

Nutrition in the Paediatric Liver Patient

Cape Town Metropole Paediatric Interest Group

Annotated Acute Liver Failure: Summary

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1. Aim of annotated guidelines for children with acute liver disease

The aim of these guidelines is to outline a summary of appropriate nutrition care practices based on current evidence with respect to the dietary management of children with liver disease. They should be used as a guide with respect to best nutrition practice, however some individual cases may deviate from the nutrition guidelines based on the medical diagnosis.

Nutrition management usually aims to maintain glucose homeostasis, manage fat malabsorption including steatorrhoea, promote appropriate aminogenesis and prevent malnutrition.

The contents of this guideline should be reviewed in two years from the date of publishing, with a view to incorporating the latest developments and research findings and field experiences. The full referenced document is available providing supportive evidence for the recommendations outlined in the text below.

2. Glossary

Term	Definition
% EHA	Percentage estimated height for age
% EWA	Percentage estimated weight for age
% EWH	Percentage estimated weight for height
AA	Arachidonic acid
ALP	Alkaline phosphatase
ALT	Alanine aminotransferase
AMA	Arm muscle area [requires MUAC & TSF to calculate]
AST	Aspartate aminotransferase
CHC	Community Health Centre
CHO	Carbohydrate
DHA	Docosahexanoic acid
DRV's	Dietary reference values [Appendix 1]
EBM	Expressed breastmilk
EFA	Essential fatty acids
ESLD	End stage liver disease
FBC	Full blood count
FBDG	Food based dietary guidelines
GGT	Gamma glutamyltransferase
GIT/ GI tract	Gastro-intestinal tract
Gomez Classification	<p><i>Acute malnutrition: Weight for age</i></p> <ul style="list-style-type: none"> • Obese >120% • Normal > 90% • Mild malnutrition 76 – 90% • Moderate malnutrition 61 – 75% • Severe malnutrition < 60%
Growth faltering (NSP Definition):	<ul style="list-style-type: none"> ▪ Birth – < 6 months growth curve flattens or drops over two consecutive visits on his/her RthC. ▪ 6 – 12 months growth curve flattens or drops over two consecutive months on his/her RthC. ▪ 1 - 5 years: when an infant or child's growth curve flattens or drops over two consecutive visits on his/her RTHC. ▪ >5 - < 18 yrs: when a child's growth curve flattens or drops over two consecutive months on his/her weight-for-age growth chart.
HA	Height age
HFA	Height for age
Hb	Haemoglobin
HE	Hepatic encephalopathy
IBM	Inborn error of metabolism
IMCI	Integrated management of childhood illness
IMCI: Not Growing Well	<p><i>Severe Malnutrition:</i></p> <ul style="list-style-type: none"> ▪ Very low weight < 60% EWA. ▪ Visible signs of severe wasting ▪ Oedema on the feet <p><i>Not Growing Well:</i></p> <ul style="list-style-type: none"> ▪ Low weight < 3rd centile ▪ Poor weight gain - gaining weight but curve flattening or ▪ Mother reports weight loss. <p><i>Growing Well:</i></p> <ul style="list-style-type: none"> ▪ Not low weight ▪ Good weight gain.
INR	International normalisation ratio
IV	Intravenous
K+	Potassium
LCPUFA	Long chain polyunsaturated fatty acids
MAC	Mid arm area circumference
MCT	Medium chain triglycerides
Mg++	Magnesium
MUAC	<p>Mid upper arm circumference [6 months – 5 years of age]</p> <ul style="list-style-type: none"> ▪ > 15cm normal ▪ >11.5cm - <14.5cm moderately malnourished ▪ <11.5 cm [<-3SD] severely malnourished
Na+	Sodium
NG	Nasogastric
NPE	Non-protein energy
NPE	Non-protein energy
NSP	Nutrition supplementation programme

