Mini Anthropometric Assessment in Pediatrics for children with cleft lip and palate for healthcare professionals
Anthropometric Assessment in Pediatrics

Author Dr. Suely Prieto de Barros, nutritionist

Co-authors

Ms. Maria Júlia Costa de Souza Villela, pediatrician and immunologist

Ms. Gesiane Cristina Born, nurse

Ms. Maila Meryellen Ferreira Garcia Manso, nurse

Dra. Gisele da Silva Dalben pediatric dentist

Coordination:

Dr. Nivaldo Alonso
Dr. Cristiano Tonello

Editorial Production: Gisele Guerra
Graphic Design and Layout: Thais Ferraz - Casa Paulistana
Illustrations: Milton Rodrigues Alves - Casa Paulistana

Copyright © Smile Train and HRAC-USP Hospital for Rehabilitation of Craniofacial Anomalies of USP

2023
Dear Professional,

We have prepared this manual to help you assess, in a simple and practical way, the nutritional status of your patients with cleft lip and palate.

Our first goal is to prevent malnutrition that compromises child growth and development and can lead to irreversible damage, including to the brain and the immune system.

Our second goal is to provide useful guidance to healthcare professionals across all specialties, fostering unity in this collective journey.

Systematically assessing the nutritional status is vital to identify patients experiencing growth faltering, at risk of malnutrition, or already malnourished, and design and implement tailored interventions at the earliest opportunity.

Various methods are available for assessing the nutritional status, including clinical, dietary, anthropometric, and biochemical approaches.

However, in this manual, we will focus on anthropometry due to its universal applicability across all life stages, cost-effectiveness, simplicity, minimal invasiveness, and reliability (Ministry of Health, 2011).

The frequency of anthropometric assessments depends on observed clinical conditions. We recommend at least monthly assessments until the age of two years.

Equally important to taking anthropometric measurements is comparing them to scientifically established references (standards). This is key to monitoring growth trends and ensuring accurate interpretation of how an individual grows and develops.

The Ministry of Health in Brazil recommends using the growth charts provided by the World Health Organization (WHO, 2006; ONIS et al., 2007), which include charts for tracking weight-for-age, length/height-for-age, weight-for-length/height, head circumference-for-age, and Body Mass Index-for-age, categorized by sex.
Between 1993 and 2003, the WHO conducted a multicenter study on child growth involving approximately 8,500 infants and children from six countries (Brazil, Ghana, India, Norway, Oman and the US). These children were all healthy, breastfed, with non-smoking, well-nourished mothers. The study resulted in the creation of growth curves, released in April 2006 for professional use. The WHO recommends the use of these growth charts (or curves) for assessing children worldwide, regardless of country, ethnicity, socioeconomic status, or diet.

The curves shown are:

- **Weight/age**, per sex ........................................................................................................ pg. 16
- **Height/age**, per sex ......................................................................................................... pg. 23
- **BodyMassIndex/age**, per sex ........................................................................................ pg. 28
- **Head circumference/age**, per sex .................................................................................. pg. 33

They can be obtained at:

**WHO Curves (2006) - 0 to 5 years old:**
https://www.who.int/tools/child-growth-standards

**WHO Curves (2007) - 5 to 19 years old:**
https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators
Important Information

The following life stages are included in the pediatric group:

- Newborns: 0 to 28 days of life
- Infants: 29 days to 2 years (exclusive)
- Preschool: 2 to 7 years old (exclusive)
- School: 7 years to 10 years (exclusive)
- Adolescents: 10 to 20 years (exclusive) (Barros et al., 2008)

- In the first days of life, full term newborns typically experience a physiological loss of weight of approximately 5-10%, while preterm newborns may experience losses of 10-15%. However, infants with clefts may incur even higher losses due to feeding difficulties.

- It is important to note that a weight loss exceeding 3% per day indicates undernourishment, often stemming from challenges in establishing effective breastfeeding. In such cases, expressing breast milk and feeding with a cup, or resorting to supplementing with a commercial formula may be considered.

- As infants grow, their weight typically doubles by the 5th-6th month, triples by 1 year, and quadruples by the 3rd year.

- Similarly, length usually increases by around 50% in the 1st year of life.

- Head circumference follows a pattern of doubling in size up to 12 months and then increasing by another 5 cm between 12 to 24 months (Barros et al., 2008).
Some Concepts

- **Nutritional Status**: refers to the overall condition of an individual’s health as influenced by the balance between the body’s nutrient intake and energy expenditure (nutrient utilization).

- **Eutrophy or being eutrophic (nutritional adequacy)**: refers to a state achieved when there is a balance between nutrient intake and nutritional needs.

- **Nutritional deficiency**: occurs when there is an insufficient quantity and/or quality of nutrient intake relative to nutritional needs.

