Normative values and effect of gender and anthropometric parameters on hand grip strength

Ruby Sharma¹, Sandeep Joshi², K.D. Singh³, Avnish Kumar⁴

Introduction:
Handgrip strength has been shown to be a fast, non-expensive and noninvasive method to assess the skeletal muscle function in general population and in clinical assessment of patients.

Materials and Methods:
The present study was conducted on healthy medical students in the age group of 18-21 years to determine the normative values and to study the effect of gender and general anthropometric parameters on handgrip strength. Handgrip strength was measured using standard handgrip dynamometer.

Results:
In our study, the mean handgrip strength in females was 18.30±4.44 kg and 16.23±3.57 kg in dominant and non-dominant hand respectively, while in males, the mean handgrip strength was 43.07±15.04 kg and 35.20±13.87 kg respectively. Our study shows a strong correlation between handgrip strength and weight and BMI of the subject in both females and males. Our study also showed a significant positive correlation between handgrip strength and height of the subject in male subjects.

Conclusion:
Normal values of handgrip strength are needed for future reference. The handgrip strength is influenced by various physiological and anthropometric parameters. This effect should be taken into consideration while using it as an assessment tool.

Key words: Handgrip strength, Dynamometer, Gender, Anthropometry

Abstract:
Introduction: Handgrip Strength has been shown to be a fast, non-expensive and noninvasive method to assess the skeletal muscle function in general population and in clinical assessment of patients. Materials and Methods: The present study was conducted on healthy medical students in the age group of 18-21 years to determine the normative values and to study the effect of gender and general anthropometric parameters on handgrip strength. Handgrip strength was measured using standard handgrip dynamometer. Results: In our study, the mean handgrip strength in females was 18.30±4.44 kg and 16.23±3.57 kg in dominant and non-dominant hand respectively, while in males, the mean handgrip strength was 43.07±15.04 kg and 35.20±13.87 kg respectively. Our study shows a strong correlation between handgrip strength and weight and BMI of the subject in both females and males. Our study also showed a significant positive correlation between handgrip strength and height of the subject in male subjects. Conclusion: Normal values of handgrip strength are needed for future reference. The handgrip strength is influenced by various physiological and anthropometric parameters. This effect should be taken into consideration while using it as an assessment tool.

Key words: Handgrip strength, Dynamometer, Gender, Anthropometry
treatment goals, and is frequently utilized during determination of hand disability ratings.

Different modalities have been used for assessing the handgrip strength in clinical settings which include manual muscle testing (MMT) and dynamometry. In general, instrumented strength testing has been demonstrated to be more reliable than MMT. Dynamometers are devices that measure force or power. Several classes of dynamometers are available which include spring-loaded compression devices, air compression devices, and hydraulic compression devices [7]. The most common and reliable method for assessment of grip strength is the use of handgrip dynamometer.

An important obstacle in the routine use of handgrip strength measurement as an assessment measure is non-availability of reference values in normal population in the same demographic region. So it is important that every laboratory should have normative values of handgrip strength which can be used as reference in future studies. The present study was designed to determine the normative values and to study the effect of general anthropometric parameters on handgrip strength in healthy normal medical students of both sexes.

Materials and Methods

The present study was conducted on 80 healthy subjects in the age group of 18-21 years, out of which there were 40 male and 40 female subjects. The subjects for the study were taken up among the students of Govt. Medical College, Patiala. The study was approved by the ethical committee of the institute. Correct procedure of the test was explained to all subjects and informed consent was taken. Subjects having any neurological, genetic or chronic illness causing muscular weakness or affecting the hand function were excluded from the study, based on clinical history and physical examination. Anthropometric parameters including age, weight, height and Body Mass Index (BMI) of all subjects were measured.

The grip strength was measured using a standard electronic handgrip dynamometer in the standing position. The subject was explained the procedure and made to relax. The dynamometer was held freely without support, not touching the subject’s trunk. The grip size was adjusted so that the middle finger mid portion was at a right angle when the dynamometer was held, so allowing optimum overlap of muscle filaments. The subject’s forearm was placed at an angle of 90° and wrist was kept in a mid prone position. The subjects were asked to put maximum force on the dynamometer. The maximum value was recorded in kilograms. The test was then repeated with the other hand after a rest of 30 seconds.

Results

Table 1 shows the comparison of anthropometric parameters and handgrip strength between male and female subjects. There was statistically significant difference in the height, weight and Body Mass Index (BMI) between the two groups, with males having higher mean values than the females. The difference in age between the two groups was found to be statistically non-significant. The handgrip strength measurements in both dominant and non-dominant hands were significantly higher in males than females (p<0.01) (Fig. 1).