NSP: Entry Criteria	<ul style="list-style-type: none"> ▪ Supplementation must be continued for only 6 months if entered onto the Nutrition Supplementation Programme. ▪ <i>Infants: 0 – 12months</i> growth curve flattens or drops over two consecutive visits on his/her RTHC and the mother is unable to breastfeed because of the following reasons: <ul style="list-style-type: none"> - Serious systemic disease, on long-term medication or treatment e.g. chemotherapy, hypothyroidism; is addicted to alcohol or drugs (condition must be formally documented/assessed); is mentally disabled and poses a threat to the baby; the infant is in foster care. ▪ <i>Children > 5 years < 18 years:</i> When child's growth curve flattens or drops over two consecutive months.
NSP: Exit Criteria	<p>a) <i>Successful:</i></p> <ul style="list-style-type: none"> • <i>Birth – 12 months</i> an adequate weight gain to attain a growth curve in relation to his/her birth weight and maintains the curve for three consecutive months on the scheme. • <i>1 - 5 years:</i> gained sufficient weight to attain a growth curve in relation to his/her normal growth curve and maintains the curve for three consecutive months. • <i>>5 < 18 years:</i> gained sufficient weight to attain normal growth curve according to the growth chart within the 6 months period on the scheme <p>b) <i>Unsuccessful:</i></p> <ul style="list-style-type: none"> • <i>Birth – 5 years:</i> Failure to attain growth curve in relation to his/her normal growth curve over a period of 6 months and if no underlying disease/condition is present e.g. Foetal Alcohol Syndrome • <i>>5 - < 18 years:</i> who do not attain a normal growth curve according to the growth chart with in the 6 months period. <p>c) <i>Defaulter:</i></p> <ul style="list-style-type: none"> ▪ <i>Birth – 5 years:</i> Failure to attend the clinic for a period of three consecutive months. • <i>> 5 - <18 years:</i> Failure to attend the clinic for a period of three consecutive months within the 6 months period. • Client has a history of irregular clinic attendance (less than three visits in a 6 month period) with in the 6 months period. <p>** <i>Re-entry:</i></p> <ul style="list-style-type: none"> • <i>UNSUCCESSFUL</i> and <i>DEFAULT</i> cases <i>MAY NOT</i> be re-entered onto the programme. • <i>SUCCESSFUL</i> cases <i>MAY</i> be re-entered onto the programme according to entry criteria.
PEG	Percutaneous endoscopic gastrostomy
PO ₄	Phosphate
RDA	Recommended daily allowance
RDI	Recommended daily intake
Schofield Equation	Predicting estimated energy requirements [Appendix 1]
SD	Standard Deviations used to determine moderate to severe malnutrition: <ul style="list-style-type: none"> • 0 - <-1 Z scores Normally Nourished • >-2 – -3 Z scores Moderately Malnourished • >-3SD Severely Malnourished
TSF	Tricep Skinfold Thickness
U&E	Urea, creatinine, sodium, potassium
WA	Weight age
Waterlow Criteria (WHO)	Used to determine malnutrition: <p><i>Acute malnutrition: Weight-for-height/ length</i></p> <ul style="list-style-type: none"> • Normal WH >90%, • Mild 81% - 90%, • Moderate 70% - 80%, • Severe <70%. <p><i>Chronic malnutrition: Height-for-age</i></p> <ul style="list-style-type: none"> • Normal >95%, • Mild 90 –95%, • Mild – moderate 85% to 89% • Severe < 85%

WCC	White blood cell count
WH	Weight for height

3. Summary of recommendations for nutrition management of infants and children with liver disease

Summary Nutrition Recommendations: Acute Liver Failure

Acute Liver Failure	
Overview	<ul style="list-style-type: none">• In rapid presentation infants and children are usually moderately – well nourished.• Management is based on maintaining nutrition status.• If child survives liver function should return to near normal.
Energy	<ul style="list-style-type: none">• RDI [Appendix 1: Table 1]• Do not usually require additional energy during an acute episode.
Protein	<ul style="list-style-type: none">• Not restricted
Fat	<ul style="list-style-type: none">• Not restricted
Vitamins	<ul style="list-style-type: none">• Vitamin K may be indicated if there is a deranged coagulopathy.• However, the administration of other fat-soluble vitamins is not advised.

4. Acute Fulminant Liver failure

Overview

- Fulminant failure is difficult to define: as it occurs as an acute episodes arising from a previously undiagnosed chronic disease e.g. inborn error of metabolism or as a result of ingestion of a toxin or poison.
- Mitochondrial disorders of metabolism should be excluded.

