**Nutrition Assessment For Child with Cerebral Palsy or “CP like NDD”**

AACPDM 2014 Meeting, Samson-Fang, I. Kupersmith M, Stevenson RD, Bell K

<table>
<thead>
<tr>
<th>Weight: _____ Kg (Weight ____ #)</th>
<th>Todays Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight Percentile: ___ %</td>
<td>Name:</td>
</tr>
<tr>
<td>Naked</td>
<td>DOB:</td>
</tr>
<tr>
<td>Clothed</td>
<td>Age: _____ months __ yrs</td>
</tr>
<tr>
<td></td>
<td>Gender M F</td>
</tr>
<tr>
<td>Standing Ht: _____ cm __ inches</td>
<td>Recumbent Lt: _____ cm __ inches</td>
</tr>
<tr>
<td>Height Percentile ___ %</td>
<td>Length Percentile ___ %</td>
</tr>
<tr>
<td></td>
<td>recumbent board utilized (best)</td>
</tr>
<tr>
<td></td>
<td>tape on bed used (? reliable)</td>
</tr>
<tr>
<td></td>
<td>considered unreliable due to</td>
</tr>
<tr>
<td></td>
<td>significant scoliosis, spasticity, or poor</td>
</tr>
<tr>
<td></td>
<td>cooperation</td>
</tr>
</tbody>
</table>

**Segmental Measures and Height Estimates**

*See equations on back, Only certain equations can be used in at certain ages so choice of measure depends on child’s age, equipment available, and training of the individual measurer.*

Ulnar Length: _____ cm (age 5-19 years old)

Side of Body: [ ] R [ ] L

Ulnar Length Percentile for age/gender (see attached curves) ___ %

Ulnar Height Estimate: ___ cm

Height Estimate Percentile on CDC or WHO Height Growth Curve ___ %

**OR**

Tibial Length: _____ cm (birth to 12 years old)

Side of Body: [ ] R [ ] L

Tibial Stature Estimate: ___ cm

Stature Estimate Percentile on CDC or WHO Height Growth Curve ___ %

**OR**

Knee Height: _____ cm (birth to 18 years old)

Side of Body: [ ] R [ ] L

Knee Height Stature Estimate: ___ cm

Stature Estimate Percentile on CDC or WHO Height Growth Curve ___ %

*Caution in using height estimates to calculate growth velocity, weight for height percentile, or BMI!!!*
<table>
<thead>
<tr>
<th>Body Fat Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSF _____ mm _____% age/gender</td>
</tr>
<tr>
<td>Side of measured: [R] [L]</td>
</tr>
<tr>
<td>SSF: _____mm _____% age/gender</td>
</tr>
<tr>
<td>Side of measured: [R] [L]</td>
</tr>
<tr>
<td>Age: _____ [months] [yrs]</td>
</tr>
<tr>
<td>Gender [M] [F]</td>
</tr>
</tbody>
</table>

Estimation of Body Fat Using Gurka Method
Use For Patients > 6 years of Age (see next page for equations)

Body Fat Percentage by Gurka Method _____ %

Assessment of Body Fat % Percentile for Gender and Age (see curves):
[ ] under  [ ] appropriate  [ ] overweight  [ ] obese

Use only in patients with CP and CP like neurodevelopment disability

Measurement of Body Fat Using BIA

Wt: ____ kg
R: ____
Ht: ____ cm

TBW (kg) = 0.59 Ht²/R + 0.065(Wt) + 0.04 = _____ kg

FFM (Kg) = TBW/hydration factor = _____ kg
(see table for age/gender hydration factors page 10)

Fat Mass (FM) = Wt - FFM = _____ kg
Percentage Body Fat = FMM/Wt x 100 = _____%

Assessment of Body Fat % Percentile for Gender and Age (see curves):
[ ] under  [ ] appropriate  [ ] overweight  [ ] obese

Height (Ht), Weight (Wt), R (resistance), TBW (total body water) FFM (fat free mass), FM (fat mass),

DEXA to measure Body Composition

[ ] ordered
[ ] unable due to hardware or pump
[ ] unable due to age or inability to cooperate
[ ] unable due to positioning concerns
[ ] not clinically needed at this time
<table>
<thead>
<tr>
<th>Stature Estimate Equations</th>
</tr>
</thead>
</table>