Table 1: Anthropometric parameters and handgrip strength in female and male subjects

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Females (Mean ± S.D.)</th>
<th>Males (Mean ± S.D.)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>18.3 ± 0.75</td>
<td>18.6 ± 0.80</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Height (cms)</td>
<td>160 ± 6.18</td>
<td>173 ± 6.22</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>55.3 ± 8.72</td>
<td>70.3 ± 11.6</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>21.6 ± 4.10</td>
<td>23.2 ± 3.25</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Dominant handgrip (kg)</td>
<td>18.3 ± 4.44</td>
<td>43.0 ± 15.0</td>
<td>P&lt;0.01</td>
</tr>
<tr>
<td>Non dominant Handgrip (kg)</td>
<td>16.2 ± 3.56</td>
<td>35.2 ± 13.8</td>
<td>P&lt;0.01</td>
</tr>
</tbody>
</table>

Correlation analysis between anthropometric parameters (Age, Ht, Wt, BMI) and handgrip strength was done using Pearson coefficient ‘r’ (Tables 2 and 3). In the female subjects, there was significantly positive correlation of handgrip strength in both hands with Weight and BMI of the subject. The correlation of handgrip strength in females with age and height was found to be statistically non-significant. In the male subjects, there was significant
positive correlation of handgrip strength with Weight, Height and BMI of the subject.

**Figure 1: Comparison of handgrip strength between female and male subjects in both hands**

![Graph showing comparison of handgrip strength between female and male subjects in both hands](chart.png)

**Table 2: Correlation analysis of anthropometric parameters with handgrip strength in females**

<table>
<thead>
<tr>
<th>Variable correlated</th>
<th>Dominant Hand</th>
<th>Non dominant Hand</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation coefficient</td>
<td>Significance</td>
</tr>
<tr>
<td>Age vs Handgrip strength</td>
<td>0.221</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>Weight vs Handgrip strength</td>
<td>0.467</td>
<td>P&lt; 0.01</td>
</tr>
<tr>
<td>Height vs Handgrip strength</td>
<td>0.222</td>
<td>P&gt;0.05</td>
</tr>
<tr>
<td>BMI vs Handgrip Strength</td>
<td>0.320</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

**Table 3: Correlation analysis of anthropometric parameters with handgrip strength in males**

<table>
<thead>
<tr>
<th>Variable correlated</th>
<th>Dominant Hand</th>
<th>Non dominant Hand</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Weight vs Handgrip strength</td>
<td>0.467</td>
<td>P&lt; 0.01</td>
</tr>
<tr>
<td>Height vs Handgrip strength</td>
<td>0.346</td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>BMI vs Handgrip Strength</td>
<td>0.362</td>
<td>P&lt;0.05</td>
</tr>
</tbody>
</table>

**Discussion**

Many factors have been documented to be related to grip strength in the literature. Hand Grip strength is a composite measure of hand function and may be influenced by dysfunction in muscles, tendons, and any of the small joints of the hand and wrist [8]. It is also influenced by various physiological and anthropometric parameters including age, gender, height, weight, body mass index and also by specific hand parameters. The values also vary from institute to institute because of the different recording instruments. Therefore every institute should have its standardized parameters according to the device used.

The hand grip strength increases with age in both male and females children. This age related increase is associated with changes in muscle mass during growth. In our study, the age group of subjects was small. So the changes in handgrip strength with age could not be correlated. In our study, the mean handgrip strength in females was 18.30±4.44 kg and 16.23±3.57 kg in dominant and non-dominant hand respectively, while in males, the mean handgrip strength was 43.07±15.04 kg and 35.20±13.87 kg respectively (p<0.01). In a study done by Luna Heredia et al [9] in healthy adults aged 17-97 years, the handgrip strength in non-dominant hand was 22.8 ± 7.2 kg in females and 35.1 ± 12.4 kg in males. Our study shows a strong correlation...
between handgrip strength and weight and BMI of the subject in both females (p<0.05) and males (p<0.05). Our study also showed a significant positive correlation between handgrip strength and height of the subject in male subjects (p<0.05). Our findings were consistent with the results of previous studies [10-17] which showed that the handgrip strength is influenced by age, sex and anthropometric parameters like height, weight and BMI. Correlation between grip strength and height in female subjects was found to be statistically non-significant.

Conclusion

Handgrip strength is a reliable indicator of general muscle strength. In our study, the handgrip strength was significantly higher in male subjects as compared to females. The grip strength is significantly influenced by the general anthropometric parameters including weight, height, BMI and hand parameters. The effect of these factors should be kept in mind while using handgrip strength as an assessment tool in clinical and research work.

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References