



Assessing nutritional status

The health care of neurologically impaired children should be addressed from a **multidisciplinary approach**:



Neuropediatrics



Dietetics and nutrition



Social care



Gastroenterology and pediatric nutrition

Nursing



Physiotherapy

Speech and language therapist Patient history







Anthropometric assessment







Patient history



Clinical situation

Diagnosis of the neurological impairment

Cerebral palsy is the most common cause of motor disability in children. The surveillance of cerebral palsy in Europe reflects that it occurs in approximately 2 out of 1,000 live births.

Cerebral palsy and undernutrition

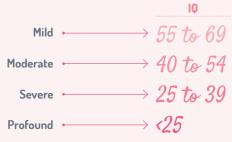
The actual prevalence of undernutrition and failure to thrive in these children is unknown but according to studies undernutrition has been documented in 29% to 46% of children with cerebral palsy.¹

Clinical history

- Other medical conditions.
- Diseases associated with their clinical condition (Gastro-oesophageal reflux disease [GORD], dysphagia, constipation, recurrent respiratory infections, convulsions, skeletal interventions and bone fractures).²
- Number of hospital admissions.

Degree of mental retardation

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



The majority of children with CP have mental retardation on the mild range. Actual number scores vary +/- 5 points.³

Degree of motor impairment* GM7CS E&R levels between 6th - 12th birthday











Children walk at home, school, outdoors and in the community. They can climb stairs without the use of a railing. Children perform gross motor skills such as running and jumping, but speed, balance and coordination are limited.

Children walk in most settings and climb stairs holding onto a railing. They may experience difficulty walking long distances and balancing on uneven terrain, inclines, in crowded areas or confined spaces. Children may walk with physical assistance, a hand-held mobility device or used wheeled mobility over long distances. Children have only minimal ability to perform gross motor skills such as running and jumping.

Children walk using a hand-held mobility device in most indoor settings. They may climb stairs holding onto a railing with supervision or assistance. Children use wheeled mobility when traveling long distances and may selfpropel for shorter distances.

Children use methods of mobility that require physical assistance or powered mobility in most settings. They may walk for short distances at home with physical assistance or use powered mobility or a body support walker when positioned. At school, outdoors and in the community children are transported in a manual wheelchair or use powered mobility.

Children are transported in a manual wheelchair in all settings. Children are limited in their ability to maintain antigravity head and trunk postures and control leg and arm movements.

GMFCS descriptors: Palisano et al. (1997) Dev Med Child Neurol 39:214–23. CanChild: www.canchild.ca Illustrations Version 2 (C) Bill Reid, Kate Willoughby, Adrienne Harvey and Kerr Graham, The Royal Children's Hospital Melbourne ERCI51050

Patient history (cont.)

Dietary assessment

Dietary history

Intake assessment (3-day dietary survey)

How to assess the intake?

Nutritional intake (considering regular food and any nutritional support) needs to be assessed in order to determine if it's appropriate to the child's needs. This assessment must also take into account the intake in terms of the different food groups.

Feeding problems:

- Attitude towards food (stressful versus pleasant).
- Time invested in each meal (over 30 min) and who supplies the food.
- Need to modify texture.
- Presence of signs of choking, coughing, facial redness, unexplained crying and irritability, apnea, eating behavioral disorders.⁵

Development indicators

Weight

Height/Length

Head circumference

Development follow-up

It is important to have serial measurements of weight and height/length prior to the consultation to detect changes in growth patterns.



Overall assessment

 It should include posture, skeletal deformities (e.g., scoliosis) and contractures.

Assessment of nutritional status

- · Assess subcutaneous cellular tissue and muscle mass.
- Presence of deficiency signs.

How to assess deficiency signs?

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

Global malnutrition can be observed by touching the skin and adipose paniculus 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 fecal retention

Anthropometric assessment

- Weight
- Height / Length
- Length segments
- Mid upper arm circumference (MUAC)
- Subcutaneous folds

From the determinations of weight and height/length, the corresponding z-scores and percentiles will 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 individualized minimum follow-up every 6 months although frequency can be increased in infants. 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 of children with normal growth (WHO)^{6,7}. However, the same patterns should be always used in order to evaluate progression.⁶

Malnutrition Risk Criteria

- BMI z score >-2 and <-1 (percentile >p2 and <p10)
- MUAC z score <-1 (percentile <p10)
- Subcutaneous folds percentile <p10⁸

Malnutrition Criteria

- BMI z score <-2 (percentile <p2)
- MUAC z score <-2 (percentile <p2)
- Subcutaneous folds percentile <p2⁸





