Section 7: Muscular Strength, Endurance and Flexibility

ACSM Guidelines: Chapter 4 (pp. 94-107)
ACSM Manual: Chapter 5,6

HPHE 4450
Dr. Cheatham

Outline

• Importance of muscular strength and endurance
• Types of muscular contractions
• General Testing Guidelines
• Muscle strength
  – Hand-Grip Dynamometry, 1-RM
• Muscular Endurance
  – Push-Up Test, Curl-Up Test, YMCA Bench Press Test
• Importance of flexibility
  – Sit and Reach Tests
  – Lumbar Flexion and Extension
  – Specific ROM Tests
**Importance of Muscular S and E**

- Health-related fitness component that may maintain or improve the following:
  - Bone mass (related to osteoporosis)
  - Glucose tolerance (related to Type 2 diabetes)
  - Musculotendinous integrity (related to lower risk of injury, low-back pain)
  - Carry out ADL's
  - Fat-free mass and RMR (related to weight management)
- Performance applications

**Types of Contractions**

- **Static (Isometric)**
  - Muscle generates force without movement (i.e. muscle does not change length)

- **Dynamic**
  - Muscle generates force while lengthening or shortening
    - Concentric: Muscle shortens
    - Eccentric: Muscle lengthens
  - Isotonic: Fixed resistance
  - Isokinetic: Fixed movement speed

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**TABLE 6.1 Health and Fitness Benefits of Aerobic Compared to Strength Training**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Aerobic Exercise</th>
<th>Resistance Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resting blood pressure</td>
<td>↓↓</td>
<td>++↓</td>
</tr>
<tr>
<td>Serum HDL cholesterol</td>
<td>↑↑</td>
<td>+↑</td>
</tr>
<tr>
<td>Insulin sensitivity</td>
<td>↑↑</td>
<td>↑</td>
</tr>
<tr>
<td>Percent body fat</td>
<td>↓↑</td>
<td>↑</td>
</tr>
<tr>
<td>Bone mineral density</td>
<td>↑↑↑</td>
<td>↑↑↑↑</td>
</tr>
<tr>
<td>Strength</td>
<td>←↑↑</td>
<td>↑↑↑↑</td>
</tr>
<tr>
<td>Physical function in old age</td>
<td>↑↑</td>
<td>↑↑</td>
</tr>
<tr>
<td>VO₂max</td>
<td>↑↑↑</td>
<td>↑↑↑↑</td>
</tr>
</tbody>
</table>

Number of arrows refers to strength of scientific evidence, with three arrows indicating conclusive evidence: ↑↑↑ increased, ↑↑ increased, ↔ no change

**General Testing Guidelines**

- Use a familiarization/practice session
- Adhere to specific protocol
  - Predetermined repetition duration and range of motion
- The standardized protocol should include:
  - Strict posture
  - Consistent movement speed
  - Full ROM
  - Use of spotters (if necessary)
  - Equipment familiarization
  - Proper warm-up

**Muscular Strength**

- Definition: Maximal force that can be generated by a specific muscle or muscle group
- Specific to:
  - Muscle group
  - Type of contraction
  - Speed of contraction
  - Joint angle tested
  - Results from a test are specific to the procedures used
  - No single test exists for evaluating total body muscular endurance or muscular strength
**Muscular Strength**

- Purpose of measurement:
  - Assess muscular fitness
  - Identify weaknesses
  - Monitor progress in rehabilitation
  - Measure the effectiveness of training

**Assessing Muscular Strength**

- Common assessments
  - Handgrip test
  - 1-repetition maximum (RM) bench press
  - Isokinetic testing
Assessing MS – Hand Grip

**BOX 5.1  Procedures for the Static Handgrip Strength Test**

1. Have the client stand for the test. Usually, this test is performed with each hand. The norms provided use a combined score for the right and left hands. The test can also be performed with only the dominant hand.
2. Adjust the grip bar so that the second joint of the fingers will be bent to grip the handle of the dynamometer.
3. Have the client hold the handgrip dynamometer parallel to the side of the body. The elbow should be flexed at 90 degrees. Make sure that the dynamometer is set to zero.
4. The client should then squeeze the handgrip dynamometer as hard as possible without holding the breath (to avoid the Valsalva maneuver). It is optional if the client wishes to extend the elbow; however, other body movement should be avoided.
5. Record the grip strength in kilograms. Repeat this procedure using the opposite hand.
6. Repeat the test two more times with each hand. Take the highest of the three readings for each hand and add these two values (one from each hand) together as the measure of handgrip strength to compare with the norms presented in Table 5.1.

