Nutritional Assessment Platform

Measuring handgrip strength

Standard Operating Procedure

Version 2

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Aim:	Inventarisation or evaluation of maximum handgrip strength
Population:	Adults and children above 5 years of age
Time:	Approximately 5 minutes

Contents

1. Objective of the measurement

This SOP describes a method for the evaluation of the maximum handgrip strength using a hand dynamometer.

2. Abbreviations and definitions

Participant	Person who is measured
Tester	Person who performs the measurement

2. Background information

The hand dynamometer can be used for measuring maximum handgrip strength. The maximum handgrip strength is a good reflection of the muscle function of the hand and forearm and is correlated with total muscle mass. The measured maximum handgrip strength has to be compared with reference values. Handgrip strength is age and gender specific. It can also be affected by other factors, like diseases.

In this document, a standardized method is described for the measurement of the maximum handgrip strength by a hand dynamometer. Furthermore, reference values are given for different age groups.

3. Population

The maximum handgrip strength can be measured by a hand dynamometer in adults and children above 5 years of age.

4. Safety and environmental issues

4.1. Safety issues

Risk class: none. No specific requirements are defined for training of the handgrip strength measurement.

4.2. Environmental issues

Not applicable

5. Description of the measurement device

The two most used hand dynamometers are Jamar™ and Baseline. Both types of these Hand Dynamometers are held by the participant without support. The handle of the device is adjustable to different hand sizes (Fig. 1). For the Jamar dynamometer this varies from 3.5 cm (1.375 inch) to 8.6 cm (3.375 inch) with intermediate steps of 1.27 cm (0.5 inch). For the In Baseline dynamometer the adjustable handgrip varies from 3.4 (1.35 inch) to 8.5 cm (3.35 inch). The weight of the baseline device is 22.6 oz. / 638 gram. Both devices are available in analogue and digital versions.

Fig. 1. Jamar™ Hand Dynamometer

The analogue device measures in pounds (lbs; inner circle) and kilograms (kg; outer circle) with a maximum of 200 lbs or 90 kg. The special peak-hold needle is used for reading of the test results. This needle stays in the highest position until the tester manually resets it to zero.

The digital devices have the same characteristics as the analoge devices The result can be read from the digital screen where the highest measured value is displayed.

6. Cleaning and maintenance

6.1. Cleaning

Before use, the handgrip dynamometer should be cleaned with alcohol tissues.

6.2. Maintenance

The device has been calibrated by the manufacturer. It is necessary to calibrate the device once a year by the manufacturer or by the technical service ward. When the dynamometer has fallen down the accuracy is no longer guarantied, the device needs to be calibrated before using it again.

7. Performing the test

7.1. Materials needed

- Hand Dynamometer
- Chair without armrest
- Data form, digital or on paper (example in attachment 1)

7.2. Measurement procedure

7.2.1. Preparation

- Give the participant the following instructions: ”I want to measure your hand grip strength. You can sit down and bend your underarm to an angle of 90 degrees. Your arm is not allowed to touch the trunk. Your shoulders should be relaxed. When I say “squeeze”, you have to squeeze as hard as you can until I say stop. You can not feel any replacement of the handles, the strength of your grip is displayed on the meter. The measurement will be repeated two times. After each measurement the muscles are allowed to relax for a while. If you experience pain or any discomfort we will not continue the measurement.”
- Demonstrate the measurement ones and show the participant how the pinch needle works or how the reading of the digital scale increases with increasing strength.
- Ask if there are any physical limitations of the hand that might affect the grip strength.
- Ask the participant if there are remaining questions regarding the measurement.

