Rehab Measures: Hand-held Dynamometer/Grip Strength

REVIEWED
By Chris at 2:39 pm, Jan 19, 2016

Link to instrument	
Title of Assessment	Hand-held Dynamometer/Grip Strength
Acronym	
Instrument Reviewer(s)	Initially reviewed by Michele Lamb, OTR in 11/2013
Summary Date	2/7/2014
Purpose	A quantitative and objective measure of isometric muscular strength of the hand and forearm
Description	- This instrument is scored using force production: kilograms or pounds - Kilograms (0-90), Pounds (0-200) - Standardized procedure for positioning of instrument when using normative data is the following: subject is seated with back, pelvis, and knees as close to 90 degrees as possible, shoulder is adducted and neutrally rotated, elbow flexed at 90 degrees, forearm neutral, wrist held between 0-15 degrees of ulnar deviation. The arm is not supported by examiner or armrest and the dynamometer is presented vertically and in line with the forearm (Horowitz, 1997) - Maximum grip is the mean of three trials
Area of Assessment	
Body Part	
ICF Domain	Body Structure; Body Function
Domain	
Assessment Type	
Length of Test	05 Minutes or Less
Time to Administer	
Number of Items	1
Equipment Required	Requires purchase of a handheld dynamometer
Training Required	Reading of the instruction manual, familiarizing oneself to the dynamometer features
Type of training required	Reading an Article/Manual
Cost	
Actual Cost	Cost of instrument varies depending on the manufature
Age Range	
Administration Mode	
Diagnosis	Geriatrics; Stroke
Populations Tested	- Geriatrics - Healthy Adults - Stroke

Standard Error of Measurement (SEM)	**Chronic Stroke:**

(Bertrand, et al, 2007; *n* = 17; mean age 53.7(13.0); paresis of the arm as a result of a unilateral stroke that occurred > one year earlier; three trials with time intervals between two sessions as well as the time of day not fixed; participants were not involved in a rehabilitation program)

Session/Trial	Paretic SEM	Non-paretic SEM
1,1	28.78 (20%)	22.27 (8%)
1,3	26.15 (18%)	17.10 (6%)
2,1	20.35 (14%)	16.07 (6%)
2,3	18.49 (13%)	12.23 (4%)

- SEM = 0.10 (19%) session 1
- SEM = 0.07 (13%) session 2

(Boissy et al, 1999; n=15; mean age = 47 (14) years; single CVA with upper limb paresis > one year ; three measurement sessions held one week apart at approximately the same time of day; Lafayette modified prehensile dynamometer)

- SEM = 33 (non-affected handgrip force)
- SEM = 25 (affected handgrip force)
- SEM = 16 (Left handgrip force control)
- SEM = 66 (Right handgrip force control)

Reported acceptable SEMs (mean SEM = 14% of mean MVGF)

Healthy Adults and Patients with Primary Osteoarthritis of the hand (POAH):
(Ziv et al, 2008; *n* = 32 POAH; mean age 70.4 (10), *n* = 25 healthy adults; mean age 74.6 (8.4); measured twice within one week; Jamar dynamometer)

- SEM = 0.90 (kgf) right grip (healthy adults)
- SEM = 0.70 (kgf) left grip (healthy adults)
- SEM = 1.51 (kgf) right grip (POAH)
- SEM = 1.98 (kgf) left grip (POAH)

Healthy Basketball players:
(Vassilis, G., 2012; *n* = 90; three groups: prepubertal 9.8(0.7), adolescents 14.4 (0.6), and adults 26.1 (5.6); three maximal isometric contractions on each hand, two occasions, one day apart)

- SEM = 2.88% preferred hand (whole group)
- SEM = 2.41% non-preferred hand (whole group)
- SEM = 5.55% preferred hand (prepubertal)
- SEM = 4.13% non-preferred hand (prepubertal)
- SEM = 2.83% preferred hand (adolescents)
- SEM = 2.86% non-preferred hand (adolescents)
- SEM = 2.40% preferred hand (adults)
- SEM = 2.22% non-preferred hand (adults)

Minimal Detectable Change (MDC)	Not Established

Minimally Clinically Important Difference (MCID)	**Stroke:**

(Lang et al, 2008; *n* = 52; mean age 64 (14); independent prior to hemiparesis, Jamar grip dynamometer, Acute Stroke)

  • 5.0 and 6.2 (kg) for the affected dominant and non-dominant sides

Cut-Off Scores	Not Established

Normative Data

Community dwelling older adults:

(Desrosiers et al, 1994; *n* = 360; mean age = 73.9 (8.0) years; community dwelling older adults, Quebec, Canada , comparison Jamar dynamometer (kg) and Martin Vigorimeter (kPa))

Mean (Standard Deviation)				
Women	**Jamar**	**Jamar**	**Martin**	**Martin**
Age	**Right Hand (kg)**	**Left Hand (kg)**	**Right Hand (kPa)**	**Left Hand (kPa)**
60-69	25.3 (4.8)	23.6 (4.7)	53.7 (10.2)	52.4 (9.9)
70-79	23.7 (5.1)	22.0 (4.7)	52.3 (12.0)	50.1 (11.2)
80+	20.0 (4.3)	18.5 (4.4)	44.1 (9.4)	42.7 (10.9)
Men				
60-69	45.6 (8.6)	43.6 (8.7)	89.4 (16.7)	88.1 (17.2)
70-79	42.4 (9.1)	40.5 (8.5)	83.0 (18.2)	79.6 (16.2)
80+	34.5 (7.2)	32.1 (7.0)	64.6 (14.5)	64.3 (14.7)

(Stegink Jansen et al, 2008; *n* = 224; mean age = 75.4 (6.8); good health with normal hand functions; Jamar dynamometer)

Men Norm in Pounds			
Age	**Hand**	**Mean**	**SD**
65-69	R	91.5	15.5
	L	88.2	14.4
70-74	R	84.2	17.2
	L	81.4	18.4
80-84	R	70.6	14.6
	L	63.1	16.2
85+	R	54.2	14.2
	L	50.3	13.8

Women Norms in Pounds			
Age	**Hand**	**Mean**	**SD**
65-69	R	54.9	10.1
	L	51.5	9.5
70-74	R	52.5	9.5
	L	48.3	10.5
75-79	R	48.2	10.3
	L	43.6	10.7
80-84	R	44.5	11.1
	L	41.0	9.3
85+	R	40.4	11.6
	L	37.7	8.6

Healthy Adults:

(Massy-Westropp et al, 2011; 1366 mean and 1312 women, community based Australian population, healthy adults, Jamar hand dynamometer)

Men Hand Grip Strength in kilograms: Mean (SD)		
Age	Right	Left
20-29	47 (9.5)	45 (8.8)
30-39	47 (9.7)	47 (9.8)
40-49	47 (9.5)	45 (9.3)
50-59	45 (8.4)	43 (8.3)
60-69	40 (8.3)	38 (8.0)
70+	33 (7.8)	32 (7.5)

Women Hand Grip Strength in kilograms: Mean (SD)		
Age	Right	Left
20-29	30 (7)	28 (6.1)
30-39	31 (6.4)	29 (6)
40-49	29 (5.7)	28 (5.7)
50-59	28 (6.3)	26 (5.7)
60-69	24 (5.3)	23 (5)
70+	20 (5.8)	19 (5.5)

(Mathiowetz et al, 1985; 628 volunteers between the ages of 20 - 94, free from disease or injury that can affect UE strength; Jamar dynamometer in pounds)

Average Men pounds				Average Women pounds	
Age	Hand	Mean	SD	Mean	SD
20-24					
25-29					
30-34					
35-39					
40-44					
45-49					
50-54					
55-59					
60-64					

Test-retest Reliability

Stroke:

(Bertland et al, 2007, Chronic Stroke)

- **Excellent** test-retest reliability (ICC 0.80 to 0.89)

Community Dwelling Older Adults:

(Bohannon et al, 2005; n = 21; mean age 75(5.9); 2 trials over a 12-week period; healthy community dwelling)

- **Excellent** test-retest reliability (ICC = 0.954 L, 0.912 R)

(Abizanda, et al., 2012, n=281; mean age = 74.3 (4.9) years, healthy older adults)

- **Excellent** test-retest reliability (ICC = 0.9874)

Healthy Adults:

(Mathiowetz et al, 1984; n = 27; mean age 25; female OT students; two separate observations)

- **Excellent** test-retest reliability (ICC = 0.822 R, 0.915 L)

(Reddon et al., 1985, n = 12, 6 men (21 to 36 yr.), 6 women (20 to 31 yr.), tested weekly for 10 weeks)

- **Excellent** test-retest reliability (ICC = 0.81-0.99) for preferred and non-preferred hands in men
- **Excellent** test-retest reliability (ICC = 0.83-1.0) for preferred and non-preferred hands in women

