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| **About the Measure** | |
| **Protocol Id** | 21101 |
| **Domain:** | Anthropometrics |
| **Measure:** | Mid-Upper Arm Circumference |
| **Definition:** | Measurement of the circumference of the mid-upper arm |
| **Purpose:** | Mid-upper arm circumference is a recognized and important anthropometric measure in children and in pregnant women to assess their nutritional status. |
| **Essential PhenX Protocols:** | Current Age [10101] Sex Assigned at Birth [11601] Gender Identity [11801] |
| **Related PhenX Protocols:** | Ethnicity and Race [11901] Maximum Adult Weight [21001] Total Pregnancy Weight Gain - Self-Reported Weight Gain [21301] Total Pregnancy Weight Gain - Abstracted From Prenatal Charts [21302] Total Pregnancy Weight Gain - Weight Measured During Gestation [21303] Weight Loss/Gain [21401] Weight - Measured Weight [21501] Weight - Self-Reported Weight [21502] Waist Circumference - Waist Circumference NHANES [21601] Waist Circumference - Waist Circumference NCFS [21602] Waist Circumference - Framingham Heart Study [21603] |
| **Measure Release Date:** | October 01, 2015 |

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| **About the Protocol** | |
| **Protocol Release Date:** | March 27, 2009 |
| **Protocol Review Date:** | October 01, 2015 |
| **PhenX Protocol Name:** | Mid-Upper Arm Circumference |
| **Protocol Name From Source:** | National Health and Nutrition Examination Survey (NHANES), Anthropometry Procedures Manual, 2007 |
| **Protocol Availability:** | Available |
| **Keywords:** | Anthropometrics; nutrition; NHANES |
| **Description:** | Arm circumference is measured at the midpoint of the distance from the acromion process of the shoulder to the tip of the olecranon process of the elbow. |
| **Specific Instructions:** | Several overarching, critical issues for high-quality data collection of anthropometric measures that optimize the data in gene-environment etiologic research include (1) the need for training (and retraining) of study staff in anthropometric data collection; (2) duplicate collection of measurements, especially under field conditions; (3) use of more than one person for proper collection of measurements where required; (4) accurate recording of the protocols and the measurement units of data collection; and (5) use of required and properly calibrated equipment.  The notion of recommending replicate measurements comes from the reduction in random errors of measurement and accompanying improved measurement reliability when the mean of multiple measurements is used rather than the a single measurement. This improvement in measurement reliability, however, depends on the reliability of a single measurement in the hands of the data collectors in a particular study (Himes, 1989). For example, if a measure such as recumbent length in a given study has a measurement reliability of 0.95 (expressed as an intraclass correlation coefficient), taking a second measurement and using the mean of the two measurements in analyses will improve the reliability to only 0.97, yielding only a 2% reduction in error variance for the additional effort. If, in the same study, the reliability of a single triceps skinfold measurement was 0.85, using the mean, including a replicate measurement, would raise the reliability to 0.92 and yield a 7% reduction in error variance, more than a three-fold improvement compared with recumbent length.  Because the benefits of taking replicate measurements are so closely linked with the existing measurement reliability, it is recommended that as a part of the training of those who will be collecting anthropometry data, a reliability study be conducted that will yield measurement reliability estimates for the data collectors, protocols, settings, and participants involved in that particular study (Himes, 1989). If the measurement reliability for a single measurement is greater than or equal to 0.95, the recommendation is that replicate measurement are not necessary and will yield little practical benefit. If the measurement reliability is less than 0.95, the recommendation is to include replicate measurements as prescribed.  If replicate measurements are indicated because of relatively low reliability, a second measurement should be taken, including repositioning the participant. A third measurement should be taken if the first two measurements differ by more than 1.0 cm. If it is necessary to take a third measurement, the two closest measurements are averaged. Should the third measurement fall equally between the first two measurements, all three should be averaged.  First, the upper arm length is measured using bone landmarks, and the midpoint distance is marked for the circumference measurement. Measure the right arm at the level of the upper arm midpoint mark. |
| **Protocol:** | The following protocol is part of a national examination study.  Note: Detailed videos illustrating this procedure can be found on the National Health and Nutrition Examination Survey (NHANES) website.  **Protocol to Determine the Midpoint**  The mid-upper arm circumference is measured on the right arm at the level of the upper arm midpoint mark. The examiner makes this mark on the posterior surface of the arm immediately after measuring the upper arm length. The procedures for making the mid-arm circumference mark are explained below:  1. Position the participant: Direct the participant to turn away from you. Ask participant to stand upright with his/her weight evenly distributed on both feet, the right arm bent 90 degrees at the elbow, and the right palm facing up. Demonstrate the correct position if necessary. Remove any covering from the participant’s arm.  For infants and children unable to stand, instruct the parent (or guardian) to sit with the child in his or her lap. Ask the parent to remove any clothes from the child’s arm.  