Anthropometry

Complete on admission & weekly until discharge

Determine:	Plot weight and length/ height using:	Calculate
<ul style="list-style-type: none"> • Length/ Height (m) • Weight (kg) • MUAC • TSF • Head Circumference < 3 years of age 	<ul style="list-style-type: none"> • Appropriate growth charts. • Weight may not be useful when there is gross ascites 	<ul style="list-style-type: none"> • HA/ HFA • WA • WH • % EWA • % EWH • % EHA

Entry Criteria for nutrition support during hospitalisation based on anthropometry

- Poor oral intake
- Weight loss or growth failure during hospitalisation
- Nutrition risk score > 6
- Growth curve flattens or drops over two consecutive months (NSP definition)
- < 5th or 3rd centile
- < 80% % EWH
- <-2 or -3 ZD
- Downward crossing of 2 or more centiles

Biochemistry

- Complete daily until acute episode has resolved.
- Once in recovery complete x 2 week until discharge
- [Follow Appendix 2: King's College Investigation protocol]

Monitor the following

- Urea, creatinine, sodium, potassium
- Calcium, magnesium and phosphorus
- Ammonia
- Glucose
- Albumin, ALT, GGT, Bilirubin [conjugated, unconjugated]
- INR & Fibrinogen
- Hb, platelets, WCC

Clinical

Acute presentation associated with:

- Severe liver impairment associated with hepatocellular necrosis.
- Fulminant liver failure is usually associated with encephalopathy

Encephalopathy in acute liver failure

Stage	Clinical	Signs
<ul style="list-style-type: none"> • Stage 0 	<ul style="list-style-type: none"> • Subclinical encephalopathy 	<ul style="list-style-type: none"> • Abnormalities in psychometric testing
<ul style="list-style-type: none"> • Stage 1 	<ul style="list-style-type: none"> • Subtle behaviour changes • Altered sleep patterns – switching night to day sleep • Shortened attention spans 	<ul style="list-style-type: none"> • Poor feeding • Vomiting • Incoordination • Fine tremor • Trivial lack of awareness • Shortened attention span
<ul style="list-style-type: none"> • Stage 2 	<ul style="list-style-type: none"> • Personality changes • Drowsiness/ lethargy • Disorientation • Agitation 	<ul style="list-style-type: none"> • Asterixis • Ataxia • Hypertonia
<ul style="list-style-type: none"> • Stage 3 	<ul style="list-style-type: none"> • Temporal and spatial disorientation • Delirium, hallucinations • Mania • Stupor, seizures 	<ul style="list-style-type: none"> • Hyperreflexia • Babinski's reflex • Somnolence to semistupor • Responsive to stimuli