Formulas to estimate stature from segmental measures⁶

Equations for estimation of stature from segmental measures

Segmental measure	Equation to estimate stature (S) (cm)	SE of estimate (cm)
Childr	en with CP (age: birth – 12 year	rs)
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

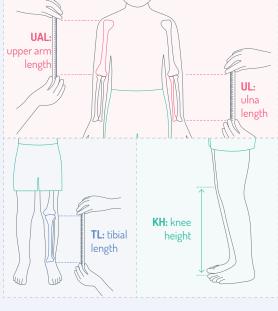
SE = standard error

Estimation of stature (S) from knee height (KH) in children aged 6-18 years

Race and gender	Equation to estimate stature (cm)	SE of estimate (cm)
	d in typically developing childrı trated in a small group of child	
White males	S = (2.22 x KH) + 40.54	4.21
Black males	S = (2.18 x KH) + 39.6	4.58
White females	S = (2.15 x KH) + 43.21	3.90
Black females	S = (2.02 x KH) + 46.59	4.39
SE = standard error		

Estimation of height (H) from ulna length (UL)

Gender	Equation to estimate height (cm)	Root Mean- Square Error
in children wil	cally developing children aged 5-19 year h CP. Performed better in typically deve ar equations, which had shown validity i validity)	loping children
Males	H = 4.605 UL + 1.308 A + 28.003	3.896
Females	H = 4.459 UL + 1.315 A + 31.485	3.785
= age		



Supplementary tests

Additional investigations may be warranted if there are specific concerns. 8

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· 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)

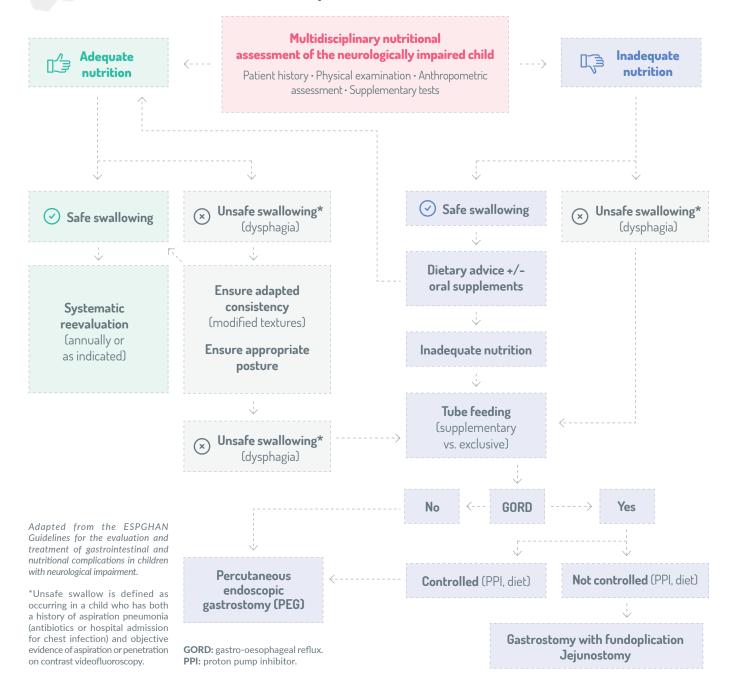
Osteoporosis risk

BMD should be considered because of a risk of osteoporosis, which may further worsen the skeletal condition.

- Observation of ingestion and videofluoroscopy (to assess the presence of dysphagia).
- 24-Hour pH-metry (to assess the presence of GORD).
- Endoscopy (to assess the presence of oesophagitis).



Nutritional management in children with neurological impairment⁸



Risk factors for aspiration⁹

- 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.

 $\{ \bigcirc \}$ Dysphagia evaluation 9

- 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. $^{\rm 10}$

Indications¹¹

Nutritional

- Meal time is extremely lengthy (>4-6 hours/day).8
- Inability to meet daily fluid requirements.
- · Inability to meet daily nutrient requirements orally.
- Malnutrition criteria (see "Anthropometric assessment" section).

Neurological

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

Route for tube feeding¹²

- Nasogastric.
- Gastrostomy.
- Jejunostomy.

Method of formula administration

- Continuous drip.
- Intermittent bolus.
- Combined continuous night time and intermittent daytime bolus.⁸

Amount of energy and nutrients

- Individualise energy based on ideal body weight for chronologic age (10th–25th percentile) in the malnourished child.
- Individualise energy based on multiples (1.0–1.2) of the resting metabolic rate in obese children.
- Ensure water intake in order to prevent dehydration.

Type of nutritional formula

- Polymeric formula preferably with fibre.
- Whey peptide based formula in cases of feeding intolerance or GORD.
- Nutrition support may be used in addition to oral diet, depending on the individual needs of the child.

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