7.2.2. Performing the measurement

- The participant needs to sit up straight and relax; For the standard measurement this means sitting down without resting/holding on to something. If this is not possible in a clinical situation, the measurement can be done in a standing or supine position. If repeated measurements are required make sure to measure participants always in the same position. Any deviation from the standard procedure has to be written down.
- Ask the participant to hold his/her arm in a 90 degree angle. The wrist needs to be in a neutral position, this means with the thumb on the top.
- Show the participant how the handgrip dynamometer works by demonstrating that a tight hold is needed and a squeeze as hard as possible for a valid result.
- When an analogue handgrip dynamometer is used, make sure the needle is set at zero before starting the measurement.
- Adjust the width of the handle of the dynamometer to the size of the participant’s hand in such a way that it feels comfortable. For the required grip the middle finger bone (phalanx) of the middle finger needs to be positioned in an angle of 90 degrees while covering the handle. Let the participant try the handgrip dynamometer first with the left and then with the right hand, write the preferred handle position down on the test form. For repeated measurements always use the same individual handle position. The handle position can influence the outcome of the measurement.
- Turn the ‘peak-hold’ needle of the handgrip dynamometer to zero.
- Encourage the participant to squeeze as hard as possible till the ‘peak-hold’ needle doesn’t move anymore. When this is the case, stop the measurement by saying ‘stop’.

- Read the maximum handgrip strength value and write this down (1 kilo accuracy).
- Take a 30 second rest period between every measurement.
- In clinical settings it is advisable to measure both hands initially. The accessibility of one hand might be lost for repeated measurements (bandages, drips, fractures). For follow up measurements you can choose to use the strongest hand.
- It is important to perform at least 2 measurements per hand, but 3 measurements are preferred.

The duration of this test is approximately 5 minutes.

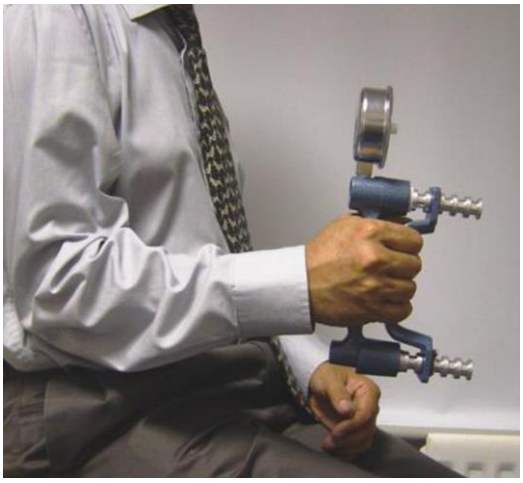

Figure 2. Handgrip measurement.

7.3. Processing of the results

7.3.1. Calculation

The highest value of the measurements will be used for analyses (1).

7.3.2. Registration

Write all the individual results down for each hand and indicate the maximum handgrip strength of these measurements.

Also register the position of the handle of the dynamometer.

7.3.3. Interpretation

The result (highest value) can be compared with the reference value of Dodds (2) for male (attachment 3) and female (attachment 4). These reference values are based on a large English population. A value under the 10th percentile will be considered a low handgrip strength. This

percentile agrees well with the P5 of Dutch reference values from the Maastricht University Medical Centre. Values are presented for different age categories: 5-9 years, 10-14 years, 15-19 years etc.

In participants with a special condition, for example: stroke, rheumatoid arthritis, or other diseases that cause loss of strength in 1 or both hands, it is expected that the maximum handgrip strength at the affected side is decreased. See for example York (3). At the non affected side measured strength will be higher. Because results of the affected side are not representative for muscle strength it can be decided not to measure at that side.

8. Methodological quality

8.1. Validity

The accuracy of the machine (after calibration; see 6.2) is, according to the manufacturer $\pm$5%, while the research of Mathiowtz (4) shows this is even better: $\pm$3%.

8.2. Reliability

The test-retest-reliability of measurements with the hand Dynamometer is good to excellent (r>0.80) (4) and the inter observer reliability is excellent (r=0.98) (5).