Assessing MS – Hand Grip
Assessing MS – Hand Grip

### TABLE 5.1. Grip-Strength Norms

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>15-19</th>
<th>20-29</th>
<th>30-39</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Above average</td>
<td>103–112</td>
<td>64–70</td>
<td>113–123</td>
</tr>
<tr>
<td>Below average</td>
<td>84–94</td>
<td>54–58</td>
<td>97–105</td>
</tr>
<tr>
<td>Poor</td>
<td>≤83</td>
<td>≤53</td>
<td>≤96</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>40–49</th>
<th>50–59</th>
<th>60–69</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender M</td>
<td>F</td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>Below average</td>
<td>94–101</td>
<td>55–58</td>
<td>87–95</td>
</tr>
<tr>
<td>Poor</td>
<td>≤93</td>
<td>≤54</td>
<td>≤86</td>
</tr>
</tbody>
</table>

Numbers are in pounds (lbs).

Assessing MS – 1-RM

- One-Repetition Maximum (1-RM)
  - Maximal force that can be generated by a specific muscle or muscle group
  - The heaviest weight that can be lifted only once using good form
  - Dynamic Strength
  - “Gold-Standard”
Assessing MS – 1-RM

BOX 5.2 Procedures for a One Repetition Maximum (1-RM) Assessment (7)

1. The subject should warm up by completing several submaximal repetitions.
2. Determine the 1-RM (or any multiple-RM) within four trials with rest periods of 3–5 min between trials.
3. Select an initial weight that is within the subject’s perceived capacity (~50%–70% of capacity).
4. Progressively increase resistance by 2.5–20 kg until the subject cannot complete the selected repetition(s); all repetitions should be performed at the same speed of movement and range of motion to ensure consistency between trials.
5. Record the final weight lifted successfully as the absolute 1-RM or multiple-RM.


Assessing MS – 1-RM

- 6 or 10-RM Test
  - Can be useful especially for determining weights for exercise prescription
  - Adapt 1-RM procedures to determine 6 or 10-RM value.
  - Optional:
    - Convert 10-RM value to a 1-RM estimation by dividing 10-RM weight by 0.75
Assessing MS – 1-RM

• Interpretation of Data:
  – ACSM provides norm charts for Upper Body Strength (Bench Press) and Lower Body Strength (Leg Press)
  – Values are often expressed as Strength-to-weight ratio
    • Strength-to-Weight Ratio = Weight Lifted / Body Weight
      – Both weights must be in the same units
Assessing MS – 1-RM

TABLE 1.8: Fitness-Components for Upper Body Strength for Men and Women by Age

<table>
<thead>
<tr>
<th></th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-79</th>
<th>80+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>200</td>
<td>150</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>Women</td>
<td>150</td>
<td>120</td>
<td>90</td>
<td>45</td>
<td>22.5</td>
<td>11.25</td>
</tr>
</tbody>
</table>

Assessing MS – 1-RM

TABLE 1.9: Fitness-Components for Upper Body Strength for Men and Women by Age

<table>
<thead>
<tr>
<th></th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-79</th>
<th>80+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>200</td>
<td>150</td>
<td>100</td>
<td>50</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>Women</td>
<td>150</td>
<td>120</td>
<td>90</td>
<td>45</td>
<td>22.5</td>
<td>11.25</td>
</tr>
</tbody>
</table>

Note: All values are in pounds.
Assessing MS – 1-RM

Muscular Endurance

- Definition: The ability of a muscle group to execute repeated contractions over a time period sufficient to cause muscular fatigue or to maintain a specific percentage of maximum voluntary contraction for a prolonged time
  - Same idea with respect to specificity and muscle strength
Assessing Muscular Endurance