- **Nutritional disorder**: results from excessive and/or imbalanced nutrient intake compared to nutritional needs (Ministry of Health, 2004).

Birth weight is the primary parameter utilized to evaluate intrauterine growth and the maturity of newborns (LOPES, 2017). Low birth weight, typically defined as less than 2,500 grams, is strongly correlated with elevated neonatal and infant mortality. However, it is essential to recognize that low weight can be the result of 2 adverse conditions: prematurity and intrauterine growth restriction, which may occur independently or in combination. In Brazil, the average incidence of low birth weight ranges from 10 to 11% (Rugolo, 2005).

Newborns can be classified based on birth weight as follows:

- **Normal birth weight**:

- **Low birth weight (LBW)**:

- **Very low birth weight (VLBW)**:

- **Extremely low birth weight**: 2
Birth weight is the primary parameter utilized to evaluate intrauterine growth and the maturity of newborns (LOPES, 2017).

Low birth weight, typically defined as less than 2,500 grams, is strongly correlated with elevated neonatal and infant mortality. However, it is essential to recognize that low weight can be the result of 2 adverse conditions: prematurity and intrauterine growth restriction, which may occur independently or in combination. In Brazil, the average incidence of low birth weight ranges from 10 to 11% (Rugolo, 2005).

Newborns can be classified based on birth weight as follows:

- **Normal birth weight**: 2.500 g - 3.999g
- **Low birth weight (LBW)**: < 2.500 g
- **Very low birth weight (VLBW)**: < 1.500 g
- **Extremely low birth weight**: < 1.000 g
There is a strong correlation between gestational age and infant weight, facilitating the classification of newborns into categories such as adequate gestational age (AGA), small gestational age (SGA), and large for gestational age (LGA) (Boulet et al., 2006; Gardosi et al., 2013). It is important to note that SGA does not always indicate intrauterine growth restriction but suggests the possibility of this condition. The diagnosis of SGA is typically based on birth weight measurement compared to a reference curve, distinguishing between constitutionally small infants and those who experienced restricted intrauterine growth.

In a study by Rodrigues et al., 2015, the curve proposed by Alexander et al., 1996, demonstrated a higher sensitivity in diagnosing of SGA compared to other methods and is thus being regarded as a robust statistical instrument for assessing fetal growth. Table 1 shows birth weights by gestational age in percentiles from 5 to 95.

Therefore, it is established that:

**AGA** (appropriate for gestational age) = between 10\(^{th}\) to 90\(^{th}\) percentile

**SGA** (small for gestational age) = < 10\(^{th}\) percentile

**LGA** (large for gestational age) = > 90 percentile
There is a strong correlation between gestational age and infant weight, facilitating the classification of newborns into categories such as adequate gestational age (AGA), small gestational age (SGA), and large for gestational age (LGA) (Boulet et al., 2006; Gardosi et al., 2013). It is important to note that SGA does not always indicate intrauterine growth restriction but suggests the possibility of this condition. The diagnosis of SGA is typically based on birth weight measurement compared to a reference curve, distinguishing between constitutionally small infants and those who experienced restricted intrauterine growth.

In a study by Rodrigues et al., 2015, the curve proposed by Alexander et al., 1996, demonstrated a higher sensitivity in diagnosing of SGA compared to other methods and is thus being regarded as a robust statistical instrument for assessing fetal growth.

Table 1 shows birth weights by gestational age in percentiles from 5 to 95.

Therefore, it is established that:

- **AGA** (appropriate for gestational age) = between 10th to 90th percentile
- **SGA** (small for gestational age) = < 10th percentile
- **LGA** (large for gestational age) = > 90th percentile

<table>
<thead>
<tr>
<th>Gestational age (week)</th>
<th>Percentiles/Weight in grams</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>249</td>
</tr>
<tr>
<td>21</td>
<td>280</td>
</tr>
<tr>
<td>22</td>
<td>330</td>
</tr>
<tr>
<td>23</td>
<td>385</td>
</tr>
<tr>
<td>24</td>
<td>435</td>
</tr>
<tr>
<td>25</td>
<td>480</td>
</tr>
<tr>
<td>26</td>
<td>529</td>
</tr>
<tr>
<td>27</td>
<td>591</td>
</tr>
<tr>
<td>28</td>
<td>670</td>
</tr>
<tr>
<td>29</td>
<td>772</td>
</tr>
<tr>
<td>30</td>
<td>910</td>
</tr>
<tr>
<td>31</td>
<td>1088</td>
</tr>
<tr>
<td>32</td>
<td>1294</td>
</tr>
<tr>
<td>33</td>
<td>1513</td>
</tr>
<tr>
<td>34</td>
<td>1735</td>
</tr>
<tr>
<td>35</td>
<td>1950</td>
</tr>
<tr>
<td>36</td>
<td>2156</td>
</tr>
<tr>
<td>37</td>
<td>2357</td>
</tr>
<tr>
<td>38</td>
<td>2543</td>
</tr>
<tr>
<td>39</td>
<td>2685</td>
</tr>
<tr>
<td>40</td>
<td>2761</td>
</tr>
<tr>
<td>41</td>
<td>2777</td>
</tr>
<tr>
<td>42</td>
<td>2764</td>
</tr>
<tr>
<td>43</td>
<td>2741</td>
</tr>
<tr>
<td>44</td>
<td>2724</td>
</tr>
</tbody>
</table>