References

1. Roberts HC, Denison HJ, Martin HJ, Patel HP, Syddall H, Cooper C, Sayer AA (2011) A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. Age Ageing 40:423–429. doi: 10.1093/ageing/afr051
2. Dodds RM, Syddall HE, Cooper R, Benzeval M, Deary IJ, Dennison EM, Der G, Gale CR, Inskip HM, Jagger C, Kirkwood TB, Lawlor DA, Robinson SM, Starr JM, Steptoe A, Tilling K, Kuh D, Cooper C, Sayer AA (2014) Grip strength across the life course: normative data from twelve British studies. PLoS One 9:e113637. doi: 10.1371/journal.pone.0113637
3. Yorke AM, Curtis AB, Shoemaker M, Vangsnes E (2015) Grip strength values stratified by age, gender, and chronic disease status in adults aged 50 years and older. J Geriatr Phys Ther 38:115–121. doi: 10.1519/JPT.0000000000000037
4. Mathiowetz V, Weber K, Volland G, Kashman N (1984) Reliability and validity of grip and pinch strength evaluations. J Hand Surg Am 9:222–226. doi: 10.1016/S0363-5023(84)80146-X
5. Peolsson A, Hedlund R, Oberg B (2001) Intra- and inter-tester reliability and reference values for hand strength. J Rehabil Med 33:36–41.

Appendix 1: Reference values according to R. Dodds et al. [2]

		Grip strength normative values at age shown (kg)						
Age (years)	Observations *	Centiles					Mean (SD)	
		10th	25th	50th	75th	90th		
Males								
5	730	6	7	8	9	10	7.7	(2.9)
10	3222	12	15	17	20	22	17.2	(4.1)
15	288	21	25	29	33	38	29.6	(5.6)
20	354	30	35	40	46	52	41.5	(7.3)
25	574	36	41	48	55	61	48.8	(8.7)
30	984	38	44	51	58	64	51.6	(9.6)
35	1380	39	45	51	58	64	51.6	(10.1)
40	880	38	44	50	57	63	50.3	(10.3)
45	798	36	42	49	56	61	48.8	(10.3)
50	820	35	41	48	54	60	47.6	(10.1)
55	3743	34	40	47	53	59	46.2	(9.8)
60	2683	33	39	45	51	56	44.6	(9.2)
65	3947	31	37	43	48	53	42.3	(8.6)
70	3286	29	34	39	44	49	39.1	(8.1)
75	1883	26	31	35	41	45	35.6	(7.6)
80	1115	23	27	32	37	42	32.2	(7.3)
85	1134	19	24	29	33	38	28.5	(7.0)
90	431	16	20	25	29	33	24.7	(6.8)
95+	5 †							
(Total)	(28,257)							
Females								
5	700	6	7	8	9	10	8.0	(3.1)
10	3339	12	14	16	19	21	16.7	(3.8)
15	345	17	20	24	27	30	23.9	(4.5)
20	463	21	24	28	32	36	28.4	(5.1)
25	870	23	26	30	35	38	30.6	(5.6)
30	1423	24	27	31	35	39	31.4	(6.0)
35	1785	23	27	31	35	39	31.3	(6.2)
40	968	23	27	31	35	39	30.7	(6.3)
45	952	22	26	30	34	38	29.9	(6.4)
50	1019	21	25	29	33	37	28.7	(6.4)
55	4250	19	23	28	32	35	27.5	(6.4)
60	2943	18	22	27	31	34	26.5	(6.2)
65	4171	17	21	25	29	33	25.3	(6.0)
70	3473	16	20	24	27	31	23.5	(5.7)
75	2135	14	18	21	25	28	21.4	(5.4)
80	1361	13	16	19	23	26	19.1	(5.1)
85	1632	11	14	17	20	23	16.6	(4.7)
90	702	9	11	14	17	20	14.2	(4.4)
95+	15 †							
(Total)	(32,546)							

Ref: Dodds RM, Syddall HE, Cooper R, Benzeval M, Deary IJ, Dennison EM, Der G, Gale CR, Inskip HM, Jagger C, Kirkwood TB, Lawlor DA, Robinson SM, Starr JM, Steptoe A, Tilling K, Kuh D, Cooper C, Sayer AA (2014) Grip strength across the life course: normative data from twelve British studies. PLoS One 9:e113637.