Nutritional support in children with neurological impairment

Information for healthcare professional use only.

The health care of children with neurological impairment should be addressed from a multidisciplinary approach:

Neurology

Gastroenterology

Physiotherapy

Nutrition and Dietetics

Nursing

Speech Therapy

Social Work

Assessing nutritional status

1

Client history

2

Physical examination

3

Anthropometric assessment

4

Supplementary tests

1

Client history

Clinical situation

Diagnosis of neurological impairment

Cerebral palsy (CP) is the most common cause of motor disability in children. It is estimated that in 2018, 1.4 per 1000 live births was identified as having a neurological impairment.[1]

Cerebral palsy and undernutrition

The prevalence of undernutrition and faltering growth in children with CP is estimated as between 29–46%.[2]

Clinical history

- Conditions associated with the clinical condition (Gastro-oesophageal reflux disease [GORD], dysphagia, constipation, recurrent respiratory infections, convulsions, oral motor dysfunction, skeletal interventions and bone fractures).[3]
- Motor type and topography.[4]
- Number of hospital admissions.
- Other medical conditions.

Degree of intellectual impairment

DSM-IV-TR (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision).

Mild
IQ 55–69

Moderate
IQ 40–54

Severe
IQ 25–39

Profound
IQ <25

IQ = intelligence quotient

The majority of children with CP have mild intellectual impairment. Actual number scores vary +/- 5 points.[5]

Degree of motor impairment[6]

Gross Motor Function Classification System (GMFCS) E&R levels between 6th and 12th birthday.

For more details on GMFCS Levels, please refer to: https://canchild.ca/en/resources/42-gross-motor-function-classification-system-expanded-revised-gmfcs-e-r

Dietary assessment

Dietary intake

All dietary assessment methods give an estimate of intake. It is important to obtain information on both the quantity and types of foods and fluids consumed (ensuring spilled food/fluid is accounted for). This will help to determine the need for any additional nutritional support which includes oral nutritional supplements and/or enteral tube feeds. Dietary assessment methods that are commonly used include food records, 24-hour dietary recalls, and food frequency questionnaires. Dietary intake information will help to determine if the child is meeting their nutritional requirements.[7]

Other helpful information to collect during a dietary assessment includes:

- Mealtime environment and parental/child attitude towards food (stressful versus pleasant).
- Meal patterns across the day.
- Time taken for meals.
- Food and fluid textures managed.
- Self-feeding ability and any equipment or modifications that are required.
- Presence of signs of choking, coughing, facial redness, unexplained crying or irritability, apnea, eating behavioural disorders (these may indicate feeding problems and/or oral motor dysfunction).[8]

Physical examination

Overall assessment

- Determine any concerns regarding posture, skeletal deformities (e.g. scoliosis) and contractures.

Assessment of nutritional status

- Assess subcutaneous fat tissue and muscle mass via body composition assessment.
- Presence of deficiency signs.

How to assess deficiency signs?

Significant deficiency signs: pallor and eczemas, thinning hair, angular stomatitis, rickety signs.

Global malnutrition can be observed by touching the skin and adipose panniculus especially on arms, groin and glutes.

- Presence of signs of dehydration.
- Oral alterations (ex: gingival, dental) and oral acid odour.
- Presence of decubitus ulcers.
- Assess signs of faecal retention.

3

Anthropometric assessment

- **Weight**
- **Height / Length**
- **Segmental lengths**
- **Mid-upper arm circumference (MUAC)**
- **Subcutaneous skinfolds**

From the determinations of weight and height/length, the corresponding z-scores and percentiles can be calculated.

These measurements will be useful to calculate the body mass index (BMI) and its corresponding z-score and percentile.