<ul style="list-style-type: none"> • Stage 4 	<ul style="list-style-type: none"> • Comatose • Semi- or unconscious 	<ul style="list-style-type: none"> • Decorticate and decerebrate posturing • Opisthotonus • Ocular palsies • Cardio respiratory arrest
Clinical Signs usually present during liver disease in children:		
<ul style="list-style-type: none"> • Clubbing • Jaundice • Oedema • Large abdomen • Hepatomegaly 	<ul style="list-style-type: none"> • Splenomegaly • Ascites • < Muscle bulk • < Skinfold thickness • Vasodilatation 	
Supportive Medical Management of Fulminant Liver failure		
<ul style="list-style-type: none"> • Sedation: No sedation for procedures. • Monitor: neuro obs 4 – 6 hrly, gastric pH [>5], blood glucose [$> 4\text{mmol/kg}$]; acid/ base electrolytes, PT, PTT • Fluid balance: 75% maintenance – maintain circulating volume with colloid/ fresh frozen plasma • Coagulation support: (fresh frozen plasma) • Drugs: Vitamin K (2 – 10mg/d orally or IV) more is required if the INR is extremely deranged, sucraflata (2- 4g/day), lactulose (5 – 20ml/day), N-acetyl cysteine – IV (70mg/kg/6 hours), +/- broad spectrum antibiotics • Enteral feed: enteral feed (aim for 1 – 2g/kg protein per day depending on age), parenteral nutrition may be occasionally required. 		
Dietary		
Overview of pathophysiology		
<p>Potential problems requiring nutrition intervention occur when there is a disturbance of normal metabolic functions of the liver including:</p> <ul style="list-style-type: none"> • Glucose homeostasis • Protein synthesis <p>Diet Therapy includes management of:</p> <ul style="list-style-type: none"> • Hypoglycaemia for poor glycogen storage • Reduction in protein synthesis especially albumin exacerbating ascites. <p>At each follow up a thorough nutrition history should be completed</p> <ul style="list-style-type: none"> • Diet history • Review through 24hour dietary recall quarterly or at each follow up review in conjunction with food frequency. 		
Fluid		
Patients may be fluid restricted to 60 – 75% of volume if cerebral oedema is a concern.		
Age (years)	ml/kg actual body weight	
Premature	180-200	
0-1	150	
1-3	100	
3-6	90	
7-10	70	
10-15	60	
Energy Expenditure & Requirements		
<p>Energy expenditure:</p> <ul style="list-style-type: none"> • In sedated, ventilated children energy expenditure is often significantly reduced. • Caution should be taken not to overfeed in these children as they have an increased risk of metabolic and clinical complications <p>Infants:</p> <ul style="list-style-type: none"> • Ventilated: 90 – 100 kcal/kg • Non ventilated: 100 – 120kcal/kg <p>Children:</p> <ul style="list-style-type: none"> • Ventilated: Schofield equation or WHO/FAO/UNU x 1.3 – 1.5 [Stress factor; No activity factor] • Non ventilated: Schofield equation or WHO/FAO/UNU x 1.7 – 1.8 [Combined activity and Stress factor] [Appendix 1: Tables 2, 3 and 4] 		

Recommendations for energy density of feeds

Infants:

- No additional energy should be required breastmilk and or standard ready to use/ hang infant formula [0.67kcal/ml] may be given.
- If the patient is volume-restricted breastmilk may be supplemented with a carbohydrate and fat powder or a ready to use/hang energy dense infant feed [1kcal/ml] may be given.

Children:

- No additional energy should be required and a standard feed [1kcal/ml] should meet energy requirements in the volume prescribed.
- If a patient is volume restricted an energy dense [1.5 kcal/ml] ready to use/hang feed should be given.

NB:

- No powders or liquids e.g. oil should be added to a sterile ready to use feed.
- If additional energy is required in non-ventilated children boluses flushes of super soluble fat and carbohydrate powder should be given prior to a drink or feed (including breastmilk).
- Recommendations for fat, protein and carbohydrate per age group concentrations should not be exceeded. [See sections below]

Carbohydrate Recommendations

Glucose requirements

- > According to tolerance

Infants

- 8-9mg/kg/min [11.5g –12.9g/kg/day]
- Max 12.5mg/min/kg [18g/kg/day]

Toddlers

- 7mg/kg/min [10g/kg/day]

Adolescents

- 4mg/kg/min [5.7g/kg/day]

NB: Always increase glucose gradually and according to tolerance.

The following concentrations of CHO per 100ml will be tolerated if a glucose polymer is used:

- Infants under 6 months: 10-12% carbohydrate concentrations (i.e. 7g from formula, 3-5g of glucose polymer added)
- Infants 6months to 1 year: 12-15%
- Toddlers 1-2 years: 15-20%
- Older children > 2 years: 20-30%

Form of CHO

- CHO's in the form of glucose polymer should be used instead of disaccharides as they have a lower osmotic effect.
- It is recommended that glucose polymer be added in increments of 1g per kg per 100ml per day until the goal amount is reached in order to decrease the risk of diarrhoea

Protein Recommendations

Protein during the first 20 – 48 hours:

Infants:

- Initial protein per kg of 0.5 – 1g/kg
- Increase with 0.5g/kg increments according to ammonia levels and the infant's clinical condition until the goal amount of protein is met.
- Goal: 1.5g – 1.9g/kg

Children > 1 year of age:

- Increase with 0.5g/kg increments according to ammonia levels and the child's clinical condition until the goal amount of protein is met.
- Goal: 0.8 – 1.0g/kg

If baseline ammonia > 100 mmol/l or be lead by clinical signs

- Start with increments of 0.25 – 0.5g/kg protein.
- Increase to goal amount daily.

