



DZHK-SOP-C-09

Grip force measurement

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Modification notice :-

This SOP is a translation from the original German SOP and valid without signatures. **Printouts are not updated!**

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1 INTRODUCTION

1.1 LIST OF ABBREVIATIONS

Abbreviation	Full form
SOP	standard operating procedure
DZHK	German Centre for Cardiovascular Research
HP	hard plausibility check, input not possible
QS	quality assurance
WP	soft plausibility check, entry possible after warning
WG	working group

1.2 OBJECTIVES

This SOP describes the procedure for performing grip strength measurement to assess physical performance. It is based on the recommendations of the American Society for Surgery of the Hand and the American Society of Hand Therapists [01].

1.3 TARGET GROUP

The SOP addresses studies that investigate grip strength.

1.3.1 Inclusion criteria

The inclusion criteria depend on the underlying study.

1.3.2 Exclusion criteria

Complete exclusion of persons from the grip strength measurement is only intended in the case of bilateral amputation or paralysis. If a person expresses reservations about the measurement (fear of causing pain, etc.), a test attempt should be made. If a person subsequently refuses the measurement or breaks off the attempt during the measurement (due to pain, etc.), this must be documented accordingly in the form (see attachment).

1.4 TERMS AND DEFINITIONS

Grip strength: short for isometric handgrip strength.

Sarcopenia: increasing loss of muscle mass and strength with an associated reduction in physical capacity.

1.5 CORRELATIONS TO OTHER EXAMINATIONS

The relationships from the individual SOP to other procedures are described here.

Mandatory preliminary examination (SOP...)	/
Recommended preliminary examination (SOP...)	/

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Preliminary examination to be excluded (SOP...)	/
Interference with other parts of the examination:	/

Mandatory follow-up examination (SOP...)	/
Recommended follow-up examination (SOP...)	/
Follow-up examination to be excluded (SOP)	/

1.6 LEVEL OF QUALITY

The requirements for this SOP correspond to DZHK quality level 2.

 DZHK Quality levels	
Implementation	
Level 1	The examination is performed in accordance with the guidelines of the scientific societies.
Level 2	The examination is performed in accordance with the specifications of the DZHK SOP. Minimum requirements for ensuring the quality of the implementation and the examiners are defined in the SOP.
Level 3	The examination is performed in accordance with the specifications of the DZHK SOP <u>and</u> certification of the examiners: Definition of intra-observer and inter-observer variability (standard of epidemiological studies).

2 PREREQUISITE OF THE EXAMINATION

Considering all the circumstances to ensure the investigation.

2.1 REQUIREMENTS FOR ROOMS/EQUIPMENTS

The measurement site should be selected so that the participant is undisturbed. He or she should be able to fully concentrate on the measurement.

2.2 DEVICES/ HARDWARE

Hand grip strength is considered a parameter of muscle strength, which in turn is a component of physical performance [1, 2]. The determination of grip strength is frequently used in clinical settings and is a widely used test in epidemiological studies [3, 6]. In this context, low grip strength is associated with a higher risk of mortality [7, 8]. The measurement of grip strength is performed using dynamometer. The Jamar hand dynamometer is a commonly used grip strength measurement device with high reliability and validity [4, 5, 9-13].

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1. dynamometer, e.g. Jamar Plus Digital (Patterson Medical, Sammons Preston, Bolingbrook, IL) (see Fig.1)
2. height-adjustable chair with upright backrest without armrests (for the participating person)
3. footstool, if applicable
4. chair or stool (for the examining person)
5. pen and protocol/eCRF or laptop
6. spare batteries for the measuring device (or spare measuring device)
7. disinfectant and paper towels

Figure 1: Dynamometer Jamar Plus Digital Hand in Grip Width Adjustment II.

2.3 REQUIRED INFORMATION

Date, patient-ID

2.4 STAFF

The examination can be performed by all staff members who have thoroughly studied this SOP, have seen an examination and have subsequently performed at least 3 examinations without error under the supervision of a person already trained in the SOP. No special certification is required.

3 PROCESS OF IMPLEMENTATION/WORK PROCESS/PREPARATION FOR THE INVESTIGATION

3.1.1 Preparation of the workplace

Actions that need to be done to perform the procedure. E.g. darkening of the room etc.