It is necessary to carry out a prospective and individualised follow-up at least every 6 months although frequency can be increased when concerns are present. Specific growth indicators are available for children with CP but the European Society for Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) does not recommend the use of these to detect malnutrition or risk of malnutrition, but the ones for typically developing children (WHO).[9-11] However, the same indicators should be always used in order to evaluate progression.[9,11]

Red flag warning signs to identify undernutrition[11]

- Weight-for-age z-score <-2.
- Triceps skinfold thickness <10th centile for age and sex.
- Mid-upper arm fat or muscle areas <10th centile.
- Faltering weight and/or faltering growth.
- Physical signs of undernutrition such as decubitis ulcers and poor peripheral circulation.

Formulas to estimate stature from segmental lengths[9]

Equations for estimation[12] of stature from segmental lengths[12].

Segmental lengths[12]	Equation to estimate stature (S) (cm)	SE of estimate (cm)
Children with CP (Age: Birth – 12 Years).		
Upper arm length, UAL	S = (4.35 x UAL) + 21.8	1.7
Tibial length, TL	S = (3.26 x TL) + 30.8	1.4
Knee height, KH	S = (2.69 x KH) + 24.2	1.1

SE = Standard error

Estimation of stature[13] (S) from knee height (KH) in children aged 6–18 years

Gender*	Equation to estimate stature (cm)	SE of estimate (cm)
Derived in typically developing children, validity demonstrated in a small group of children with CP.		
Males	S = (2.22 x KH) + 40.54	4.21
Females	S = (2.15 x KH) + 43.21	3.90

SE = Standard error

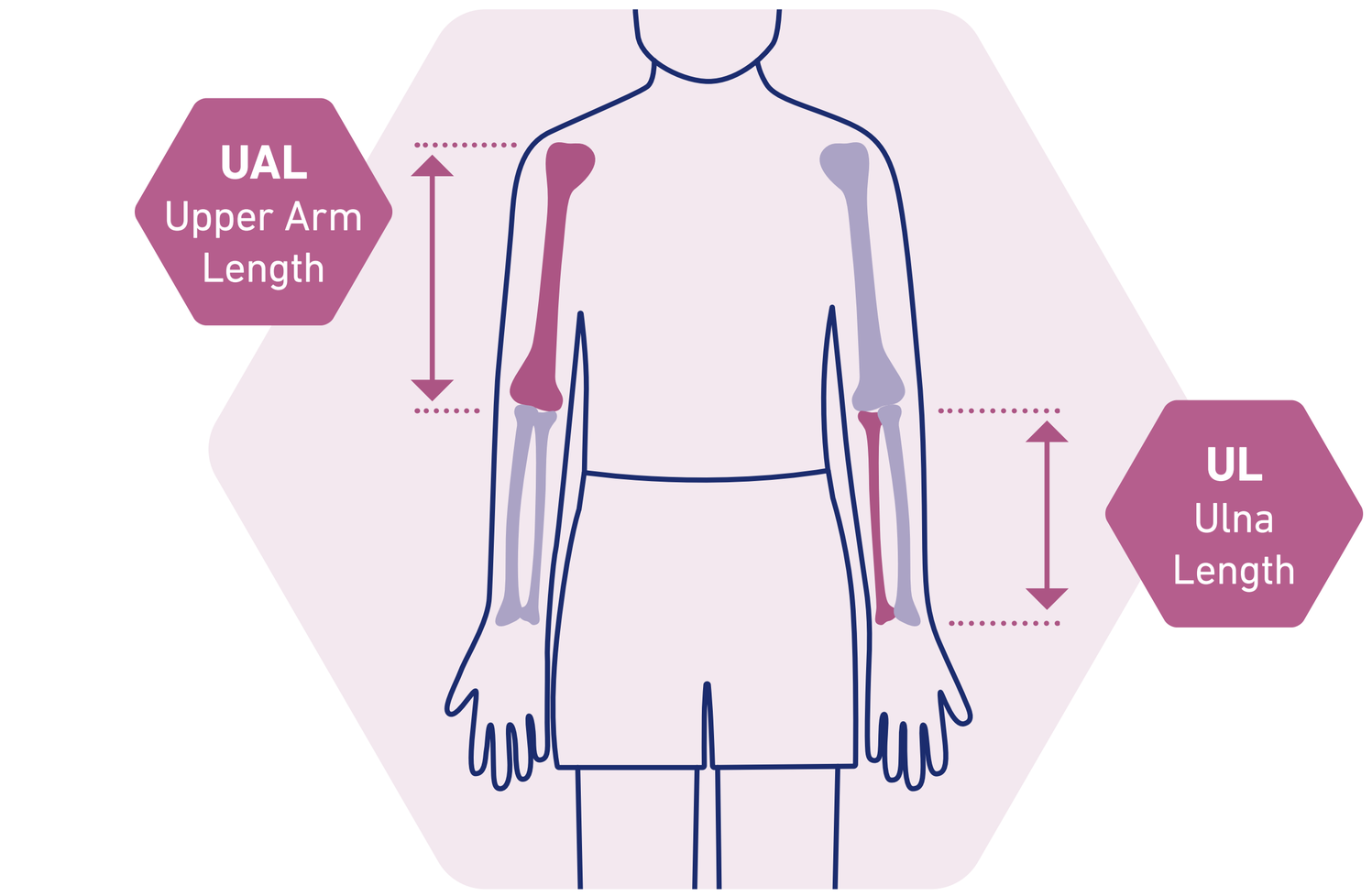
*These figures are estimates only. Other factors that are relevant to an individual's height, including genetics and hereditary factors must be considered.

