Verification of Conversion Formulae for MUAC on Skin and Clothing

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*Background***:** This paper investigated the feasibility of measurements of mid-upper-arm circumferences (MUAC) on loose-fitting clothing, whereas the standard protocols require the measurements to be performed on bare skin. For cultural reasons it is, sometimes, not feasible to take measurements on bare skin for peripubertal/adolescent girls as part of field studies conducted in semi-private settings.

*Methods***:** MUAC measurements were taken on 88 children (47 boys, 41 girls), age range 6-10 years. 2 measurements were taken on each child, one with left arm covered with loose-fitting clothing covering the arm and the other on bare skin using tailor's tape maintaining the same environmental conditions in the morning hours (9 am to 12 noon) using the equations

$$g = G - 2\pi a \text{ (tight-fitting clothing)};\ \ g = G' + 2a(1-\pi) \text{ (loose-fitting clothing)}$$

where, g MUAC on bare skin G MUAC on tight-fitting clothing
              a Thickness of clothing (obtained using G' MUAC on loose-fitting clothing, not including 2
                 micrometer screw gauge)   layers, held in front to fix things

*Step-by-Step Procedures***:** Child sat on stool and place both hands on thighs, arm aligned with the upper torso. If child's feet did not touch the floor, wooden planks were placed on the floor so that the feet were resting on the plank and making an angle of 90^0 with shin. In case legs were long, with the result that thigh and shin were making angle greater than 90^0, when the child was sitting on the stool, the stool was raised to make the angle exactly 90^0, feet resting on floor. The acromial and the radial landmarks were located and distance between the two landmarks measured. The reading was divided by 2 and the circumference measured at the midpoint distance from shoulder.

*Source of Hazard/Injury***:** Pressing too hard on the skin of hand and blocking circulation.

*Sources of Error***:** The following could contribute to errors in readings**:**

a) Not measuring exactly at the center   d) Swelling due to allergy and inflammation
b) Stretching the tailor tape   e) Position of hands
c) Measuring after exercise/after IV infusion   f) Child holding on to something in hands

*Results***:** This study has provided MUAC-measurement standard for children 6-10-year old. The relationship between bare-skin and loose-fitting MUAC has a goodness of fit of 99.7%.

*Conclusion***:** Results of this study indicated that MUAC of children measured lie in the category of nourished. The formula is applicable only if one layer of clothing of uniform thickness is worn.

Fig. 1*a-c*. Illustrating (*a*) positioning of feet on wooden planks, (*b*) determining separation of acromial and radial landmarks as well as (*c*) measuring MUAC at the midpoint of acromial and radial landmarks

*Keywords***:** Anthropometry, calibration, children, mid-upper-arm circumference, nutritional status

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