- Common assessments
  - Push-up test
  - Partial curl-up test
  - YMCA bench press test

Assessing ME – Push-Up Test

**BOX 5.4 Push-up Test Procedures for Measurement of Muscular Endurance**

1. The push-up test is administered with male subjects starting in the standard “down” position (hands pointing forward and under the shoulder, back straight, head up, using the toes as the pivotal point) and female subjects in the modified “knee push-up” position (legs together, lower leg in contact with mat with ankles plantar-flexed, back straight, hands shoulder width apart, head up, using the knees as the pivotal point).
2. The subject must raise the body by straightening the elbows and return to the “down” position, until the chin touches the mat. The stomach should not touch the mat.
3. For both men and women, the subject’s back must be straight at all times and the subject must push up to a straight arm position.
4. The maximal number of push-ups performed consecutively without rest is counted as the score.
5. The test is stopped when the client strains forcibly or is unable to maintain the appropriate technique within two repetitions.

Assessing ME – Push-Up Test

![Push-Up Test Image](image)

### Table 5.5: Fitness Categories for Push-up

<table>
<thead>
<tr>
<th>Category</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>F</td>
<td>M</td>
<td>F</td>
<td>M</td>
</tr>
<tr>
<td>Excellent</td>
<td>36</td>
<td>30</td>
<td>30</td>
<td>27</td>
<td>25</td>
</tr>
<tr>
<td>Very good</td>
<td>35</td>
<td>29</td>
<td>29</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>Good</td>
<td>28</td>
<td>21</td>
<td>22</td>
<td>20</td>
<td>17</td>
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<tr>
<td>Fair</td>
<td>22</td>
<td>15</td>
<td>17</td>
<td>13</td>
<td>13</td>
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<tr>
<td>Needs improvement</td>
<td>17</td>
<td>10</td>
<td>12</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

Assessing ME – Curl-Up Test

BOX 5.5 Curl-up (Crunch) Test Procedures for Measurement of Muscular Endurance

CURL-UP (CRUNCH)
1. The individual assumes a supine position on a mat with the knees at 90 degrees. The arms are at the side, palms facing down with the middle fingers touching a piece of masking tape. A second piece of masking tape is placed 10 cm apart.\(^a\) Shoes remain on during the test.
2. A metronome is set to 50 beats \(\text{min}^{-1}\) and the individual does slow, controlled curl-ups to lift the shoulder blades off the mat (trunk makes a 30-degree angle with the mat) in time with the metronome at a rate of 25 per minute. The test is done for 1 minute. The low back should be flattened before curling up.
3. Individual performs as many curl-ups as possible without pausing, to a maximum of 25.\(^b\)

\(^a\) Alternatives include: (a) having the hands held across the chest, with the head activating a counter when the trunk reaches a 30-degree position (3) and placing the hands on the thighs and curling up until the hands reach the knee caps (6). Elevation of the trunk to 30 degrees is the important aspect of the movement.
\(^b\) An alternative includes doing as many curl-ups as possible in 1 minute.