**Ulnar Height Estimate (age 5 to 19 years old) Gaud et al.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (all races but asian)</td>
<td>$H = 4.605U + 1.308A + 20.432$</td>
</tr>
<tr>
<td>Male Asian</td>
<td>$H = 4.17U + 1.594A + 33.650$</td>
</tr>
<tr>
<td>Female (all races but asian)</td>
<td>$H = 4.459U + 1.315A + 31.485$</td>
</tr>
<tr>
<td>Female Asian</td>
<td>$H = 4.665U + 1.079A + 29.115$</td>
</tr>
</tbody>
</table>

$H =$ height in cm, $A =$ age years, $U =$ Ulnar Length in cm

**Tibial Length Stature Estimate (age birth - 12 years old) Stevenson et al.**

<table>
<thead>
<tr>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S = (3.26 \times TL) + 30.8$</td>
</tr>
</tbody>
</table>

$S =$ stature in cm, $TL =$ tibial length in cm

Standard Error 1.4 cm

**Knee Height Stature Estimate (Age Birth to 12 years) Stevenson et al.**

<table>
<thead>
<tr>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S = (2.69 \times KH) + 24.2$ Standard Error 1.1 cm</td>
</tr>
</tbody>
</table>

$S =$ stature in cm, $KH =$ knee height in cm

**Knee Height Stature Estimate (Age 6-18 years) Chumlea et al.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Equation</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>White Boys</td>
<td>$S = (2.22 \times KH) + 40.54$ (Standard Error 4.21 cm)</td>
<td></td>
</tr>
<tr>
<td>Black Boys</td>
<td>$S = (2.18 \times KH) + 39.6$ (Standard Error 4.58 cm)</td>
<td></td>
</tr>
<tr>
<td>White Girls</td>
<td>$S = (2.15 \times KH) + 43.21$ (Standard Error 3.90 cm)</td>
<td></td>
</tr>
<tr>
<td>Black Girls</td>
<td>$S = (2.02 \times KH) + 46.89$ (Standard Error 4.39 cm)</td>
<td></td>
</tr>
</tbody>
</table>

$S =$ stature in cm, $KH =$ knee height in cm
**Ulnar Length**

**Ideal position:** sitting position ideal, forearm resting on surface with elbow 90 degrees, palm face down, fingers extended and together

**Ideal side:** right unless asymmetric motor function, then less involved side.

**Land Marks:** Measure from the proximal end of ulna to tip of styloid process at wrist

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**Tibial Length**

**Ideal position:** sitting or lying with knee flexed at 90 degrees

**Ideal side:** right unless asymmetric motor function, then less involved side.

**Land Marks:** medial joint line of knee to distal edge of medial malleolus using tight tape non-stretchable tape measure.

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**Knee Height**

**Ideal position:** sitting w/ knee flexed at 90 degrees

**Land Marks:** knee and ankle must be at 90 degree flexion, use caliper, one end under the heel below lateral malleolus and the other on teh anterior surface of the thigh just proximal to the patella. Slight pressure must be applied while aligning the long axis of the leg with the shaft of the caliper.

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*Measure right side unless asymmetric motor function, then less involved side.*
Figure 3: Growth charts for ulna length change with age for males and females.
Methodology to Estimate Body Fat From Skin Folds Patients ≥6 years old

Two step process!!!
1. Perform Slaughter equations
2. Then perform CP specific correction!!!

\[ TSF+SSF = \_\_\_\_ \text{mm} \]

Slaughter Equations

**Sum TSH+SSSF ≤ 35 mm**
- Male Prepubescent White: \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 1.7 \)
- Male Prepubescent Black: \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 3.2 \)
- Male Pubescent White: \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 3.4 \)
- Male Pubescent Black: \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 5.2 \)
- Male Postpubescent white: \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 5.5 \)
- Male Postpubescent black: \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 6.8 \)
- Females (all): \( \%BF = 1.21 \times (TSF+SSSF) - 0.008 \times (TSF+SSSF)^2 + 3.4 \)

**Sum TSF+SSSF > 35 mm**
- Males (all): \( \%BF = 0.783 \times (TSF+SSSF) + 1.6 \)
- Females (all): \( \%BF = 0.546 \times (TSF+SSSF) + 9.7 \)

Slaughter Body Fat Calculation Result: \( \_\_\_\_ \% \)

**Make the Corrections for CP which apply to the patient**
- For all patients with CP add 12.2%
- Additionally add or subtract as follows:
  - male: \( - 5.0 \% \)
  - severe motor impairment: \( + 5.1 \% \)
  - black race: \( - 3.1 \% \)
  - pubescent: \( + 2.0 \% \)
  - post pubescent: \( - 4.6 \% \)
  - sum of TSF+SSF >35: \( - 3.2 \% \)

Patients Gurka Percentage Body Fat Calculation Results:

**Percentage of body fat after all CP corrections relevant to patient \( \_\_\_\_ \% \)**
Normative data for fat percentile

Figure 1  Body fat centile curves for Caucasian boys and girls. Data from 1116 boys and 869 girls aged 5–18 years smoothed by the LMS method. Numbers on right-hand side represent centiles.
Figure 2  Recommended cutoffs for defining underfat, normal, overfat and obese children. Data as in Figure 1 Charts apply to Caucasian children.
Tricep Skinfold

Measurement is taken at the midpoint of the upper arm (midpoint between acromion process to the tip of the radial head) grasping 1 cm proximal to midpoint on the posterior side of the arm and measure skinfold below.