If ammonia < 100 mmol/l or be lead by clinical signs

- Start with increments of 0.5g/kg day
- Increase to goal amount daily.

If ammonia levels show a sudden upward trend or there is a sudden deterioration in patients clinical condition

- Decrease protein intake by 0.25 – 0.5g/kg/day
- Increase again slowly as tolerated and according to levels/

NB:

- Lactulose 5 – 20ml/day should be prescribed in all children with encephalopathy with the aim of producing 2 – 3 loose stools per day.
- In addition to this fleet enema may be used along with neomycin to purge the large bowel of faecalant matter.

Fat Recommendations
<p><i>Birth - < 5 years of age</i></p> <ul style="list-style-type: none"> • 40% NPE <p><i>Children > 5 years of age</i></p> <ul style="list-style-type: none"> • 30 – 35% NPE <p><i>Adding fat to feeds:</i></p> <ul style="list-style-type: none"> • Should be done as a last resort – rather add extra oil/ margarine to food. • Infants: will tolerate a total fat concentration of 5 – 6 % [e.g. 5 – 6g per 100ml of feed]. • Children > 1yr will tolerate a fat concentration of 7% - concentrations above this may cause nausea/ vomiting. • Liquigen, Calogen, Duocal or Energivit is recommended for supplementing fat. • If the intake of long chain fats is restricted in order to prevent EFA deficiency: 2 ml per 100kcal/ day Walnut oil to prevent EFA. • Increments of 1% per 24 hours or 0.5g/kg per 100ml per day up to goal amount. <p>NB: Fat is restricted only if an inborn error of metabolism (IBM) is suspected.</p>
Vitamins Recommendations
<ul style="list-style-type: none"> • Coagulopathy will present when INR > 1.5 • Supplement Vitamin K: 2-10 mg/ day orally • Do not supplement with other fat soluble vitamins • Water soluble vitamins in the form of a multivitamin may be prescribed
Entry and Exit Criteria for Nutrition Support
Entry Criteria for nutrition support during hospitalisation: Daily Dietetic Review
<ul style="list-style-type: none"> • Poor oral intake • Weight loss or growth failure during hospitalisation • Nutrition risk score > 6
Entry Criteria for nutrition support on discharge home: Monthly Dietetic Review
<p><i>Acute malnutrition: Weight/ Height</i></p> <ul style="list-style-type: none"> • < 80% <p><i>Acute Malnutrition: Weight for age</i></p> <ul style="list-style-type: none"> • < 76% <p><i>Chronic malnutrition: height for age</i></p> <ul style="list-style-type: none"> • < 89% <p><i>Moderate Malnutrition</i></p> <ul style="list-style-type: none"> • MUAC < 14.5 cm - >11.5cm in children < 5 years of age <p><i>Severe Malnutrition</i></p> <ul style="list-style-type: none"> • MUAC < 11.5cm in children < 5years of age. <p>Qualifies for entry into the Nutrition supplementation programme (NSP)</p> <ul style="list-style-type: none"> ▪ Infants: 6 months – 1 year: when infants' growth curve flattens or drops over two consecutive visits. ▪ Children > 5 years ≤ 18 years: When child's growth curve flattens or drops over two consecutive months. <p>Referral NSP Scheme</p> <ul style="list-style-type: none"> • Access from local day hospital/ CHC <p>Private Medical Aid Patients</p> <ul style="list-style-type: none"> • Growth failure – flattening or down ward crossing of centiles. • Downward crossing of 2 or more centiles over a period of 1 month or 2 consecutive visits. <p><i>Acute malnutrition: Weight/ Height</i></p> <ul style="list-style-type: none"> • < 80% <p><i>Acute Malnutrition: Weight for age</i></p> <ul style="list-style-type: none"> • < 76% <p><i>Chronic malnutrition: height for age</i></p> <ul style="list-style-type: none"> • < 89% <p><i>Moderate Malnutrition</i></p> <ul style="list-style-type: none"> • MUAC < 14.5 cm - >11.5cm in children < 5 years of age <p><i>Severe Malnutrition</i></p> <ul style="list-style-type: none"> • MUAC < 11.5cm in children < 5years of age.