Source: Alexander et al., 1996.
Prematurity, as defined by the WHO, occurs before 37 full weeks of gestation. It can be further categorized into extremely preterm (< 28 weeks), very preterm (28-31 weeks) and moderate preterm (32-36 weeks of gestation).

The Brazilian Society of Pediatrics (2017) has identified prematurity as the leading cause of mortality in the first year of life in Brazil, accounting for 11.5% of deaths. To monitor the nutritional status of premature infants, it is recommended to utilize the INTERGROWTH 21 curves (Intergrowth-21st, 2012; Villar et al., 2015) available for weight, length, and head circumference. These curves are designed to be used up to 64 weeks post-conception, after which the WHO charts are recommended.

The INTERGROWTH 21 curves are prescriptive and multiethnic, employing the best anthropometric methodology and aligning closely with the WHO curves.

**CLASSIFICATION**

Ideally, the data collected from the baby should closely align with the 50th percentile, representing the center point or median (highlighted in green), which is considered indicative of “normal” growth.

To access:
https://intergrowth21.tghn.org/standards-tools/

The Z-score and percentile can be calculated for each sex using:
http://intergrowth21.ndog.ox.ac.uk/en/ManualEntry
Preterm Newborn

Prematurity, as defined by the WHO, occurs before 37 full weeks of gestation. It can be further categorized into extremely preterm (< 28 weeks), very preterm (28-31 weeks) and moderate preterm (32-36 weeks of gestation).

The Brazilian Society of Pediatrics (2017) has identified prematurity as the leading cause of mortality in the first year of life in Brazil, accounting for 11.5% of deaths. To monitor the nutritional status of premature infants, it is recommended to utilize the INTERGROWTH 21 curves (Intergrowth-21st, 2012; Villar et al., 2015) available for weight, length, and head circumference. These curves are designed to be used up to 64 weeks post-conception, after which the WHO charts are recommended. The INTERGROWTH 21 curves are prescriptive and multiethnic, employing the best anthropometric methodology and aligning closely with the WHO curves.

To access:
https://intergrowth21.tghn.org/standards-tools/

Classification according to INTERGROWTH-21st

Ideally, the data collected from the baby should closely align with the 50th percentile, representing the center point or median (highlighted in green), which is considered indicative of "normal" growth.
**Weight (kg)**

"It represents the magnitude of body mass or volume, comprising both adipose tissue and lean mass. Prone to fluctuations over short periods, its monitoring facilitates early diagnosis of malnutrition and serves as an indicator of nutritional status recovery" (Duarte and Castellani, 2002).

It is easy to measure and sensitive to changes, particularly in cases of malnutrition, often used to calculate various nutritional assessment indexes.

---

**Up to 2 years old**

- Pediatric scale with a capacity of 16kg and a graduation of 10g

**Above 2 years old**

- Platform or anthropometric scale with a capacity of 100 to 150kg and a graduation of 100g.
Weight

“It represents the magnitude of body mass or volume, comprising both adipose tissue and lean mass. Prone to fluctuations over short periods, its monitoring facilitates early diagnosis of malnutrition and serves as an indicator of nutritional status recovery” (Duarte and Castellani, 2002). It is easy to measure and sensitive to changes, particularly in cases of malnutrition, often used to calculate various nutritional assessment indexes.

Equipment

**Up to 2 years old** - Pediatric scale with a capacity of 16kg and a graduation of 10g

**Above 2 years old** - Platform or anthropometric scale with a capacity of 100 to 150kg and a graduation of 100g.
To measure weight: It should be measured in kilograms (kg), with minimal clothing, with the child barefoot and motionless.

If you do not have a pediatric scale, use a floor scale and weigh the baby in the caregiver’s arms.

Proceed as follows:

1. Take off the baby’s clothes

2. Weigh the baby in the caregiver’s arms

3. Weigh only the caregiver, without the baby

4. Subtract the weight of the caregiver from the total weight (baby + caregiver)

5. Ready: We have the baby’s weight!
To measure weight
It should be measured in kilograms (kg), with minimal clothing, with the child barefoot and motionless. If you do not have a pediatric scale, use a floor scale and weigh the baby in the caregiver's arms.

