.0 - 249.9					*17.0	0.0	*24.5	0.0				
250.0 - 259.9					*16.1	0.0						
260.0+							*27.5	0.0	*22.4	0.0		

* = Less than 5 subjects

Table 4a
Isokinetic Ankle Inversion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)											
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60	
	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)
	18	4.2-15.0	76	8.2-27.6	449	4.1-49.0	570	5.5-46.0	147	3.9-29.0	22	4.0-18.7
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0.0 - 59.9	*4.7	.5										
60.0 - 69.9	*9.2	1.8	*8.2	0.0								
70.0 - 79.9	*11.5	1.8	*14.4	0.0								
80.0 - 89.9	12.1	1.6					*14.3	1.1	*8.4	0.0		
90.0 - 99.9	13.7	1.2	17.6	1.2	13.2	2.6	12.8	6.8	14.9	1.6		
100.0 - 109.9	*8.6	0.0	14.4	2.7	14.8	3.1	15.1	4.0	*14.6	4.8		
110.0 - 119.9			14.4	3.5	16.5	3.2	15.3	3.7	12.5	4.6	10.1	3.0
120.0 - 129.9			17.4	4.4	16.9	4.2	15.9	3.6	15.5	4.4	11.6	2.8
130.0 - 139.9			18.4	5.3	17.4	4.2	16.3	3.9	15.5	4.1	13.9	2.5
140.0 - 149.9			18.0	5.8	18.3	5.4	16.7	4.4	16.0	3.4	*14.2	0.0
150.0 - 159.9			18.1	2.9	20.3	8.1	16.7	3.9	17.0	3.3	*14.7	.2
160.0 - 169.9			*16.0	1.0	19.6	7.4	17.4	3.5	15.6	3.1	*14.3	.7
170.0 - 179.9			*21.4	3.9	20.7	4.9	20.7	8.9	16.3	3.8		
180.0 - 189.9					19.5	4.3	16.8	2.8	*18.0	3.8		
190.0 - 199.9			*27.6	0.0	*17.2	1.6	18.4	3.0	16.5	6.1		
200.0 - 209.9			*21.9	0.0	16.4	3.0	14.7	3.5	*14.7	0.0		
210.0 - 219.9			*19.6	0.0	*21.6	5.4	18.0	7.3	*10.6	0.0		
220.0 - 229.9					*19.0	2.0	*12.6	4.1				
230.0 - 239.9							*15.5	3.3				
240.0 - 249.9					*15.5	0.0	*15.5	0.0				
250.0 - 259.9					*17.6	0.0						
260.0+							*10.7	0.0	*17.2	0.0		

* = Less than 5 subjects

Table 4b
Isokinetic Ankle Eversion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)											
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60	
	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)	(Sample Size)	(Torq. Range)
	18	4.9-12.5	76	6.7-25.0	449	5.1-45.0	570	5.4-34.5	147	4.4-21.9	22	5.2-14.5
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0.0 - 59.9	*6.4	1.5										
60.0 - 69.9	*7.0	.8	*6.7	0.0								
70.0 - 79.9	*7.9	.9	*8.8	0.0								
80.0 - 89.9	10.4	1.5					*12.3	1.7	*8.6	0.0		
90.0 - 99.9	10.4	1.6	13.1	.6	11.6	2.1	10.6	4.3	12.5	1.4		
100.0 - 109.9	*8.7	0.0	13.2	1.6	13.1	3.0	12.3	3.3	*8.9	1.2		
110.0 - 119.9			12.6	3.0	13.6	2.7	13.1	2.9	11.1	3.1	8.9	2.2
120.0 - 129.9			15.5	3.1	14.6	3.1	13.5	2.7	13.1	2.8	12.0	1.7
130.0 - 139.9			14.1	2.9	15.1	3.5	13.8	3.1	12.7	3.0	12.1	2.0
140.0 - 149.9			15.4	2.8	15.7	4.8	14.2	3.2	13.1	2.4	*12.1	0.0
150.0 - 159.9			17.6	2.5	18.0	5.1	15.3	2.6	13.9	2.9	*12.0	.9
160.0 - 169.9			*18.2	.3	17.7	4.4	15.0	3.1	13.7	2.4	*11.5	.5
170.0 - 179.9			*16.1	1.4	18.2	4.1	18.2	5.1	14.8	4.0		
180.0 - 189.9					18.1	4.2	15.4	2.9	*13.4	1.0		
190.0 - 199.9			*25.0	0.0	*16.2	1.1	15.9	2.0	14.4	4.5		
200.0 - 209.9			*20.3	0.0	15.4	1.8	12.8	3.5	*12.0	0.0		
210.0 - 219.9			*20.0	0.0	*15.9	2.9	16.3	7.4	*9.2	0.0		
220.0 - 229.9					*15.5	2.4	*13.3	4.8				
230.0 - 239.9							*13.9	1.0				
240.0 - 249.9					*16.8	0.0	*11.8	0.0				
250.0 - 259.9					*19.0	0.0						
260.0+							*13.6	0.0	*21.9	0.0		

