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## **The impact of variation in the device used to measure grip strength on the identification of low muscle strength: Findings from a randomised cross-over study**

### **APPENDIX 1 – Grip strength measurement protocol**

Four different types of dynamometer will be used during the calibration study: the Nottingham electronic; Jamar hydraulic; Jamar digital; Smedley. Wherever possible, four measures will be ascertained using each device (2 measures in each hand (in the order: Left 1, Right 1, Left 2, Right 2)).

To ensure comparability of measures across devices a standard protocol will be used when performing each set of grip strength tests (see Roberts et al, Age and Ageing 2011;40(4):423-9). This standard protocol is described below.

#### **Equipment:**

- Dynamometer
- A standard straight backed chair with solid arms

#### **Checks before performing the first set of grip strength measurements:**

Exclusion criteria.

- swelling or inflammation, severe pain or recent injury in their hands
- surgery to the hand in the last 6 months (if there is a problem with one hand only use just take measurements on the other hand)
- blood pressure over  $\geq 200$ mmHg for systolic or  $\geq 120$ mmHg for diastolic.

If the participant has any of these, explain to the participant that they cannot do the grip strength tests as it would not be safe

#### **EXPLAIN THE TEST:**

READ OUT:

**“We would like to assess the strength of your hand in a gripping action. This test will be done using 4 different machines and each time I would like to take 2 measurements in each hand.”**

*NOTE: The participant should have use of both hands as a screening question will have been asked before recruitment. However, if the participant only has use of one hand please record this and perform the two measurements in that hand.*

READ OUT:

**“Which is your dominant hand?”**

Proceed with the tests (if participant has use of both hands the order of the tests for each device will be: Left hand, Right hand, Left hand, Right hand)

#### **GENERAL PROTOCOL:**

1. Sit the participant comfortably in a standard chair with legs, back support and fixed arms. Use the same chair for every measurement.
2. Ask the participant to rest their left forearm on the arm of the chair in the mid-prone position (i.e. with the thumb facing upwards) and their wrist just over the end of the arm of the chair in a neutral but slightly extended position.
3. Place the dynamometer handle in their left hand (and when using either of the Jamar devices carefully place the wrist strap around the participant’s left wrist)

4. Position the hand so that the thumb is round one side of the handle and the four fingers are around the other side. The instrument should feel comfortable in the hand. Alter the position of the handle if necessary. Large rings may need to be removed.

5. Tell the participant that after I say 'And Go' I will need you to squeeze the handle of the device as hard as you can, just for a couple of seconds until I tell you to stop and then let go. Make it clear that gripping very tightly registers the best score.

6. Once you are happy that the participant's arm is positioned correctly and that the device is ready to record you are then ready to take the measure.

7. Say '**And Go!**' at which point the participant should squeeze as hard as they can for a couple of seconds and then release quickly. You should provide verbal encouragement by telling the participant to '**Squeeze, squeeze, squeeze**' and then you should tell them after a few seconds to stop.

8. During the test please make sure that the participant's arm remains in position resting on the arm of the chair.

9. Record the value on the display to the nearest 0.1kg (for the Jamar digital and Nottingham Electronic devices), 1kg (for the Jamar hydraulic device) or 0.5kg (for the Smedley device).

10. Once the value for the left hand is recorded carefully take the dynamometer from the participant and repeat the test in the participant's right hand.

NOW REPEAT THE INSTRUCTIONS ABOVE AND TAKE A SECOND MEASUREMENT IN THE LEFT HAND, FOLLOWED BY A SECOND MEASUREMENT IN THE RIGHT HAND

**Appendix Supplementary Figure 1:** Overlap between men and women classified as low muscle strength by four different hand-held dynamometers (Jamar Hydraulic (Jamar H); Jamar Plus+ Digital (Jamar D); Nottingham Electronic; Smedley)