Proceed as follows:
1. Take off the baby’s clothes
2. Weigh the baby in the caregiver’s arms
3. Weigh only the caregiver, without the baby
4. Subtract the weight of the caregiver from the total weight (baby + caregiver)
5. Ready: We have the baby's weight!

Classification according to the WHO (2006 and 2007) by percentile and Z-score

### Weight-for-age

<table>
<thead>
<tr>
<th>CRITICAL VALUES</th>
<th>NUTRITIONAL DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>percentile &lt; 0.1</td>
<td>Z-score &lt; -3</td>
</tr>
<tr>
<td>percentile ≥ 0.1and &lt; 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Z-score ≥ -3 and &lt; -2</td>
</tr>
<tr>
<td>percentile ≥ 3&lt;sup&gt;rd&lt;/sup&gt; and ≤ 97&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Z-score ≥ -2 and ≤ +2</td>
</tr>
<tr>
<td>percentile &gt; 97&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Z-score &gt; +2</td>
</tr>
<tr>
<td></td>
<td>Severe underweight</td>
</tr>
<tr>
<td></td>
<td>Moderate underweight</td>
</tr>
<tr>
<td></td>
<td>Weight appropriate for age</td>
</tr>
<tr>
<td></td>
<td>High weight for age</td>
</tr>
</tbody>
</table>
WHO CURVES, 2006
WEIGHT-FOR-AGE - BOYS FROM 0 TO 5 YEARS OLD
WHO CURVES, 2007
WEIGHT-FOR-AGE - BOYS FROM 5 TO 10 YEARS OLD
WHO CURVES, 2006
WEIGHT-FOR-AGE - GIRLS FROM 0 TO 5 YEARS OLD
WHO CURVES, 2007

WEIGHT-FOR-AGE - GIRLS FROM 5 TO 10 YEARS OLD

[Graph showing weight-for-age curves for girls from 5 to 10 years old]
Length/Height

Length/height is an essential indicator of a child’s body size and linear growth. Changes in height occur over a more extended period, making it a reflection of long-term nutritional issues. Length/height deficits may indicate impairment in protein compartments (Duarte and Castellani, 2002) and, like weight, length/height is utilized to calculate various nutritional status assessment indexes.

When measured with a baby lying down, usually under 24 months, in a supine and horizontal position, with minimal clothing and bare feet, it is referred to as length. Instruments such as infantometers are commonly used for that purpose.

Types of Infantometers

To measure length: Place the baby lying down on a flat, hard surface with minimal clothing and bare feet, facing upwards, and legs straight. Ensure the head is held firmly by the caregiver, and the arms are extended at the sides or secured over the belly.

Position the child’s head against the fixed cursor of the infantometer, keeping the neck straight, chin away from the chest, and the head resting comfortably. Gently press over the knees to keep the legs extended.
Length/height is an essential indicator of a child's body size and linear growth. Changes in height occur over a more extended period, making it a reflection of long-term nutritional issues. Length/height deficits may indicate impairment in protein compartments (Duarte and Castellani, 2002) and, like weight, length/height is utilized to calculate various nutritional status assessment indexes.

When measured with a baby lying down, usually under 24 months, in a supine and horizontal position, with minimal clothing and bare feet, it is referred to as length. Instruments such as infantometers are commonly used for that purpose.

**Types of Infantometers**

To measure length:
- Place the baby lying down on a flat, hard surface with minimal clothing and bare feet, facing upwards, and legs straight.
- Ensure the head is held firmly by the caregiver, and the arms are extended at the sides or secured over the belly.
- Position the child’s head against the fixed cursor of the infantometer, keeping the neck straight, chin away from the chest, and the head resting comfortably. Gently press over the knees to keep the legs extended.
- Record the measured length at the nearest 0.1 centimeter (cm).

If an infantometer is not available, it is important to note that using a measuring tape may not provide an accurate measurement of length.

It is referred to as **height** when measuring a child standing up, typically for those aged 2 years old and older. The measurement is taken using a stadiometer, which should be mounted on a fixed base and placed parallel to a wall. Some scales come equipped with a stadiometer.
To measure height: have the child stand barefoot, straight, with feet together. The heels, buttocks, and back should be touching the vertical backboard of the stadiometer. The head should be positioned so that the sight line is parallel to the ground. The movable headboard of the stadiometer should be brought down gently on top of the child’s head. Read the measurement out loud, and record at the nearest 0.1 cm.

If you don’t have a stadiometer, a measuring tape attached to the wall will not provide an accurate measurement of the height.