Exit Criteria for nutrition support:

- **Monthly review for first 3 months, if growing well quarterly, followed by 6 monthly and annually.**

NSP

- Birth – 5 years: gained sufficient weight to attain a growth curve in relation to his/her normal growth curve and maintains the curve for three consecutive months.
- > 5yrs – 18 years who attain normal growth curve according to the growth chart within the 6 months period on the NSP scheme.
- WH >90%
- HA >95%
- WA > 90%

Or Private Patients

- Upward crossing of 2 or more centiles over a period of 1 month or 2 consecutive visits
- MUAC >15cm in children < 5 years of age
- WH >90%
- HA >95%
- WA > 90%

4.1 Summary: Establishing Nutrition Support in the Acute Liver patient

Goal: To ensure that each patient with chronic liver disease attains/ maintains an optimal nutrition status.

To read the chart:
Follow the arrows

Assess patient using the following approach:

- A = Anthropometry
- B = Biochemistry
- C = Clinical
- D = Dietary
- Implement nutrition support where appropriate

Start Here

Anthropometric assessment to determine patient's nutritional status & risk:

- Height MAC TSF %EHA HC MUAC Weight %EWA
- %EWH AMA

Assess dietary intake: Interview caregiver

- Complete 24 hour diet recall
- Food frequency
- Is the intake appropriate according to the DRV's?

Is there growth faltering or failing during last the month or over 2 consecutive visits?

Yes

Yes

No

Monitor
3 month review

Good intake: Pre Discharge

- Educate caregiver about appropriate and affordable food intake.
- Inform caregiver of the food based dietary guidelines [FBDG]

Supportive Medical Management of Acute Liver failure with encephalopathy

- No sedation for procedures
- **Monitor:** neuro obs 4 – 6 hrly, gastric pH [>5], blood glucose [>4 mmol/kg]; acid/ base electrolytes, PT, PTT.
- **Fluid balance:** 75% maintenance – maintain circulating volume with colloid/ fresh frozen plasma.
- **Coagulation support:** (fresh frozen plasma)
- **Drugs:** Vitamin K (2 – 10mg/d IV or orally), sucralfate (2- 4g/day), lactulose (5 – 20ml/day), N-acetyl cysteine – IV (70mg/kg/6 hours), +/- broad spectrum antibiotics, neomycin.
- **Enteral feed:** enteral feed (aim for 1 – 2g/kg protein per day depending on age), parenteral nutrition may be occasionally required.

Poor intake: Pre Discharge

- Encourage caregiver.
- Advise caregiver around food based dietary guidelines [FBDG]
- Promote small frequent meals x 3 and snacks 2 – 3 per day.
- Recommend energy & nutrient dense foods & drinks

Entry to Nutrition Support:

Calculate Dietary Requirements & recommend nutrition supplementation.

- Growth faltering
- WH $< 90\%$ expected
- HA $< 95\%$ expected
 1. Government: NSP Programme
 2. Private Medical aid motivation

Nutrition Support

Infants

- Breastmilk
- Infant cereal > 6 months age

Children

- Enriched maize meal porridge
- Nutritionally complete age appropriate supplement.

Exit Nutrition Support when:

- Birth to 5 years – Normal growth curve RTCH following 3 months on NSP scheme.
- $> 5 - 18$ yrs: Normal growth curve RTCH 6 months on NSP scheme.
- Upward crossing of 2 or more centiles over a period of 1 month or 2 consecutive visits.
- MUAC > 15 cm in children < 5 years of age.
- WH $> 90\%$ expected
- HA $> 95\%$ expected

Acute Phase

Provide sufficient glucose:

- Infants 8 – 10 mg/min/kg/gluc
- Children 7mg/min/kg/gluc
- Adolescents 4 mg/min/kg /gluc

Protein

- If baseline ammonia > 100 mmol/l.
- Start with 0.5g/kg increments during first 24 – 28 hours.
- Increase 0.5g/kg daily until goal amount is reached.
- If there is an increase in ammonia levels or $<$ in levels of consciousness $<$ protein by 0.5g/kg.
- All patients should receive lactulose therapy – 5 – 20ml per day.