Interrater/Intrarater Reliability	### Stroke: (Boissey et al, 1999, Chronic Stroke) - **Excellent** intrarater reliability (ICC > 0.086-0.95) ### Healthy Adults: (Lindstrom-Hazel et al., 2009, n = 73 convenience sample, three trials bilaterally, healthy students, facility, and staff members from Midwest University) - **Excellent** interrater reliability (ICC = 0.996-0.998) (Mathewetz, V., 2002; n = 60; 30 females 30-49 years old mean 38.4 and 30 males 20-50 mean age 37.8; free from any neuromuscular or orthopedic dysfunction; testing between Jamar and Rolyan dynamometers) - **Excellent** inter-instrument reliability Male R hand (ICC = 0.97) - **Excellent** inter-instrument reliability Male L hand (ICC = 0.90) - **Excellent** inter-instrument reliability Female R hand (ICC = 0.90) - **Excellent** inter-instrument reliability Female L hand (ICC = 0.93) (Mathiowetz, et al, 1984,) - **Excellent** interrater reliability (ICC = 0.996 R, 0.999 L) (Peolsson, 2001; n = 32; mean age = 29; convenient sample healthy adults; three test leaders) - **Excellent** intrarater reliability (ICC = 0.94 and 0.98) - **Excellent** interater reliability (ICC = 0.98 for right and left handgrip strength)
Internal Consistency	Not Established
Criterion Validity (Predictive/Concurrent)	### Healthy Adults: (Bellace et al, 2000; n = 62; ages of 18-50, randomized order of testing between Jamar and Dexter dynamometer; healthy adults) - **Excellent** concurrent validity between dominant hand (ICC = 0.99) and nondominant hand (ICC = 0.98) (Mathewetz, V., 2002, healthy adults) - **Excellent** concurrent validity Rolyan dynamometer with known weights

(0.9994 and 0.9997 before and after study)
- **Excellent** concurrent validity Jamar dynamometer with known weights (0.9998 and 0.9998 before and after study)

Construct Validity (Convergent/Discriminant)	**Stroke:**

(Boissy et al, 1999, stroke >1 yr, Chronic Stroke)

- **Adequate** correlation with Fugi-Myer upper limb performance test (r = 0.84)
- **Adequate** correlation with TEMPA upper limb function test
- **Adequate** correlation with Box and Block affected upper limb score
- **Adequate** correlation with finger-to-nose affected limb score

Content Validity	Not Established
Face Validity	Not Established
Floor/Ceiling Effects	Not Established

Responsiveness

Healthy Adults :

(Nitschke et al, 1999; n = 42; mean age 32.3 (7.3) healthy female subjects & 42.6 (11.8) nonspecific regional pain in upper arm female subjects; Jamar dynamometer)

- A change of more than 6 kg (13.2 lb) is necessary to detect a genuine change in grip strength 95% of the time.

(Reddon et al., 1985)

- **Small change**: effect size 0.01 for men's non-preferred and women's preferred hand and 0.13 for men's preferred and 0.14 for women's non-preferred hands over 10 week trial

Stroke:

(Roberts et al, 2011)

- Recovery after a stroke estimate the differences in repeat measures of hand grip strength to be between 4.7 kg and 6.2 kg

Professional Association Recommendations	

Considerations

- There is a wide range of instruments that test grip strengths, most studies use the Jamar dynamometer
- Must follow the standardized testing protocol and testing position for reliability and normative data. Changes in body position from protocol will result in altered grip strengths (Richards et al., 1996)
- The positioning of the handle will affect result in measurement discrepancies, instrument should be set at the second position on hydraulic instruments (Innes, 1999)
- Maximal grip is the mean of three trials, studies have shown that the mean of three trials is the most accurate measure of hand strength (Mathiowetz, V., Weber, K. et al., 1984)
- It is recommended that a 3 second or less grip contraction is sufficient to register maximum reading (Innes, 1999)
- 60 second rest periods between trials may prevent fatigue although studies have shown measurements taken at shorter durations result in

minimal differences (Innes, 1999)
- Instrument calibration is required annually or more frequently if used on a daily basis (Roberts et al., 2011)
- Use the same test instrument for pre and post-testing for accurate results
- Coefficient of variation (CV), a statistical stability of measures, is based on three trials of maximum grip strength at a single setting. Acceptable CV for the Jamar dynamometer are 10% male and 12% female (Innes, 1999)

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