Classification according to the WHO (2006 AND 2007) by percentile and Z-score

Height-for-age

<table>
<thead>
<tr>
<th>CRITICAL VALUES</th>
<th>NUTRITIONAL DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>percentile &lt; 0.1</td>
<td>Z-score &lt; -3</td>
</tr>
<tr>
<td>percentile ≥ 0.1 and &lt; 3&lt;sup&gt;rd&lt;/sup&gt;</td>
<td>Z-score ≥ -3 and &lt; -2</td>
</tr>
<tr>
<td>percentile ≥ 3&lt;sup&gt;rd&lt;/sup&gt; and ≤ 97&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Z-score ≥ -2 and ≤ +2</td>
</tr>
</tbody>
</table>

To measure height, have the child stand barefoot, straight, with feet together. The heels, buttocks, and back should be touching the vertical backboard of the stadiometer. The head should be positioned so that the sight line is parallel to the ground. The movable headboard of the stadiometer should be brought down gently on top of the child’s head. Read the measurement out loud, and record at the nearest 0.1 cm.

If you don’t have a stadiometer, a measuring tape attached to the wall will not provide an accurate measurement of the height.


Classification according to the WHO (2006 AND 2007) by percentile and Z-score

HEIGHT-FOR-AGE - BOYS FROM 0 TO 5 YEARS OLD
WHO CURVES, 2006
HEIGHT-FOR-AGE - GIRLS FROM 0 TO 5 YEARS OLD
WHO CURVES, 2007
HEIGHT-FOR-AGE - GIRLS FROM 5 TO 19 YEARS OLD
Weight For Length/Height

Weight-for-length/height expresses the harmony between body mass and height, without considering age.

(SISVAN, Ministry of Health, Brazil, 2004)

Classification according to WHO (2006 and 2007), by percentile and Z score
Weight-for-age

<table>
<thead>
<tr>
<th>CRITICAL VALUES</th>
<th>NUTRITIONAL DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>percentile &lt; 0.1</td>
<td>Z-score &lt; -3</td>
</tr>
<tr>
<td>percentile ≥ 0.1 and &lt; 3rd</td>
<td>Z-score ≥ -3 and &lt; -2</td>
</tr>
<tr>
<td>percentile ≥ 3rd and ≤ 85th</td>
<td>Z-score ≥ -2 and ≤ +1</td>
</tr>
<tr>
<td>percentile &gt; 85th and ≤ 97th</td>
<td>Z-score &gt; +1 and ≤ +2</td>
</tr>
<tr>
<td>percentile &gt; 97th and ≤ 99.9th</td>
<td>Z-score &gt; +2 and ≤ +3</td>
</tr>
<tr>
<td>percentile &gt; 99.9th</td>
<td>Z-score &gt; +3</td>
</tr>
</tbody>
</table>
The Body Mass Index (BMI) is performed through a simple calculation that allows checking whether or not someone is at the ideal weight with the square of the current height (WHO, 2006, 2007)

**Calculation**

\[ \text{BMI} = \frac{\text{WEIGHT}}{\text{HEIGHT}^2} \]

Classification according to WHO (2006 and 2007) by percentile and Z score.

**BMI-for-age**

<table>
<thead>
<tr>
<th>CRITICAL VALUES</th>
<th>NUTRITIONAL DIAGNOSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>percentile &lt; 0.1</td>
<td>Z-score &lt; -3</td>
</tr>
<tr>
<td>percentile ≥ 0.1 and &lt; 3\textsuperscript{rd}</td>
<td>Z-score ≥ -3 and &lt; -2</td>
</tr>
<tr>
<td>percentile ≥ 3\textsuperscript{rd} and ≤ 85\textsuperscript{th}</td>
<td>Z-score ≥ -2 and ≤ +1</td>
</tr>
<tr>
<td>percentile &gt; 85\textsuperscript{th} and ≤ 97\textsuperscript{th}</td>
<td>Z-score &gt; +1 and ≤ +2</td>
</tr>
<tr>
<td>percentile &gt; 97\textsuperscript{th} and ≤ 99.9\textsuperscript{th}</td>
<td>Z-score &gt; +2 and ≤ +3</td>
</tr>
<tr>
<td>percentile &gt; 99.9\textsuperscript{th}</td>
<td>Z-score &gt; +3</td>
</tr>
</tbody>
</table>
Classification according to WHO (2006 and 2007) by percentile and Z score.
BMI - BOYS FROM 0 TO 5 YEARS

BMI - GIRLS FROM 0 TO 5 YEARS

This measurement is related to the size of the head, with its normal growth reflecting appropriate brain growth and development. It is recommended to measure head circumference up to 2 years of age, corresponding to a period of rapid brain growth (Barros, 2008).

To measure head circumference: Use a non-extensible measuring tape graduated in centimeters. Place the tape around the most prominent region of the frontal area (above the eyebrows). Extend the tape to the protuberance of the occipital region at the back of the head. Take the measurement in cm (BARROS et al., 2008; BARROS et al., 2021).