Subscapular Skinfold

Below the inferior angle of the scapula.

*Measure right side unless asymmetric motor function, then less involved side.
Bioelectrical Impedance Analysis

To estimate total body water (TBW) from resistance (R), weight (wt) and height (ht) using the tetrapolar technique:

\[ TBW \text{ (kg)} = 0.59 \text{ ht}^2 \text{(cm)} / R + 0.065 \text{ wt (kg)} + 0.04 \]

**Ideal position:**
- Supine with arms and legs slightly abducted from the trunk
- All jewellery and metallic objects removed prior to measurement.
- If using diaper, ensure it is dry

**Landmarks for electrode placement:**
Place one set of surface electrodes over the distal aspect of the second and third metacarpals and metatarsals.
Place a second set of surface electrodes at the right pisiform prominence of the wrist and between the lateral and medial malleoli of the ankle (or at a minimum of 5cm proximal to the first set).

*Measure on the right side or less impaired side of the body.
*NB measurement will be inaccurate in persons with internal metalwork

**Fat Free Mass:** To convert total body water to fat free mass (FFM), divide total body water by age and gender specific hydration constants:

<table>
<thead>
<tr>
<th>Age</th>
<th>Hydration factor</th>
<th>Age</th>
<th>Hydration factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 mo</td>
<td>0.79</td>
<td>12 mo</td>
<td>0.788</td>
</tr>
<tr>
<td>18 mo</td>
<td>0.785</td>
<td>16 mo</td>
<td>0.784</td>
</tr>
<tr>
<td>24 mo</td>
<td>0.781</td>
<td>24 mo</td>
<td>0.762</td>
</tr>
<tr>
<td>3 yr</td>
<td>0.775</td>
<td>3 yr</td>
<td>0.779</td>
</tr>
<tr>
<td>4 – 5.99 yr</td>
<td>0.766</td>
<td>4 – 5.99 yr</td>
<td>0.773</td>
</tr>
<tr>
<td>6 – 7.99 yr</td>
<td>0.761</td>
<td>6 – 7.99 yr</td>
<td>0.753</td>
</tr>
<tr>
<td>8 – 9.99 yr</td>
<td>0.758</td>
<td>8 – 9.99 yr</td>
<td>0.752</td>
</tr>
<tr>
<td>10 – 11.99 yr</td>
<td>0.752</td>
<td>10 – 11.99 yr</td>
<td>0.75</td>
</tr>
<tr>
<td>12 – 13.99 yr</td>
<td>0.752</td>
<td>12 – 13.99 yr</td>
<td>0.748</td>
</tr>
<tr>
<td>14 – 15.99 yr</td>
<td>0.75</td>
<td>14 – 15.99 yr</td>
<td>0.741</td>
</tr>
<tr>
<td>16 – 17.99 yr</td>
<td>0.731</td>
<td>16 – 17.99 yr</td>
<td>0.737</td>
</tr>
<tr>
<td>18 – 19.99 yr</td>
<td>0.734</td>
<td>18 – 19.99 yr</td>
<td>0.735</td>
</tr>
<tr>
<td>20 – 22.99 yr</td>
<td>0.736</td>
<td>20 – 22.99 yr</td>
<td>0.737</td>
</tr>
</tbody>
</table>
Interpretation of BIA Result

After determining the patient's fat free mass (FFM), determine the patient's percentage body fat as follows:

\[
\text{Fat Mass (FM)} = \text{Wt (kg)} - \text{FFM (kg)}
\]

\[
\text{Percentage Body Fat} = \frac{\text{FM (kg)}}{\text{Wt (kg)}} \times 100
\]

See graphs and tables (pages 7 and 8) for interpretation of percentage body fat for age and gender.
References BIA


General References

- Prediction of stature from knee height for black and white adults and children with application to mobility-impaired or handicapped persons. Chumlea et al. *Journal of the American Dietetic Association* 1994, 94, 1385-8