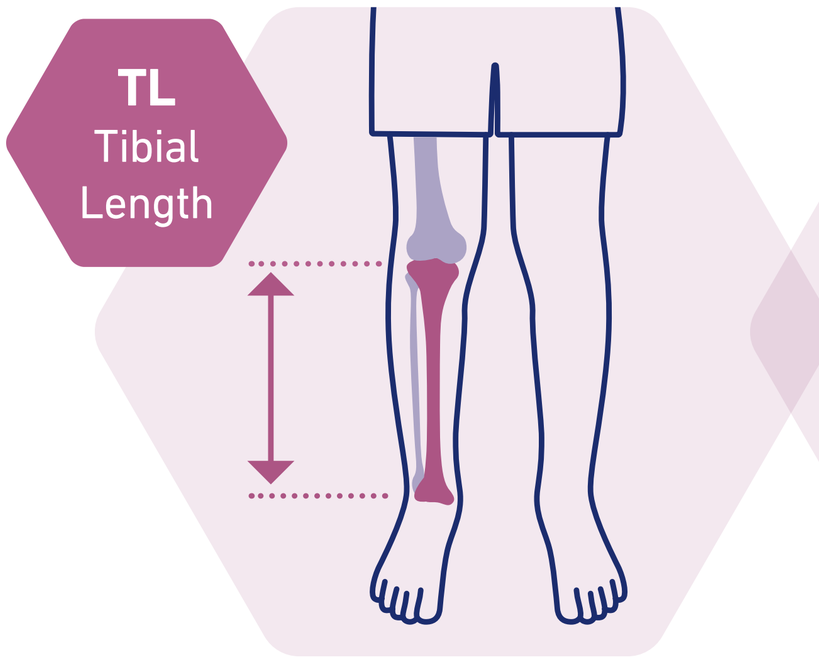
Estimation of height[14] (H) from ulna length (UL)