3.1.2 Preparation of the equipment

Grip width



Figure 1: Releasing the locking lever

Grip width II is used uniformly for all participating persons, as also recommended by the American Society of Hand Therapists [3, 4, 11, 13-14]. To adjust the grip width, first loosen the lower locking lever (see Fig. 2). Then pull the handle out of the upper device and place it in the device for grip width II (corresponds to a distance of 4.8 cm). Then close the locking lever again.

Unit

The device can display the measurement result in kilograms (KG) or pounds (LB). Depending on the dynamometer, the switch is located on the back of the instrument or below the batteries. Before each examination, check whether the display shows KG (see Fig. 3A). If this is not the case, the selector switch must be moved accordingly (Fig. 3B).

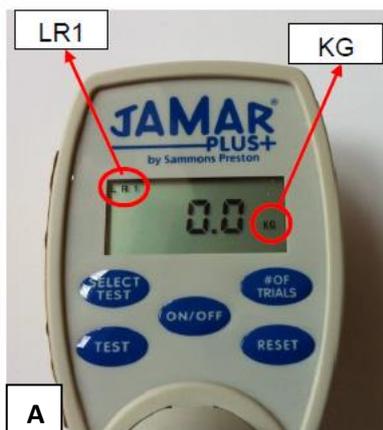


Figure 2 A: Display of the Jamar dynamometer. **B:** selector switch.

3.1.3 Principles of preparation of the person to be examined

Actions that need to be done to carry out the procedure, checking participation criteria/identification, etc.

3.2 CONDUCT THE EXAMINATION

The grip force measurement is based on the recommendations of Roberts et al [15]: Three measurements are performed for each hand (six measurements in total). The first measurement is performed on the right hand, followed directly by the measurement on the left hand. The pause between measurements on the same hand is at least 15 seconds [4]. All six measured values are noted. The target value is the maximum value of all six measurements [3, 4, 15, 16].

The Jamar Plus meter offers the possibility to use different pre-programmed test modes (left, right, left and right, continuous measurements, 2-5 repetitions). The selection is made using the SELECT TEST and # OF TRIALS buttons. The selected test is shown in the upper left corner of the display (see marking in Fig. 3A). Repeated pressing of the SELECT TEST key selects the LR1 test mode.

3.2.1 Measuring position

Following the recommendation of the American Society of Hand Therapists [17] and the recommendations of Roberts et al [15], the participant should adopt the following measurement position (Fig. 4):

- upright sitting position
- feet: placed on the floor (for small persons use foot bench if necessary)
- shoulder: adducted and neutrally rotated
- elbow: 90 degrees flexion
- forearm: neutral position
- Measurement of grip strength is performed without hand jewelry, i.e. rings or watches (if hand jewelry cannot be removed, this must be documented). Pressed breathing during the measurement must be prevented.



Figure 3 Measuring position. During the measurement, the examiner counts aloud ("1 - 2 - 3"), where at "1" the force should build up slowly and at "3" the maximum force should be reached.

3.2.2 Procedure of grip force measurement

Note: Before starting the test, check that the grip width II is set.

1. have the person sit on the chair and take off his or her hand jewelry
2. explain the aim and procedure of the measurement
3. ask for and document the person's handedness.

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4. ask if there are any restrictions regarding the feasibility of the measurement (acute injuries, operations, etc.) and document them accordingly
5. switch on the dynamometer
6. transfer the dynamometer to the person's right hand and press the TEST key
7. give the start command "Attention - ready - go", carry out the measurement and count the seconds "1 - 2 - 3" (see 3.2.3 Instruction)
8. the examiner takes the dynamometer and documents the measured value; press the RESET button
9. transfer the measuring device to the left hand of the participant and press the TEST button
10. give the start command, perform the measurement, note the measured value
11. this measurement cycle (testing of both hands) is performed three times
12. if necessary, document any special events
13. disinfect and dry the handle of the measuring instrument

3.2.3 Instruction

Participating subjects will be instructed prior to testing with the following wording:

1. This test measures your maximum gripping force. It is a static test, which means that you have to push against a fixed, immovable resistance. We test both your right hand and your left hand. Each hand is tested three times. We start with the right hand. The left hand is measured directly afterwards.
2. Is the measurement of maximum hand strength feasible for you, or do you have any limitations that could prevent the test from being performed on one or both hands, e.g. diseases of the hand and finger joints, acute injuries or operations, inflammations, etc.?
3. During the test, be sure to keep the following position. This is very important. (The examiner will demonstrate the position to be maintained during the instruction). Sit on the chair with your upper body upright. Feet are planted and maintain contact with the floor throughout the test. Let the shoulders and upper arms hang loosely so that the upper arms are close, but not resting, next to your body. The elbow on the side being tested should be bent 90 degrees. The other hand rests on your thigh (if necessary, let the back of your hand rest on your thigh to avoid strong compensating movements). Now enclose the handle of the measuring device with your fingers (the examiner hands the measuring device to the participant). Keep the wrist in a neutral position.
4. On my command "Attention - ready - go" you start the test. I will then count "1 - 2 - 3" so you know how long you need to maintain the force. Please build up the force slowly at "1" and at

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"3" you should have reached maximum force. After that, release your grip and hand over the device to me. Please continue to breathe normally during the test.

5. If you feel pain or discomfort during the measurement, please stop the test.

During the test, there is no verbal motivation on the part of the examiner. The person merely counts out loud ("1 - 2 - 3"). After the last measurement, the participant can be informed of the maximum measured value. If desired, an age- and gender-specific reference value can also be communicated (see appendix). Finally, the dynamometer is cleaned with disinfectant and paper towels.

3.2.4 Termination criteria

If one or more specifications for the measurement position (see 3.2.1 Measurement position) are not adhered to (e.g. angle of the elbow joint deviates significantly from 90 degrees, feet leave the ground), the measurement is invalid. The invalid measurement is repeated on the same hand after a pause of at least 15 seconds (maximum two repeat attempts). Only after a valid attempt or after a maximum of three invalid attempts is the measuring device transferred to the other hand.

3.2.5 Calibration and review of measurement accuracy

Calibration of the device is performed in consultation with the manufacturer.

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5 MODIFICATION

Modifications as compared to the previous version.

Section	Description of the modification as compared to the previous version
	None, since first version.

6 LIST OF CONTRIBUTORS

Name	Function	Contribution
Dr. Anna Feuerstein	Author	Drafted the SOP
Prof. Frank Edelmann	Review	Review and draft of the SOP
Mahsa Lee	WG Data standardization	IT implementation
Dr. Ilka Wilhelmi	WG Data standardization	Coordination

7 APPENDIX

7.1 eCRF-MODUL

Grip force																					
<p>1. Was the examination performed? <input type="radio"/> yes <input type="radio"/> no <input type="radio"/> unknown <input type="radio"/> not assessed</p>	<p>Comment Query</p>																				
<p>2. Date of examination <input type="text"/> - <input type="text"/> - <input type="text"/> dd.mm.yyyy </p>	<p>Comment Query</p>																				
<p>3. Handedness <input type="radio"/> Right <input type="radio"/> Left</p>	<p>Comment Query</p>																				
<table border="0" style="width: 100%;"> <thead> <tr> <th style="width: 15%;"></th> <th style="width: 35%; text-align: center;">Right</th> <th style="width: 10%;"></th> <th style="width: 35%; text-align: center;">Left</th> <th style="width: 5%;"></th> </tr> </thead> <tbody> <tr> <td>Test 1</td> <td style="text-align: center;"><input type="text"/> . <input type="text"/> kg</td> <td></td> <td style="text-align: center;"><input type="text"/> . <input type="text"/> kg</td> <td></td> </tr> <tr> <td>Test 2</td> <td style="text-align: center;"><input type="text"/> . <input type="text"/> kg</td> <td></td> <td style="text-align: center;"><input type="text"/> . <input type="text"/> kg</td> <td></td> </tr> <tr> <td>Test 3</td> <td style="text-align: center;"><input type="text"/> . <input type="text"/> kg</td> <td></td> <td style="text-align: center;"><input type="text"/> . <input type="text"/> kg</td> <td></td> </tr> </tbody> </table>		Right		Left		Test 1	<input type="text"/> . <input type="text"/> kg		<input type="text"/> . <input type="text"/> kg		Test 2	<input type="text"/> . <input type="text"/> kg		<input type="text"/> . <input type="text"/> kg		Test 3	<input type="text"/> . <input type="text"/> kg		<input type="text"/> . <input type="text"/> kg		<p>Comment Query</p>
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Test 1	<input type="text"/> . <input type="text"/> kg		<input type="text"/> . <input type="text"/> kg																		
Test 2	<input type="text"/> . <input type="text"/> kg		<input type="text"/> . <input type="text"/> kg																		
Test 3	<input type="text"/> . <input type="text"/> kg		<input type="text"/> . <input type="text"/> kg																		
<p>5. Comment</p> <div style="border: 1px solid #ccc; height: 40px; width: 100%;"></div>	<p>Comment Query</p>																				