Assessing ME – Curl-Up Test

[Images of individuals performing curl-ups]
Assessing ME – Curl-Up Test

### TABLE 5.6: Fitness Categories for the Partial Curl-Up by Age and Sex

<table>
<thead>
<tr>
<th>Percentile</th>
<th>Gender</th>
<th>20–29</th>
<th>30–39</th>
<th>40–49</th>
<th>50–59</th>
<th>60–69</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>M</td>
<td>W</td>
<td>M</td>
<td>W</td>
<td>M</td>
</tr>
<tr>
<td>90</td>
<td>Well above average</td>
<td>75</td>
<td>70</td>
<td>75</td>
<td>55</td>
<td>75</td>
</tr>
<tr>
<td>80</td>
<td>Above average</td>
<td>56</td>
<td>45</td>
<td>69</td>
<td>43</td>
<td>75</td>
</tr>
<tr>
<td>70</td>
<td>Average</td>
<td>41</td>
<td>37</td>
<td>46</td>
<td>34</td>
<td>67</td>
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<tr>
<td>60</td>
<td>Below average</td>
<td>31</td>
<td>32</td>
<td>36</td>
<td>28</td>
<td>51</td>
</tr>
<tr>
<td>50</td>
<td>Average</td>
<td>27</td>
<td>27</td>
<td>31</td>
<td>21</td>
<td>39</td>
</tr>
<tr>
<td>40</td>
<td>Below average</td>
<td>24</td>
<td>21</td>
<td>26</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>30</td>
<td>Average</td>
<td>20</td>
<td>17</td>
<td>19</td>
<td>12</td>
<td>26</td>
</tr>
<tr>
<td>20</td>
<td>Below average</td>
<td>13</td>
<td>12</td>
<td>13</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>10</td>
<td>Average</td>
<td>4</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
</tbody>
</table>

M, men; W, women. Adapted from (4). Used with permission.

Assessing ME – YMCA Bench Press Test

### BOX 5.3 Procedures for the YMCA Submaximal Bench Press Test (6)

The test requires a 35-lb bar for women and a bar with weights totaling 80 lb for men.

1. Position the client on the bench (supine position) with both feet on the floor.
2. A spotter should hand the barbell to the client (hands shoulder width apart) and be available throughout the test to grasp the barbell when necessary. The test is started in the down position with the bar touching the chest.
3. Set a metronome to 60 beats per minute and have the client perform a contraction by lifting the bar to full extension with one beat and then lowering the bar to touch the chest with the next beat. The lifting cadence will produce 30 repetitions per minute. Encourage the client to breathe regularly to avoid the Valsalva maneuver.
4. The test continues until the client is unable to reach full extension of elbows or cannot complete a repetition on schedule with the cadence while using correct form. (Note: For highly fit subjects, an upper limit may need to be established.)

Results are compared with the norms presented in Table 5.4.
Assessing ME – YMCA Bench Press Test

Flexibility

- Definition: Functional capacity of the joints to move through the full range of motion (ROM)
- Joint-specific
- Depends on:
  - Joint capsule distensibility
  - Adequate warm-up
  - Muscle viscosity
  - Compliance of the ligaments and tendons
Flexibility

• Why is flexibility important?
  – Performance of ADL’s
  – Relationship to lower back pain
  – Athletic performance

Assessing Flexibility

• Common assessments:
  – Sit-and-Reach Box Test (trunk flexion)
  – YMCA Sit-and-Reach Test
  – Lumbar Flexion and Extension
  – Specific Range of Motion Tests

• General Testing Guidelines
  – Stretching, light aerobic exercise (5-10 min)
  – Practice session to assess pain, discomfort
Assessing Flexibility – Sit and Reach Tests

**BOX 6.1 Trunk Flexion (Sit-and-Reach) Test Procedures**

**Preparation:** Clients/Patients should perform a short warm-up prior to this test and include some stretches (e.g., modified hurdler’s stretch). It is also recommended that the participant refrain from fast, jerky movements, which may increase the possibility of an injury. The participant’s shoes should be removed.

1. For the Canadian Trunk Forward Flexion test, the client sits without shoes and the soles of the feet flat against the flexometer sit-and-reach box at the 26 cm mark. Inner edges of the soles are placed within 2 cm of the measuring scale. For the YMCA sit-and-reach test, a yardstick is placed on the floor and tape is placed across it at a right angle to the 15 in mark. The client/patient sits with the yardstick between the legs, with legs extended at right angles to the taped line on the floor. Heels of the feet should touch the edge of the taped line and be about 10 to 12 in apart. (Note: zero point at the foot/box interface and use the appropriate norms.)

2. The client/patient should slowly reach forward with both hands as far as possible, holding this position approximately 2 s. Be sure that the participant keeps the hands parallel and does not lead with one hand. Fingertips can be overlapped and should be in contact with the measuring portion or yardstick of the sit-and-reach box.