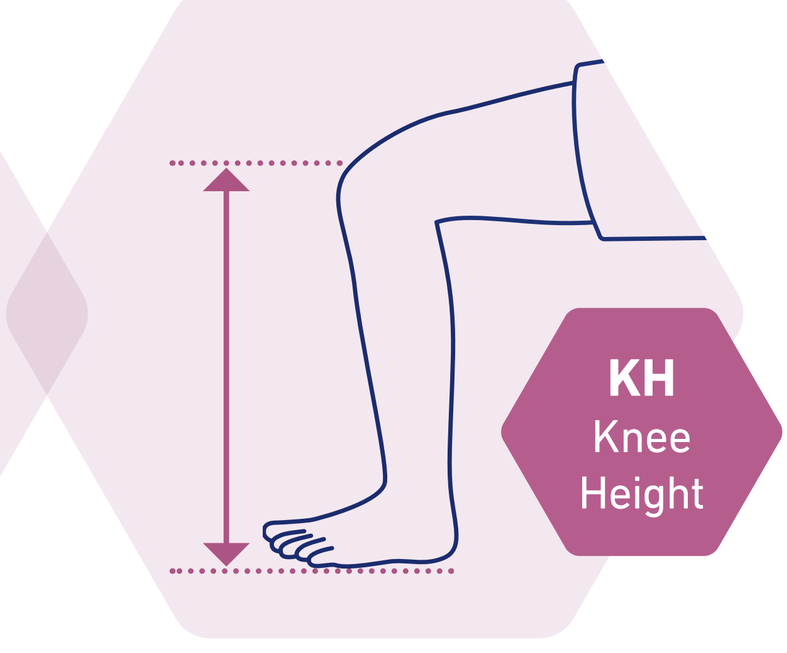
Gender	Equation to estimate height (cm)	Root Mean - Square Error
Males	H = 4.605 UL + 1.308 A + 28.003	3.896
Females	H = 4.459 UL + 1.315 A + 31.485	3.785

Derived in typically developing children aged 5–19 years. Not validated in children with CP. Performed better in typically developing children than prior ulnar equations, which had shown validity in CP (construct validity).

A = age







4

Supplementary tests

Additional investigations may be warranted if there are specific concerns.[11]

- **Hematological and biochemical analysis**

  The hematological and biochemical analysis may include the following determinations: hemogram, protein metabolism (albumin and prealbumin), iron metabolism, zinc levels as well as Ca, P, Mg, ALP, PTH, vitamin D and B12, folic acid, Na, K, urea, Cr, glycemia and liver enzymes.

  Haematological and biochemical analysis should be carried out on an annual basis.

- **Bone Mineral Density (BMD)**

Osteoporosis risk

BMD should be considered because of a risk of osteoporosis, which may further worsen the skeletal condition. BMD is often assessed by dual-energy x-ray absorptiometry (DEXA) in children with CP.

- Observation of ingestion and videofluoroscopy (to assess the presence and degree of dysphagia).
- 24-Hour pH-metry (to assess the presence of gastro-oesophageal reflux disease [GORD]).
- Endoscopy (to assess the presence of oesophagitis).

Nutritional management in children with neurological impairment[11]

Multidisciplinary nutritional assessment of the child with a neurological impairment

- Anthropometric assessment
- Patient history
- Physical examination
- Supplementary tests

Adequate nutrition

Safe swallowing

Systematic re-evaluation (annually or as indicated)

Unsafe swallowing†

Ensure adapted consistency (modified textures)

Ensure appropriate posture/positioning

Unsafe swallowing†

Inadequate nutrition

Safe swallowing

Dietary advice +/- oral supplements

Inadequate nutrition

Unsafe swallowing†

Tube feeding (supplementary vs. exclusive)

GORD

NO

YES

Gastrostomy

Controlled (PPI, diet)

Not controlled (PPI, diet)

Gastrostomy with fundoplication Jejunostomy

Adapted from the ESPGHAN Guidelines for the evaluation and treatment of gastrointestinal and nutritional complications in children with neurological impairment.

†Unsafe swallow is defined as occurring in a child who has both a history of aspiration pneumonia (antibiotics or hospital admission for chest infection) and objective evidence of aspiration or penetration on contrast videofluoroscopy.

GORD: Gastro-oesophageal reflux disease. **PPI:** Proton pump inhibitor.