* = Less than 5 subjects

Table 5a
Isokinetic Ankle Plantarflexion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)													
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60			
	(Sample Size)	(Torq. Range)	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
0.0 - 59.9	18	12.3-48.0	*14.9	2.6										
60.0 - 69.9			*21.6	3.7	*25.5	0.0								
70.0 - 79.9			*31.0	2.5	*35.0	0.0								
80.0 - 89.9			34.7	10.6			*43.0	2.0	*26.0	0.0				
90.0 - 99.9			34.0	5.7	43.5	.5	37.6	5.5	39.0	10.9	35.3	6.8		
100.0 - 109.9			*40.0	0.0	41.5	13.1	50.0	10.8	46.7	8.0	*42.5	12.2		
110.0 - 119.9					46.8	15.5	52.1	9.5	48.9	12.0	39.1	11.2	26.9	5.2
120.0 - 129.9					53.4	11.3	54.5	12.5	52.0	13.6	42.7	13.0	38.1	6.0
130.0 - 139.9					61.8	12.5	60.2	13.3	52.7	12.4	51.2	15.5	38.5	7.6
140.0 - 149.9					58.2	9.8	62.7	14.3	55.0	15.5	53.9	14.7	*33.0	0.0
150.0 - 159.9					68.4	10.4	66.9	17.1	57.9	17.5	52.3	13.6	*40.3	7.8
160.0 - 169.9					*65.3	1.8	68.6	25.1	57.7	16.6	49.1	10.0	*54.8	1.8
170.0 - 179.9					*50.0	5.4	74.2	17.9	67.4	20.1	58.7	27.0		
180.0 - 189.9							73.4	27.7	56.8	10.1	*43.9	8.8		
190.0 - 199.9					*88.0	0.0	*58.8	23.2	69.0	11.4	50.2	17.3		
200.0 - 209.9					*65.5	0.0	63.4	18.1	45.4	11.8	*37.0	0.0		
210.0 - 219.9					*62.5	0.0	*75.1	11.8	49.3	18.3	*36.5	0.0		
220.0 - 229.9							*66.5	30.5	*47.5	11.0				
230.0 - 239.9									*51.8	10.4				
240.0 - 249.9							*71.5	0.0	*55.5	0.0				
250.0 - 259.9							*91.5	0.0						
260.0+									*24.5	0.0	*61.0	0.0		

* = Less than 5 subjects

Table 5b
Isokinetic Ankle Dorsiflexion in Females
(Ft. lbs. Torque; Mean and Standard Deviation)