3. The score is the most distant point (cm or in) reached with the fingertips. The best of two trials should be recorded. To avoid with the best attempt, the client/patient should relax and drop the head between the arms when reaching. Testers should ensure that the knees of the participant stay extended; however, the participant’s knees should not be pressed down. The client/patient should breathe normally during the test and should not hold their breath at any time. Norms for the Canadian test are presented in Table 6.1. Note that these norms use a sit-and-reach box in which the “zero” point is set at the 26 cm mark. If a box is used in which the zero point is set at 25 cm (e.g., FitnessGram), subtract 3 cm from each value in this table. The norms for the YMCA test are presented in Table 6.2.

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Assessing Flexibility – Sit and Reach Tests

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Assessing Flexibility – Sit and Reach Tests

![Image of two individuals performing a sit and reach test]

**TABLE 6.1: Fitness Categories for Trunk Forward Flexion Using a Sit-and-Reach Box (cm)** by Age and Sex

<table>
<thead>
<tr>
<th>Category</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>M</td>
<td>W</td>
<td>M</td>
<td>W</td>
<td>M</td>
</tr>
<tr>
<td>Excellent</td>
<td>40</td>
<td>41</td>
<td>38</td>
<td>41</td>
<td>36</td>
</tr>
<tr>
<td>Very good</td>
<td>39</td>
<td>40</td>
<td>37</td>
<td>40</td>
<td>34</td>
</tr>
<tr>
<td>Good</td>
<td>34</td>
<td>37</td>
<td>33</td>
<td>36</td>
<td>29</td>
</tr>
<tr>
<td>Fair</td>
<td>30</td>
<td>33</td>
<td>28</td>
<td>32</td>
<td>24</td>
</tr>
<tr>
<td>Needs improvement</td>
<td>25</td>
<td>28</td>
<td>23</td>
<td>27</td>
<td>18</td>
</tr>
</tbody>
</table>

*These norms are based on a sit-and-reach box in which the “zero” point is set at 26 cm. When using a box in which the zero point is set at 23 cm, subtract 3 cm from each value in this table.

M, man; W, woman.

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Assessing Flexibility – Sit and Reach Tests

<table>
<thead>
<tr>
<th>PERCENTILE</th>
<th>18-25</th>
<th>26-35</th>
<th>36-45</th>
<th>46-55</th>
<th>56-65</th>
<th>&gt;65</th>
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</thead>
<tbody>
<tr>
<td>M</td>
<td>22</td>
<td>24</td>
<td>21</td>
<td>23</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>F</td>
<td>20</td>
<td>22</td>
<td>19</td>
<td>21</td>
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<td>18</td>
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<td>17</td>
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<td>11</td>
</tr>
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<td>17</td>
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<td>9</td>
<td>13</td>
<td>12</td>
<td>11</td>
</tr>
</tbody>
</table>

M, male; F, female.

The following may be used as descriptors for the percentile rankings: well above average (90), above average (70), average (50), below average (30), and well below average (10).

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Making a Sit and Reach Box

Making “Sit-and-Reach” Devices

To make the box, cut the following pieces using wood or 1/4” plywood.

4 pieces: 12” x 12”
1 piece: 12” x 2”

Assemble the pieces using wood screws and glue.

Inscribe the top panel with gradations so that the 9-inch mark is in line with the vertical panel against which the boy’s feet are placed. The measuring scale should extend from 0 at the front edge to 21 inches at the far end. You may choose to simply tape a yardstick to the top panel.

As an alternative to the sit-and-reach box, tape a yardstick to the top of a bench. Or, tape a yardstick to the edge of a bench laid on its side so that the front is the panel against which the feet are placed. Make sure to invert the yardstick so that the 9-inch mark is in line with the panel against which the feet are placed.
Assessing Flexibility – Lumbar Flexion

- Seated with pelvis stabilized
- Tape is positioned with zero at the spinous process C7
- Measure down the superior iliac
- Lumbar flexion performed until first sign of resistance
- Average healthy range: 4-inch increase
Assessing Flexibility – Lumbar Extension