Risk factors for aspiration[15]

- Previous episodes of aspiration.
- Decreased level of consciousness.
- Neuromuscular diseases and structural abnormalities of the aerodigestive tract.
- Endotracheal intubation.
- Vomiting.
- Persistently elevated gastric residual volumes.
- Need for prolonged supine posture of the patient.

Dysphagia evaluation[15]

- Detailed feeding history.
- Physical examination (especially neurological examination).
- Modified barium swallow (videofluoroscopy).
- Oesophageal manometry.
- Oesophageal pH monitoring.
- Endoscopic evaluation (hypopharynx or oesophageal).

Tube feeding in children with neurological impairment

Feeding decisions should always be made in agreement with the family and/or caregivers.[16]

Indications[17]

Nutritional

- Total meal time is extremely lengthy (>3 hours/day).[11]
- Inability to meet daily fluid requirements.
- Inability to meet daily nutrient requirements orally.

Red flag warning signs to identify undernutrition[11]

- Weight-for-age z-score <-2.
- Triceps skinfold thickness <10th centile for age and sex.
- Mid-upper arm fat or muscle areas <10th centile.
- Faltering weight and/or faltering growth.
- Physical signs of undernutrition such as decubitis ulcers and poor peripheral circulation.

Neurological

- Speech and language therapist assessment indicates aspiration risk.
- Recurrent complications of swallowing difficulties (aspiration, pneumonia, oesophagitis).

Route for tube feeding[18]

- Nasogastric.
- Gastrostomy.
- Jejunostomy.

Method of formula administration

- Continuous feeding via pump.
- Intermittent bolus via pump, gravity or syringe.
- Combined continuous night time and intermittent daytime bolus.[11]

Amount of energy and nutrients[7]

- Energy and nutrient requirements should be assessed based on individual Gross Motor Function Classification System (GMFCS). Those children who are a GMFCS of I and II and more active will have greater energy requirements than those children classified as GMFCS of IV or V.
- The clinician may also need to consider motor type and topography when determining energy and nutrient requirements.
- Individualise energy requirement based on estimations for typically developing children (for example, the Schofield equations[19]) and adjust as required. Regularly monitor energy balance.
- Energy requirements for children with CP are generally lower than those of typically developing children, so regular monitoring is essential to ensure appropriate growth and development.[19]
- Individualise macronutrient and micronutrient requirements based on those published for typically developing children, and adjust as required.
- Ensure fluid intake in order to prevent dehydration.

Type of nutritional formula[11]

- Breastmilk or appropriate infant formula for infants less than 1 year of age.
- Standard polymeric formula with added fibre for children older than 1 year of age.
- Trial of a whey-based formula in cases of gastro-oesophageal reflux disease (GORD).
- High-energy density formula (1.5 kcal/ml) with fibre can be used in children with high energy requirements (GMFCS I and II) or poor volume tolerance.
- Nutrition support may be used in addition to oral diet, depending on the individual needs of the child.

