

Table 1
Characteristics of Subjects: Age, Sex, and Hand Dominance (N = 471)

Age	No. of Males	Dominance		No. of Females	Dominance	
		Right	Left		Right	Left
6-7	26	21	5	33	28	5
8-9	30	26	4	32	27	5
10-11	43	39	4	40	36	4
12-13	34	25	9	36	32	4
14-15	34	32	2	34	28	6
16-17	31	27	4	35	30	5
18-19	33	27	6	30	26	4
Total	231	197 (85%)	34 (15%)	240	207 (86%)	33 (14%)

and neutrally rotated, elbow flexed to 90°, and the forearm and wrist in neutral position (Fess & Moran, 1981). A recent study (Mathiowetz, Rennells, & Donahoe, 1985) clearly supports the ASHT recommendations that elbow position affects grip strength. The results of two conditions, elbow flexed to 90° and elbow fully extended, showed a significantly stronger grip strength measurement in the 90° elbow flexed position than in the fully extended position. In another study, Mathiowetz et al. (1984) used standardized procedures (i.e., subject position and instructions) to assess the reliability and accuracy of grip and pinch strength evaluations. The highest test-retest reliability for each test was achieved when the mean of three trials was used.

None of the normative data studies for grip strength (Ager et al., 1984; Fullwood, 1986; Kellor et al., 1971), except Mathiowetz et al. (1984) and Mathiowetz, Kashman, Volland, Weber, Dowe, and Rogers (1985), reported that specific verbal instructions were given to subjects during the evaluations. Fullwood gave subjects verbal encouragement during the evaluation, but it is not clear what type of verbal encouragement or whether it was consistent for all subjects. It is believed that the verbal instructions can affect performance on evaluation tests (Davis, 1974).

Pinch Strength Evaluations

There are various operational definitions for the different types of pinch. Burmeister, Flatt, and Weiss (1974) defined palmar pinch as thumb pad to each individual finger pad, whereas Kellor et al. (1971), Ager et al. (1984), and Fullwood (1986) defined it as thumb pad to pads of the index and middle fingers. The latter definition was used in this study. Ager et al. defined lateral pinch as the pad of the thumb against the lateral surface of the index finger. Burmeister et al. and Fullwood defined lateral pinch as thumb against the radial side of the proximal interphalangeal joint of the index finger, whereas Kellor et al. defined it as the pad of the thumb against the radial side of the index finger between the distal and proximal interphalangeal joint. The ASHT (Fess & Moran, 1981) referred to the latter as key pinch and defined tip pinch as thumb tip to index finger. The recommendations of the ASHT, developed to avoid further confusion over terminology, were followed in this study.

Burmeister et al. (1974) established pinch strength norms in 5- to 13-year-olds and assessed the relationship between hand size and pinch strength. The forearm of each subject was pronated while pinch

Table 2
Average Performance of Normal Subjects on Grip Strength (lb)

Age	Hand	Males			Females		
		Mean	SD	Range	Mean	SD	Range
6-7	R	32.5	4.8	21-42	28.6	4.4	20-39
	L	30.7	5.4	18-38	27.1	4.4	16-36
8-9	R	41.9	7.4	27-61	35.3	8.3	18-55
	L	39.0	9.3	19-63	33.0	6.9	16-49
10-11	R	53.9	9.7	35-79	49.7	8.1	37-82
	L	48.4	10.8	26-73	45.2	6.8	32-59
12-13	R	58.7	15.5	33-98	56.8	10.6	39-79
	L	55.4	16.9	22-107	50.9	11.9	25-76
14-15	R	77.3	15.4	49-108	58.1	12.3	30-93
	L	64.4	14.9	41-94	49.3	11.9	26-73
16-17	R	94.0	19.4	64-149	67.3	16.5	23-126
	L	78.5	19.1	41-123	56.9	14.0	23-87
18-19	R	108.0	24.6	64-172	71.6	12.3	46-90
	L	93.0	27.8	53-149	61.7	12.5	41-86

Note: The mean scores for individuals, aged 14 to 19 years, may be slightly low (0-10 lb lower than they should be) due to instrument error detected after the study.