• Same body and tape position as for flexion assessment
• Lumbar extension is performed until first sign of resistance
• Average healthy range: 2-inch increase
Assessing Flexibility – ROM Tests

• Use of Goniometers:
  – Fulcrum centered to identified anatomic landmark
  – Stabilization arm remains fixed (establishes the start position)
  – Movement arm moves in relation to client’s movement (establishes the ending position)

Assessing Flexibility – ROM Tests

• General Procedures:
  – Before beginning:
    • Provide the client with a demonstration of an ROM test
    • Position the goniometer
    • Locate the fulcrum at the joint axis or hinge point
      – Where the axis of rotation occurs for the two body segments
    • Place the stabilization and movement arms
      – Centered along each body segment
Assessing Flexibility – ROM Tests

• Goniometry is an accurate measure if:
  – All anatomic landmarks are identified
  – Joint axis point has been clearly defined
  – Body is stabilized in proper alignment
  – Client is instructed to move slowly through the proper ROM and the goniometer is properly aligned
  – Test administrator is familiar with normal ROM for each joint
  – Observation of whether ROM assessment is pain free occurs

Assessing Flexibility – ROM Tests

For each assessment, locations of the goniometer for the following three points are specified:

1. Fulcrum
2. Stabilization arm
3. Movement arm
Assessing Flexibility – ROM Tests – Shoulder

Movement: Flexion

Goniometer position
1. Fulcrum: Lateral aspect of greater tubercle
2. Stabilization arm: Perpendicular to the floor
3. Movement arm: Align with the midline of humerus and reference the lateral epicondyle

Stabilization
– Client is in good posture with a stabilized scapula (retracted), thoracic, and lumbar
– Stabilize scapula to prevent tilting, rotation, or elevation

Assessing Flexibility – ROM Tests – Shoulder

Movement: Flexion

Starting/ending body position
• Seated with glenohumeral in 0 degrees of flexion, extension, abduction, or adduction
• Head is in neutral position
• Palm of hand facing body
• Elbow completely extended
• Client performs glenohumeral flexion until the first sign of resistance

Average ROM: 0-180°
Assessing Flexibility – ROM Tests – Shoulder

Movement: Extension

Goniometer position
1. Fulcrum: Lateral aspect of greater tubercle
2. Stabilization arm: Perpendicular to the floor
3. Movement arm: Align with the midline of humerus and reference the lateral epicondyle

Stabilization
– Client is in good posture with a stabilized scapula (retracted), thoracic, and lumbar
– Stabilize scapula to prevent tilting, rotation, or elevation
– Place towel under humerus to stabilize and align with acromion process

Assessing Flexibility – ROM Tests – Shoulder

Movement: Extension

Starting/ending body position
• Client is prone on table with glenohumeral in 0 degrees of flexion, extension, abduction, or adduction
• Head is in neutral position
• Palm of hand facing the body
• Elbow is extended completely
• Perform glenohumeral extension until the first sign of resistance

Average ROM: 0-60°
Assessing Flexibility – ROM Tests – Shoulder

Movement: Internal Rotation

Goniometer position
1. Fulcrum: Olecranon process of the elbow
2. Stabilization arm: Perpendicular to the floor
3. Movement arm: Align with lateral midline of ulna and reference the ulnar styloid

Stabilization
– Client is in good posture with a stabilized scapula (retracted), thoracic, and lumbar
– Stabilize scapula to prevent tilting, rotation, or elevation
– Place towel under humerus to stabilize and align with acromion process

Assessing Flexibility – ROM Tests – Shoulder

Movement: Internal Rotation

Starting/ending body position
• Client is supine on table with humerus abducted at 90 degrees and elbow is flexed at 90 degrees.
• Elbow is at 0 degrees of supination and pronation
• Client performs glenohumeral internal rotation until the first sign of resistance

Average ROM: 0-70°
Assessing Flexibility – ROM Tests – Shoulder

Movement: External Rotation

• Goniometer position and stabilization are the same as in internal rotation of the shoulder

• Starting position is the same, but the client performs external rather than internal rotation until signs of resistance occur