How to interpret the Head circumference?

**MICROCEPHALY:** Smaller than average: Percentile < 3rd or Z-score < -2

**MACROCEPHALY:** Larger than average: Percentile < 97th or Z-score < -2

It is important to note that even small differences in percentiles at the extremes (percentiles < 3rd or >97th) represent clinically important differences such that close attention should be paid to measurements falling outside the normal range.

**NORMAL LIMITS:** Percentile ≥ 3rd and ≤97th OR Z-score ≥ -2 and ≤ +2.
This measurement is related to the size of the head, with its normal growth reflecting appropriate brain growth and development. It is recommended to measure head circumference up to 2 years of age, corresponding to a period of rapid brain growth (Barros, 2008).

To measure head circumference:

1. Use a non-extensible measuring tape graduated in centimeters.
2. Place the tape around the most prominent region of the frontal area (above the eyebrows).
3. Extend the tape to the protuberance of the occipital region at the back of the head.
4. Take the measurement in cm (BARROS et al., 2008; BARROS et al., 2021).

**How to interpret the Head circumference**

- **MICROCEPHALY**: Smaller than average:
  - Percentile < 3rd or Z-score < -2

- **MACROCEPHALY**: Larger than average:
  - Percentile < 97th or Z-score < -2

It is important to note that even small differences in percentiles at the extremes (percentiles < 3rd or >97th) represent clinically important differences such that close attention should be paid to measurements falling outside the normal range.

**NORMAL LIMITS**:

- Percentile ≥ 3rd and ≤ 97th OR Z-score ≥ -2 and ≤ +2.
Brachial circumference or mid-upper arm circumference (MUAC) serves as an indicator of muscle growth and reflects the adequacy of protein intake. It provides an estimation of protein and adipose tissue levels (Duarte and Castellani, 2002).

To measure MUAC:
- Measure at the central point of the left arm (by convention), between the bone segments of the acromion in the scapula and the olecranon in the ulna. Use a millimeter cellulose tape that is inextensible and inelastic (such as a tape measure), with a precision of 0.1 cm.
- Have the patient stand (for children) or sit on the lap (for infants).
- Ensure the arm is positioned vertically, keeping it relaxed and extended, with the palm of the hand facing the thigh.
- Place the measuring tape around the midpoint of the arm, without compressing the tissues.
- Take the measurements without stretching the tape and record the result at the nearest 0.1 cm (Duarte and Castellani, 2002).

Critical Values Nutritional Diagnosis

- Percentile < 5th
- Percentile ≥ 5th and ≤ 95th
- Percentile > 95th

- Risk of wasting
- Eutrophy
- Risk of excess weight

Classification according to the WHO (2006 and 2007) by percentiles

Source:
- ��S��, 200��
- ��S��
- OMS, 200��

WHO Child Growth Standards
Brachial circumference or mid-upper arm circumference (MUAC) serves as an indicator of muscle growth and reflects the adequacy of protein intake. It provides an estimation of protein and adipose tissue levels (Duarte and Castellani, 2002).

**To measure MUAC:** Measure at the central point of the left arm (by convention), between the bone segments of the acromion in the scapula and the olecranon in the ulna. Use a millimeter cellulose tape that is inextensible and inelastic (such as a tape measure), with a precision of 0.1 cm. Have the patient stand (for children) or sit on the lap (for infants). Ensure the arm is positioned vertically, keeping it relaxed and extended, with the palm of the hand facing the thigh. Place the measuring tape around the midpoint of the arm, without compressing the tissues. Take the measurements without stretching the tape and record the result at the nearest 0.1 cm (Duarte and Castellani, 2002).

**Classification according to the WHO (2006 and 2007) by percentiles**

**Brachial circumference (MUAC)-for-age**

<table>
<thead>
<tr>
<th>Critical Values</th>
<th>Nutritional Diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>percentile &lt; 5&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Risk of wasting</td>
</tr>
<tr>
<td>percentile ≥ 5&lt;sup&gt;th&lt;/sup&gt; and ≤ 95&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Eutrophy</td>
</tr>
<tr>
<td>percentile &gt; 95&lt;sup&gt;th&lt;/sup&gt;</td>
<td>Risk of excess weight</td>
</tr>
</tbody>
</table>

MUAC values in percentiles (Frisancho, 1990)