Energy

- Aim to provide sufficient non protein energy in order to prevent endogenous catabolism of somatic and visceral tissues and maintain glucose homeostasis

Recovery Phase

Provide sufficient energy & protein to support growth and weight gain.

Infants

- 2 - 3g/kg protein
- 100 - 120kcal/kg

Children

- 1.5 - 2g/kg protein
- 1.2 – 1.5 x RDA OR
- Schofield equation or WHO x 1.7 – 1.9 [combined activity & stress factor]

5.1 Appendix 1: Energy Calculations

Table 1: Selected Dietary Reference Values (DRV's) for Infants and Children requiring Oral/Enteral Nutrition ¹

Age	Weight (kg)	KJ/kg/day	Kcal/kg/day	Protein g/kg/day
Males				
0 – 3months	5.1	420 – 480	100 – 115	2.1
4 – 6	7.2	400	95	1.6
7 – 9	8.9	400	95	1.5
10 –12	9.6	400	95	1.5
1 – 3 years	12.9	400	95	1.1
4 – 6	19.0	380	90	1.1
7 – 10		8240/day	1970/day	28.3g/day
11 – 14		9270/day	2220/day	42.1g/day
15 – 18		11510/day	2755/day	55.2g/day
Females				
0 – 3 months	4.8	420 – 480	100 – 115	2.1
4 – 6	6.8	400	95	1.6
7 – 9	8.1	400	95	1.5
10 –12	9.1	400	95	1.5
1 – 3 years	12.3	400	95	1.1
4 – 6	17.2	380	90	1.1
7 – 10		7280/day	1740/day	28.3g/day
11 – 14		7920/day	1845/day	42.1g/day
15 - 18		8830/day	2110/day	45.4g/day

Table 2: Schofield Equation for Calculating Resting Metabolic Rate (RMR) – Kcal/day ^{1,29}

Age (yr)	Male	Female
< 3	$0.167(W) + 1517.4(H) - 617.6$	$16.252(W) + 1023.2(H) - 413.5$
3 – 10	$19.59(W) + 130.3(H) + 414.9$	$16.696(W) + 161.8(H) + 371.2$
10 –18	$16.25(W) + 317.2(H) + 515.5$	$8.365(W) + 465(H) + 200.0$
> 18	$15.057(W) + 10.04(H) + 705.8$	$13.623(W) + 283(H) + 98.2$

Table 3: FAO/WHO/UNU kcal/day^{1,29}

Age (yr)	Male	Female
3 – 10	$22.7 (W) + 495$	$22.5 (W) + 499$
10 - 18	$17.5 (W) + 651$	$12.2 (W) + 746$

PHYSICAL ACTIVITY FACTORS ¹	
ACTIVITY	ACTIVITY FACTOR (AF)
• Sleeping (ICU, Sedation and muscle relaxation)	1.0
Hospitalized	
• Non Ambulant	1.2
• Ambulant	1.3
At Home	
• Relatively inactive	1.4
• Very active	1.9
STRESS FACTORS	
DISEASE	STRESS FACTOR
Trauma	
• Little (long bone fracture)	1.2
• Central Nervous System	1.3
• Moderate to severe (multiple)	1.5
Sepsis	
• Moderate	1.3
• Severe	1.6