7.2 REFERENCE VALUES

Reference values of the dominant hand. From: Werle S, Goldhahn J, Drerup S, Simmen BR, Sprott H, Herren DB. Age- and gender-specific normative data of grip and pinch strength in a healthy adult Swiss population. J Hand Surg Eur Vol 2009; 34(1): 76-84

Sex	Age	Grip force (kg) mean	Grip force (kg) standard deviation	Grip force (kg) min	Grip force (kg) max
male	18-19	51,2	6,6	33,7	64,0
male	20-24	53,9	8,7	40,7	79,0
male	25-29	53,0	7,5	40,7	74,3
male	30-34	55,0	7,1	42,0	68,0
male	35-39	55,9	7,9	36,0	73,0
male	40-44	54,2	8,1	40,0	78,0
male	45-49	51,8	8,3	30,7	64,0
male	50-54	50,8	9,1	26,3	73,3
male	55-59	53,6	8,6	35,7	72,0
male	60-64	47,9	6,4	33,7	62,7
male	65-69	43,0	6,8	25,3	57,0
male	70-74	41,7	8,9	22,7	61,0
female	18-19	32,0	4,8	22,7	42,7
female	20-24	33,4	5,4	23,7	42,3
female	25-29	34,3	5,7	22,0	45,0
female	30-34	33,8	5,9	20,3	45,7
female	35-39	35,8	6,7	18,7	50,0
female	40-44	34,0	6,0	24,3	51,3
female	45-49	34,1	5,3	24,3	47,7
female	50-54	33,7	4,5	24,0	42,0
female	55-59	31,9	4,9	25,3	48,0
female	60-64	28,7	5,5	13,3	37,0
female	65-69	29,5	3,6	23,3	36,7
female	70-74	26,4	6,8	10,3	40,7

7.3 GUIDELINE GRIP FORCE MEASUREMENT

- Completeness of the measuring utensils:
 - documentation sheet
 - disinfectant and paper towels
 - spare batteries for the measuring device
 - dynamometer (handle width 2, measuring unit in kg and test mode LR1 set)
- brief explanation of the examination module
- adjust sitting position (feet on the floor); have hand jewelry taken off
- ask the participant about restrictions (diseases of the hand or finger joints, acute inflammations, surgeries, ...) - Consideration of whether the test is useful or a criterion for exclusion
- explain and demonstrate measurement position:
 - shoulders and upper arms hang loosely (upper arm close, but not resting against the body)
 - elbow of the tested side should be bent 90 degrees (possibly check at the side of the participant)
 - other hand rests on the thigh
 - normal breathing (no forced breathing) during the test
 - inform the participant that the measurement will be taken three times on each side
 - give the command "Attention - ready - go" and then count "1 - 2 - 3" (at "1" slowly build up the force and at "3" exert maximum force)
- performing the measurement
 - switch on the device (ON/OFF key)
 - press the TEST key
 - transfer the measuring device to the right hand of the participant, if necessary put the safety loop on the device during the measurement
 - check correct arm position
 - do not motivate the participant during the measurement
 - after completion of the measurement, enter the values into the eCRF

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- press RESET and then TEST on the device and place it in the participant's left hand
- wait at least 15 sec. for repeated measurements on the same hand
- disinfection and switching off of the device after completion of the measurement
- note special features or reason if test cannot be performed: acute swelling, inflammation or severe pain, surgery or injury to arm/hand/fingers/armpit within the last six months; amputations, paralysis

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