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>N</th>
<th>Average</th>
<th>SD</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>25</th>
<th>50</th>
<th>75</th>
<th>85</th>
<th>90</th>
<th>95</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GENDER: MALE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-1.9</td>
<td>681</td>
<td>16.1</td>
<td>1.2</td>
<td>14.2</td>
<td>14.7</td>
<td>14.9</td>
<td>15.2</td>
<td>16.0</td>
<td>16.9</td>
<td>17.4</td>
<td>17.7</td>
<td>18.2</td>
</tr>
<tr>
<td>2-2.9</td>
<td>672</td>
<td>16.4</td>
<td>1.4</td>
<td>14.3</td>
<td>14.8</td>
<td>15.1</td>
<td>15.5</td>
<td>16.3</td>
<td>17.1</td>
<td>17.6</td>
<td>17.9</td>
<td>18.6</td>
</tr>
<tr>
<td>3-3.9</td>
<td>715</td>
<td>16.9</td>
<td>1.4</td>
<td>15.0</td>
<td>15.3</td>
<td>15.5</td>
<td>16.0</td>
<td>16.8</td>
<td>17.6</td>
<td>18.1</td>
<td>18.4</td>
<td>19.0</td>
</tr>
<tr>
<td>4-4.9</td>
<td>708</td>
<td>17.2</td>
<td>1.4</td>
<td>15.1</td>
<td>15.5</td>
<td>15.8</td>
<td>16.2</td>
<td>17.1</td>
<td>18.0</td>
<td>18.5</td>
<td>18.7</td>
<td>19.3</td>
</tr>
<tr>
<td>5-5.9</td>
<td>676</td>
<td>17.7</td>
<td>1.8</td>
<td>15.5</td>
<td>16.0</td>
<td>16.1</td>
<td>16.6</td>
<td>17.5</td>
<td>18.5</td>
<td>19.1</td>
<td>19.5</td>
<td>20.5</td>
</tr>
<tr>
<td>6-6.9</td>
<td>298</td>
<td>18.3</td>
<td>2.1</td>
<td>15.8</td>
<td>16.1</td>
<td>16.5</td>
<td>17.0</td>
<td>18.0</td>
<td>19.1</td>
<td>19.8</td>
<td>20.7</td>
<td>22.8</td>
</tr>
<tr>
<td>7-7.9</td>
<td>312</td>
<td>19.6</td>
<td>2.1</td>
<td>16.1</td>
<td>16.8</td>
<td>17.0</td>
<td>17.6</td>
<td>18.7</td>
<td>20.0</td>
<td>21.0</td>
<td>21.8</td>
<td>22.9</td>
</tr>
<tr>
<td>8-8.9</td>
<td>296</td>
<td>19.6</td>
<td>2.3</td>
<td>16.5</td>
<td>17.2</td>
<td>17.5</td>
<td>18.1</td>
<td>19.2</td>
<td>20.5</td>
<td>21.6</td>
<td>22.6</td>
<td>24.0</td>
</tr>
<tr>
<td>9-9.9</td>
<td>322</td>
<td>20.7</td>
<td>2.7</td>
<td>17.5</td>
<td>18.0</td>
<td>18.4</td>
<td>19.0</td>
<td>20.1</td>
<td>21.8</td>
<td>23.2</td>
<td>24.5</td>
<td>26.0</td>
</tr>
<tr>
<td>10-10.9</td>
<td>333</td>
<td>21.8</td>
<td>3</td>
<td>18.1</td>
<td>18.6</td>
<td>19.1</td>
<td>19.7</td>
<td>21.1</td>
<td>23.1</td>
<td>24.8</td>
<td>26.0</td>
<td>27.9</td>
</tr>
<tr>
<td>11-11.9</td>
<td>324</td>
<td>22.8</td>
<td>3.4</td>
<td>18.5</td>
<td>19.3</td>
<td>19.8</td>
<td>20.6</td>
<td>22.1</td>
<td>24.5</td>
<td>26.1</td>
<td>27.6</td>
<td>29.4</td>
</tr>
<tr>
<td>12-12.9</td>
<td>349</td>
<td>23.8</td>
<td>3.5</td>
<td>19.3</td>
<td>20.1</td>
<td>20.7</td>
<td>21.5</td>
<td>23.1</td>
<td>25.4</td>
<td>27.1</td>
<td>28.5</td>
<td>30.3</td>
</tr>
<tr>
<td>13-13.9</td>
<td>350</td>
<td>24.8</td>
<td>3.3</td>
<td>20.0</td>
<td>20.8</td>
<td>21.6</td>
<td>22.5</td>
<td>24.5</td>
<td>26.6</td>
<td>28.2</td>
<td>29.0</td>
<td>30.8</td>
</tr>
<tr>
<td>14-14.9</td>
<td>358</td>
<td>26.2</td>
<td>3.5</td>
<td>21.6</td>
<td>22.5</td>
<td>23.2</td>
<td>23.8</td>
<td>25.7</td>
<td>28.1</td>
<td>29.1</td>
<td>30.0</td>
<td>32.3</td>
</tr>
<tr>
<td>15-15.9</td>
<td>359</td>
<td>27.3</td>
<td>3.2</td>
<td>22.5</td>
<td>23.4</td>
<td>24.0</td>
<td>25.1</td>
<td>27.2</td>
<td>29.0</td>
<td>30.3</td>
<td>31.2</td>
<td>32.7</td>
</tr>
<tr>
<td>16-16.9</td>
<td>350</td>
<td>28.7</td>
<td>3.2</td>
<td>24.1</td>
<td>25.0</td>
<td>25.7</td>
<td>26.7</td>
<td>28.3</td>
<td>30.6</td>
<td>32.1</td>
<td>32.7</td>
<td>34.7</td>
</tr>
<tr>
<td>17-17.9</td>
<td>339</td>
<td>29.3</td>
<td>3.4</td>
<td>24.3</td>
<td>25.1</td>
<td>25.9</td>
<td>26.8</td>
<td>28.6</td>
<td>30.8</td>
<td>32.2</td>
<td>33.3</td>
<td>34.7</td>
</tr>
</tbody>
</table>