References

1. 2018 Australian Cerebral Palsy Register Report. Available at: https://cpregister.com/wp-content/uploads/2019/02/Report-of-the-Australian-Cerebral-Palsy-Register-Birth-Years-1995-2012.pdf (Accessed 27 April, 2022).
2. Marchand V. et al. Nutrition support for neurologically impaired children: a clinical report of the North American Society for Pediatric Gastroenterology, Hepatology, and Nutrition. J Pediatr Gastroenterol Nutr. 2006;43(1):123-35.
3. Sullivan PB. Nutrition and growth in children with cerebral palsy. Eur J Clin Nutr. 2013; 67: S3-S4.
4. Surveillance of Cerebral Palsy in Europe (SCPE) Scientific report 1998 - 2018, Available at: https://eu-rd-platform.jrc.ec.europa.eu/sites/default/files/SCPE%20Scientific%20report%201998-2018.pdf (Accessed: 27 April 2022).
5. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition: DSM-IV-TR. Washington, DC: APA; 2000.
6. Palisano RJ, Rosenbaum PL, Walter SD, Russell DJ, Wood EP, Galuppi BE. Development and reliability of a system to classify gross motor function in children with cerebral palsy. Dev Med Child Neurol.1997;39:214-23.
7. Walker JL, Bell KL, (2020) Chapter 7: Assessment of Nutritional State: Dietetics, Energy and Macronutrients. In Sullivan PB, Anderson GL, Andrew MJ (Eds.) Nutrition and Neurodisability (pp. 109-130). London, UK: Mac Keith Press).
8. Benfer KA, Bell KL, Ware RS, Davies PSW, Boyd RN. Oropharyngeal dysphagia and gross motor skills in children with cerebral palsy. Pediatrics. 2013; 131: e1553-e1562.
9. Samson-Fang L, Bell KL. Assessment of growth and nutrition in children with cerebral palsy. Eur J Clin Nutr. 2013; 67: S5-S8.
10. WHO Multicentre Growth Reference Study Group. WHO Child Growth Standards: Length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: Methods and development. Geneva: World Health Organization, 2006.
11. Romano C, van Wynckel M, Hulst J et al. European Society for Paediatric Gastroenterology, Hepatology and Nutrition Guidelines for the Evaluation and Treatment of Gastrointestinal and Nutritional Complications in Children with Neurological Impairment. J Pediatr Gastroenterol Nutr. 2017; 65(2): 242-64.
12. Stevenson RD. Use of segmental measures to estimate status in children with cerebral palsy. Arch Pediatr Adolesc Med 1995; 149:658-662.
13. Chumlea WC. Prediction of stature from knee height for black and white adults and children with application to mobility-impaired or handicapped persons. J Am Diet Assoc 1994; 94: 1385–1390.
14. Gauld LM, Kappers J, Carlin JB, Robertson CF (2004) Height prediction from ulna length. Dev Med Child Neurol 46(7): 475-480. doi: 10.1111/j.1469-8749.2004.tb00508.x.
15. DeLegge MH. Enteral nutrition and the neurologic diseases. In: Rolandelli RH. Enteral and Tube Feeding, eds. 4th ed. Elsevier, Inc., 2005, 410.
16. Martínez Costa C, Borraz S, Benlloch C, López-Sáiz A, Sanchiz V, Brines J. Early decision of gastrostomy tube insertion in children with severe developmental disability: A current dilemma. J Hum Nutr Diet. 2011; 24: 115-21.
17. Ekvall S, Ekvall V. Nutrition Support for Children with Developmental Disabilities. In: Baker SS, Baker RD, Davis AM, eds. Pediatric Nutrition Support. Jones & Barlett, 2007:363.
18. Pedrón Giner C, Martínez Costa C, Navas López VM. Consensus on paediatric enteral nutrition access: a document approved by SENPE/SEGHNP/ANECIPN/SECP. Nutr Hosp. 2011; 26: 1-15.
19. Schofield WN (1985) Predicting basal metabolic rate, new standards and review of previous work. Hum Nutr Clin Nutr 39C: S5–41.

Nestlé HealthScience

NCONNECT

REGISTER HERE TODAY!

For more information call 1800 671 628
or visit **www.nestlehealthconnect.com.au**

IMPORTANT NOTICE: Breast milk is best for babies and provides ideal nutrition. Good maternal nutrition is important for the preparation and maintenance of breastfeeding. Introducing partial bottle feeding could negatively affect breastfeeding and reversing a decision not to breastfeed is difficult. Professional advice should be followed on infant feeding. Infant formula should be prepared and used exactly as directed or it could pose a health hazard. The preparation requirements and weekly cost of providing infant formula until 12 months of age should be considered before making a decision to formula feed. Mothers should be encouraged to continue breastfeeding even when their infants have cow's milk protein allergy. If a decision to use an infant formula for special dietary use is taken, it must be used under medical supervision.

Information for healthcare professional use only.

Prepared in June 2022.

Nestlé HealthScience