Have the participant bend the arm or have the parent bend the child’s arm at the elbow to a 90-degree angle.  2. Mark the measurement site: Locate the lateral end of the spine of the right scapula by following the scapula out to the arm until it makes a sharp V-turn to the front of the body. Using the cosmetic pencil, make a horizontal line on the uppermost edge of the posterior border of the spine extending from the acromion process (see Exhibit 1).  3. Take the measurement: Hold the zero end of the measuring tape at this mark and extend the tape down the posterior surface of the arm to the tip of the olecranon process, the bony protrusion of the elbow (Exhibit 5). Take the measurement to the nearest 0.1 cm. IMPORTANT: The tape must be centered on the posterior surface of the arm. Exhibit 2 shows the correct placement of the measuring tape centered on the posterior surface of the arm; whereas Exhibit 3 shows the measuring tape placed incorrectly.  4. Divide the measure in half to calculate the midpoint of the measured length. Make a horizontal mark at the midpoint and cross this mark with a perpendicular line (Exhibit 4). IMPORTANT: The vertical line must be centered on the posterior surface of the arm. This mark defines the site at which the arm circumference will be measured.  5. Finally, tell the participant to relax the right arm. Proceed to the arm circumference measurement.  [img[021101\_Mid\_Upper\_Arm\_Circumference\_1.jpg|]]  Exhibits 1-4.  [img[021101\_Mid\_Upper\_Arm\_Circumference\_2.jpg|]]  **Mid-Upper Arm Circumference Measurement Protocol**  1. Position the participant: Ask the study participant to turn so that you stand facing his or her right side. Have the participant stand upright with the weight evenly distributed on both feet, the shoulders relaxed, and the right arm hanging loosely at the sides. Flexing or tightening the arm muscles will yield an inaccurate measurement.  2. Take the measurement: Continue to stand facing the right side of the study participant. Wrap the measuring tape around the arm at the level of the upper arm midpoint mark. Position the tape perpendicular to the long axis of the upper arm and make sure the tape is level around the circumference. Pull the two ends of the overlapping tape together so that the zero end sits below the measurement value and the result lies on the lateral aspect of the arm (not the posterior surface). Check that the tape fits snug around the arm but does not compress the skin. Take the measurement to the nearest 0.1 cm. |
| **Selection Rationale:** | The National Health and Nutrition Examination Survey 2007-2008 protocols were selected as best practice methodology and are the most widely used protocols to assess mid-upper arm circumference. |
| **Source:** | Centers for Disease Control and Prevention (CDC), National Center for Health Statistics (NCHS). (2007-2008). *National Health and Nutrition Examination Survey Anthropometry Procedures Manual*. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.  Detailed training videos are available from the CDC and World Health Organization websites  CDC website: [link[www.cdc.gov/nchs/video/nhanes3\_anthropometry/circumference/circumference.htm|http://www.cdc.gov/nchs/video/nhanes3\_anthropometry/circumference/circumference.htm]]  WHO website:[link[www.who.int/childgrowth/training/en/|http://www.who.int/childgrowth/training/en/]] |
| **Language** | English Chinese Other languages available at source |
| **Participant:** | Participants aged 2 months or older |
| **Personnel and Training Required:** | Technicians should be trained in the basic techniques of anthropometric measurements. |
| **Equipment Needs:** | Calibrated measurement tape in centimeters and inches, cosmetic pencil used to mark measurement site |
| **Standards** | |  |  |  |  | | --- | --- | --- | --- | | **Standard** | **Name** | **ID** | **Source** | | Logical Observation Identifiers Names and Codes (LOINC) | PhenX - upper arm circ protocol | 62412-2 | [LOINC](http://s.details.loinc.org/LOINC/<INSERT_ID>.html?sections=Web) | |
| **General References:** | Brahmbhatt, S. R., Brahmbhatt, R. M., & Boyages, S. C. (2001). Impact of protein energy malnutrition on thyroid size in an iodine deficient population of Gujarat (India): Is it an aetiological factor for goiter? *European Journal of Endocrinology, 145*(1), 11-17.  Trowbridge, F. L., & Staehling, N. (1980). Sensitivity and specificity of arm circumference indicators in identifying malnourished children. *American Journal of Clinical Nutrition, 33*(3), 687-696.  Waterlow, J. (1999). Treatment of children with malnutrition and diarrhoea. *Lancet, 354*(9185), 1142.  Yuksekkaya, H. A., Cakir, M., Tumgor, G., Baran, M., Arikan, C., Yagci, R. V., & Aydogdu, S. (2008). Nutritional status of infants with neonatal cholestasis. *Digestive Diseases and Sciences, 53*(3), 803-808. |
| **Mode of Administration:** | Physical Examination |
| **Derived Variables:** | None |
| **Requirements:** | |  |  | | --- | --- | | **Requirement Category** | **Required (Yes/No)** | | **Major equipment** | No | | **Specialized training** | No | | **Specialized requirements for biospecimen collection** | No | | **Average time of greater than 15 minutes in an unaffected individual** | No | |
| **Annotations for Specific Conditions:** | None |
| **Process and Review:** | The [link[phenxtoolkit.org/about/teams#erp1-members|Expert Review Panel #1]] reviewed the measures in the Anthropometrics, Diabetes, Physical Activity and Physical Fitness, and Nutrition and Dietary Supplements domains.  Guidance from the ERP includes:  • Added replicate measure language  • Changed unit of measurement  Back-compatible: no changes to Data Dictionary  Previous version in Toolkit archive ([link[www.phenxtoolkit.org/domains/view/20000#tab5content|link]]) |