| **GENDER: FEMALE** |     |         |     |     |     |     |     |     |     |     |     |     |
| 1-1.9       | 622 | 15.7    | 1.3 | 13.6| 14.1| 14.4| 14.8| 15.7| 19.4| 17.0| 17.2| 17.8|
| 2-2.9       | 615 | 16.2    | 1.3 | 14.2| 14.6| 15.0| 15.4| 16.1| 17.0| 17.4| 18.0| 18.5|
| 3-3.9       | 651 | 16.6    | 1.4 | 14.4| 15.0| 15.2| 15.7| 16.6| 17.4| 18.0| 18.4| 19.0|
| 4-4.9       | 680 | 17.1    | 1.5 | 14.8| 15.3| 15.7| 16.1| 17.0| 18.0| 18.5| 19.0| 19.5|
| 5-5.9       | 673 | 17.7    | 1.8 | 15.2| 15.7| 16.1| 16.5| 17.5| 18.5| 19.4| 20.0| 21.0|
| 6-6.9       | 296 | 18.2    | 2   | 15.7| 16.2| 16.5| 17.0| 17.8| 19.0| 19.9| 20.5| 22.0|
| 7-7.9       | 330 | 19.6    | 2.2 | 16.4| 16.7| 17.0| 17.5| 18.6| 20.1| 20.9| 21.6| 23.3|
| 8-8.9       | 275 | 20.2    | 2.6 | 16.7| 17.2| 17.6| 18.2| 19.5| 21.2| 22.2| 23.2| 25.1|
| 9-9.9       | 321 | 21.1    | 2.8 | 17.6| 18.1| 18.6| 19.1| 20.6| 22.2| 23.8| 25.0| 26.7|
| 10-10.9     | 330 | 21.8    | 3.1 | 17.8| 18.4| 18.9| 19.5| 21.2| 23.4| 25.0| 26.1| 27.3|
| 11-11.9     | 302 | 23.2    | 3.6 | 18.8| 19.6| 20.0| 20.6| 22.2| 25.1| 26.5| 27.9| 30.0|
| 12-12.9     | 324 | 24.4    | 3.4 | 19.2| 20.0| 20.5| 21.5| 23.7| 25.8| 27.6| 28.3| 30.2|
| 13-13.9     | 361 | 25.7    | 3.7 | 20.1| 21.0| 21.5| 22.5| 24.3| 26.7| 28.3| 30.1| 32.7|
| 14-14.9     | 370 | 25.9    | 3.6 | 21.2| 21.8| 22.5| 23.5| 25.1| 27.4| 29.5| 30.9| 32.9|
| 15-15.9     | 309 | 26.9    | 3.5 | 21.6| 22.2| 22.9| 23.5| 25.2| 27.7| 28.8| 30.0| 32.2|
| 16-16.9     | 343 | 26.8    | 3.5 | 22.3| 23.2| 23.5| 24.4| 26.1| 28.5| 29.9| 31.6| 33.5|
| 17-17.9     | 293 | 27.3    | 4.1 | 22.0| 23.1| 23.6| 24.5| 26.6| 29.0| 30.7| 32.8| 35.4|
References


LOPES JMA et al, Monitoramento do crescimento de RN pré-termos, Departamento Científico de Neonatologia • Sociedade Brasileira de Pediatria, n° 1, fev 2017.


WHO child growth standards : length/height-for-age, weight-for-age, weight-for-length, weight-forheight and body mass index-for-age : methods and development. Coordinating team: Mercedes de Onis ... [et al.]. ISBN 92 4 154693 X
Smile Train is an international charity, a world leader in cleft and lip palate treatment. Your treatment center is a partner of Smile Train.

Follow us on our social networks:

@smiletrainbrasil

smiletrainbrasil.com

CHANGING THE WORLD
ONE SMILE AT A TIME