Range of Weight (lbs)	Age Group (Yrs.)													
	9 - 12		13 - 18		19 - 30		31 - 45		46 - 60		Over 60			
	(Sample Size)	(Torq. Range)	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD		
0.0 - 59.9	18	5.1-16.5	*7.7	2.6										
60.0 - 69.9			*10.4	1.2	*9.5	0.0								
70.0 - 79.9			*12.9	1.5	*12.5	0.0								
80.0 - 89.9			13.0	2.9			*17.8	1.8	*12.5	0.0				
90.0 - 99.9			15.5	.4	16.3	.8	14.9	2.0	15.2	4.1	12.0	3.0		
100.0 - 109.9			*14.0	0.0	14.5	2.9	16.3	2.7	15.5	1.9	*16.0	2.9		
110.0 - 119.9					17.2	3.3	17.7	2.9	16.4	3.2	16.0	2.9	14.3	2.0
120.0 - 129.9					18.8	2.2	18.8	3.2	17.7	3.2	17.4	4.4	15.3	1.8
130.0 - 139.9					16.8	3.4	19.3	3.8	17.9	2.8	17.8	3.1	15.8	1.8
140.0 - 149.9					17.9	3.1	20.2	4.0	18.5	3.1	17.2	3.7	*16.5	0.0
150.0 - 159.9					20.5	2.2	21.2	4.0	19.8	3.5	18.8	2.9	*15.5	1.0
160.0 - 169.9					*22.3	.3	22.8	6.7	19.9	4.2	18.7	2.6	*17.3	.3
170.0 - 179.9					*19.7	1.7	23.5	4.7	21.5	4.1	21.1	3.7		
180.0 - 189.9							24.6	6.0	20.2	4.4	*20.2	1.9		
190.0 - 199.9					*32.0	0.0	*20.0	5.5	24.1	3.1	18.9	1.7		
200.0 - 209.9					*26.0	0.0	22.1	2.1	18.9	2.8	*19.5	0.0		
210.0 - 219.9					*27.5	0.0	*23.3	4.7	21.9	6.8	*16.0	0.0		
220.0 - 229.9							*21.3	4.3	*23.0	4.0				
230.0 - 239.9									*20.4	1.6				
240.0 - 249.9							*24.0	0.0	*20.0	0.0				
250.0 - 259.9							*27.0	0.0						
260.0+									*19.0	0.0	*30.0	0.0		

* = Less than 5 subjects

periods between subsequent test. All joint tests were completed in the same testing session.

The age groupings were determined as follows: preadolescent 9-12, adolescent 13-18, young adult 19-30, adult 31-45, menopausal 45-60, post menopausal over 60. Total body weight groupings were divided into 10 pound increments.

RESULTS

Mean peak torque values are presented for each muscle group as it related to age and weight in Tables 1-5. In all cases of joint motion, peak torque increased with increasing age with the highest peak values occurring within the 19-30 year age group. Values progressively and incrementally decreased with further increase in age. Mean torque output increased with increased body weight in all age groups. The exception to this occurred in certain subjects over 220 pounds. These individuals frequently displayed a decrease in torque output in upper extremity and ankle inversion/eversion.

DISCUSSION

The use of normative data is controversial, but if used properly relative to the specific population they can be used as guidelines for testing and/or rehabilitation (4). The trend toward unlimited sports participation for women has created a need for normative peak torque data (6). These data allow clinicians to set rehabilitation and training goals for females specific to their weight and age group.

The scarcity of data on women over 30 was increasingly apparent as this study progressed. The increase in masters level athletes as well as the numbers of women involved in all levels of recreational activities would seem to indicate the need for information on this group. The fact that torque values continue to increase until 30 should provide professionals responsible for strength training programs with an increased expectation for strength development in older athletes. The fact that the 31 - 45 age group shows only a 20% drop in most muscle groups tested identifies the possibility of sustaining activities with only slight decreases in performance level.

There has been much discussion concerning the anthropometric variables that influence strength. Strength has been shown to be correlated to age (1,18,19), height and weight (6,12,13,22,23,28). Data available on children prior to this study were categorized by age and height. However, the range of mean scores in this study closely resembled those noted by Molnar and Alexander (10) who evaluated 25 9 to 15 year old females. The similarity in the range would suggest that both height and weight may be used with age to identify reasonable norms for children. This study also supports the works of others (7,8,9,11,14,26) in that age is a primary contributing factor to the decrease of strength.

Hopefully, the normative peak torque data will serve as a base to enable clinicians to identify realistic strength goals for healthy female clients. The clinician will be able to evaluate each client with relation to age and weight. These guidelines should be of benefit in the development of both strength training and rehabilitation programs. Prior to this study there were no norms to use as guidelines for return to activity for the older female athlete. Continued study is recommended to develop increased normative data for women. Areas suggested for further study include, power, agonist/antagonist ratios, body weight to torque output and lean body weight to torque output ratios.

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