5.2 Appendix 2: ²⁵

King's College Hospital, Special Investigations protocol for acute liver failure

Biochemical Tests
<ul style="list-style-type: none">• Liver function Tests (Total & direct bilirubin, AST, ALT, GGT, ALP, albumin)• Blood sugar• Serum calcium, phosphorus, magnesium• Uric Acid• Cholesterol• Triglyceride• Amalyse• Alpha-1 antitrypsin phenotype• Galactose –1 phosphate uridyl transferase (in infants and neonates)• Serum copper & caeruloplasmin (in children 3 years old)• Serum aminoacids• Blood gas analysis
Haematological Tests
<ul style="list-style-type: none">• Full blood count• Reticulocyte count• Prothrombin time or INR• Blood for grouping & cross matching• Direct coombs test• Bone marrow examination (in seronegative hepatitis or haematological malignancy or HLH is suspected)
Ultrasound
<ul style="list-style-type: none">• US scan of abdomen especially liver, portal and hepatic vein, inferior vena cava, biliary system and spleen• Microbiological Tests• Bacterial cultures: blood, urine, stool, throat swab, sputum, skin lesion if present, ascetic fluid if present.• Viral culture of urine and skin lesions if present
Serological tests
<ul style="list-style-type: none">• Viral hepatitis: anti HAV IgM antibody, HbsAg, HB core antigen, Hepatitis D antigen and antibody, anti hepatitis C antibody, anti hepatitis E antibody.• CMV• EBV• HIV• Measles• Varicella• Herpes simplex virus• Adenovirus• Echovirus
Immunological tests
<ul style="list-style-type: none">• Immunoglobulins (IgG, IgA, IgM)• Tissue antibodies (anti SMA, GPC, anti SLA, LKM and anti nuclear antibody)• Complement C3 & C4• Ascitic fluid or cerebrospinal fluid cytospin for evidence of hemophagocytosis• Urine• Toxicology• Chemical analysis, osmolality and electrolytes• Succinyl acetone• 24 hour urinary copper pre penicillamine and post penicillamine (2 doses of 500mg 12 hours apart)
Tissue studies
<ul style="list-style-type: none">• Buccal mucosal biopsy• Skin fibroblast culture

5.3 APPENDIX 3

Nutrition Risk Score

Patients Name ----- Ward -----
 Hospital Name ----- Date -----
 Date of birth ----- Height/ Length -----

Please circle relevant score. Only select one score from each section. Select the highest score that applies.

COMPLETE ON ADMISSION AND WEEKLY IF PATIENTS CONDITION HAS CHANGED

1

Paediatrics (0-17 years) **score**

Present Weight

Expected weight for length	0
90-99% of expected weight for length	2
80-89% of expected weight for length	4
<79% of expected weight for length	6

2

Omit question 2
For paediatrics

Adults (18 years) **score**

Weight loss in last 3 months (unintentional)

No weight loss	1
0-3kg weight loss	2
>3-6kg weight loss	3
>6kg weight loss	3

BMI (Body Mass Index)

20 or more	0
18 or 19	1
15-17	2
Less than 15	3

3

Appetite

- Good appetite, manages most of 3 meals/ day (or equivalent) 0
- Poor appetite, poor intake – leaving > half of meals provided (or equivalent) 2
- Appetite nil or virtually nil, unable to eat. NMB (No food for > 4 meals) 3

4

Ability to eat/ retain food		
•	No difficulties in eating, able to eat independently No diarrhoea or vomiting	0
•	Problems handling food e.g. needs special cutlery 1 Vomiting/ frequent regurgitation (or possetting)/ mild diarrhoea	
•	Difficulty swallowing, requiring modified consistency. Problems with dentures, affecting food intake. Problems with chewing affecting food intake. Slow to feed. Moderate vomiting and/or diarrhoea (1-2/day children) Needs help with feeding (e.g. physically handicap)	2
•	Unable to take food orally. Unable to swallow (complete dysphagia) Severe vomiting and/or diarrhoea (>2/ day for children). Malabsorption	3

5

Stress Factor		
•	No stress factor (includes admission for investigations only)	0
•	Mild Minor surgery. Minor Infection	1
•	Moderate Chronic disease. Major surgery/ infarctions Fractures. Pressure sore/ ulcers. CVA Inflammatory bowel disease. Other gastrointestinal disease	2
•	Severe Multiple injuries. Multiple fractures/burns Multiple deep pressure sores/ ulcers Severe sepsis. Carcinoma/ malignant disease	3

Total

Nutrition Risk Score Results

Score	Action
0 – 3 Low Risk	No action necessary Check Weight weekly
4 – 5 Needs Monitoring	Check weight weekly Encourage eating & drinking Replace missed meals with Supplements. (Check with Dietitian if on special diet) Repeat scores after 1 week refer to dietitian if no improvement
6 – 15 High Risk	Refer to dietitian as soon possible

ALSO REFER TO DIETITIAN IF:

- The patients needs a special diet not available on the normal menu
- The patient needs advice about a special diet