Average ROM: 0-90°

Assessing Flexibility – ROM Tests – Hip

Goniometer position

1. Fulcrum: Greater trochanter of the lateral thigh
2. Stabilization arm: Lateral midline of the pelvis
3. Movement arm: Lateral midline of the femur, using the lateral epicondyle as a reference

Stabilization

– Client is in good posture with a stabilized scapula, thoracic, lumbar spine, and pelvic area
– Pelvis should not rise off table
– Opposite leg not being assessed should have knee flexed and foot flat on table for added stability and protection for the back
Assessing Flexibility – ROM Tests – Hip

Movement: Flexion (Testing Leg Fully Extended)

- Client is supine on table with hip in 0 degrees of flexion, extension, abduction, adduction, and rotation
- Testing leg has knee fully extended
- Client performs hip flexion until the first sign of resistance or until the pelvis rotates or knee breaks extension

Average ROM: 0-90°

Assessing Flexibility – ROM Tests – Hip

Movement: Flexion (Testing Knee and Hip Flexed at 90 Degrees)

Starting/ending body position

- Client is supine on table with knee flexed at 90 degrees and hip flexed at 90 degrees; hip is in 0 degrees of abduction, adduction, and rotation
- Knee is flexed to reduce contraction of hamstrings
- Client performs hip flexion until the first sign of resistance or until the pelvis rotates

Average ROM: 0-120°
Assessing Flexibility – ROM Tests – Hip

Movement: Extension (Testing Leg Fully Extended)

Starting/ending body position
- Client is prone on table with hip in 0 degrees of flexion, extension, abduction, adduction, and rotation
- Testing leg has knee fully extended
- Client performs hip extension until the first sign of resistance or until the pelvis rotates

Average ROM: 0-30°

Assessing Flexibility – ROM Tests – Hip

Movement: Abduction

Goniometer position
1. Fulcrum: Locate at the ASIS (anterior superior iliac spine)
2. Stabilization arm: Imaginary horizontal line connecting axis point ASIS to the other ASIS
3. Movement arm: Anterior midline of the femur, using the midline of the patella as a reference

Stabilization
- Client is in good posture with a stabilized scapula, thoracic, lumbar spine, and pelvic area
- Stabilize for lateral trunk flexion on both sides
**Assessing Flexibility – ROM Tests – Hip**

**Movement: Abduction**

**Starting/ending body position**
- Client is supine on table with hip in 0 degrees of flexion, extension, and rotation
- Testing leg has knee fully extended
- Client performs hip abduction until the first sign of resistance or lateral trunk flexion occurs on either side

**Assessing Flexibility – ROM Tests – Hip**

**Movement: Adduction**

**Goniometer position**
1. Fulcrum: Locate at the ASIS (anterior superior iliac spine)
2. Stabilization arm: Imaginary horizontal line connecting axis point ASIS to the other ASIS
3. Movement arm: Anterior midline of the femur, using the midline of the patella as a reference

**Stabilization**
- Client is in good posture with a stabilized scapula, thoracic, lumbar spine, and pelvic area
- Opposite leg not being tested should be abducted fully to allow for testing hip to be assessed
Assessing Flexibility – ROM Tests – Hip

Movement: Adduction

Starting/ending body position
• Client is supine on table with hip in 0 degrees of flexion, extension, and rotation
• Testing leg has knee fully extended
• Client performs hip adduction until the first sign of resistance or lateral trunk flexion or pelvic rotation occurs

Average ROM: 0–30°
Assessing Flexibility – ROM Tests

• It is important to recognize that a learning effect is likely with flexibility measurements.
• Thus, the following statement from ACSM's Resource Manual for Guidelines for Exercise Testing and Prescription is of importance:
  – A recommendation from the American Medical Association suggests that ROM should be measured using three consecutive trials and averaged as the true value. If the average ROM is 50 degrees, three of the measurements must fall within ±5 degrees of the mean. If the average is greater than 50 degrees, three measurements must fall within ±10 degrees of average. Such measures may be taken up to six times until they meet the criteria; otherwise, they are considered invalid.