

DISEASE RELATED UNDERNUTRITION

How to overcome barriers to better clinical outcome and to maximum growth?

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Importance of nutrition

in childhood

► Appropriate nutritional intake is particularly relevant to children

- high requirements for growth & maturation
- limited body reserves & rapid losses
- developmental aspects of feeding
- long-lasting consequences of malnutrition

Disease-related undernutrition

LECTURE OUTLINE

"Food is medicine, let your medicine be your food"

Hippocrates, 400 y BC

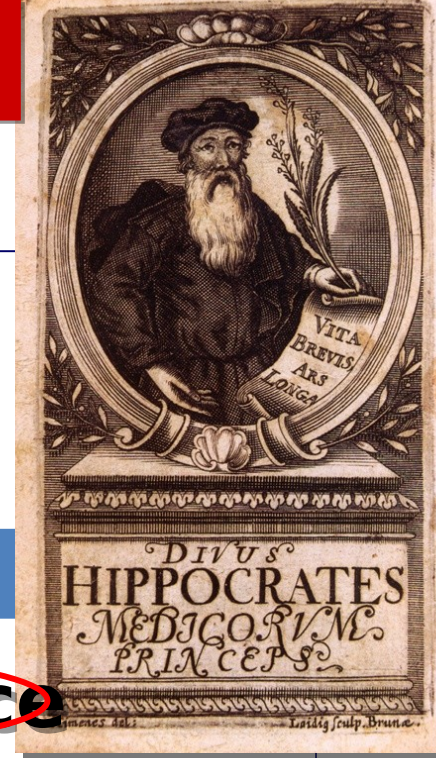
▶ Definition, criteria, prevalence

▶ Influence of undernutrition on:

- **clinical outcome**
- **costs of health care**

▶ Causes & pathogenesis & diagnosis

▶ Treatment & benefits of nutr. support



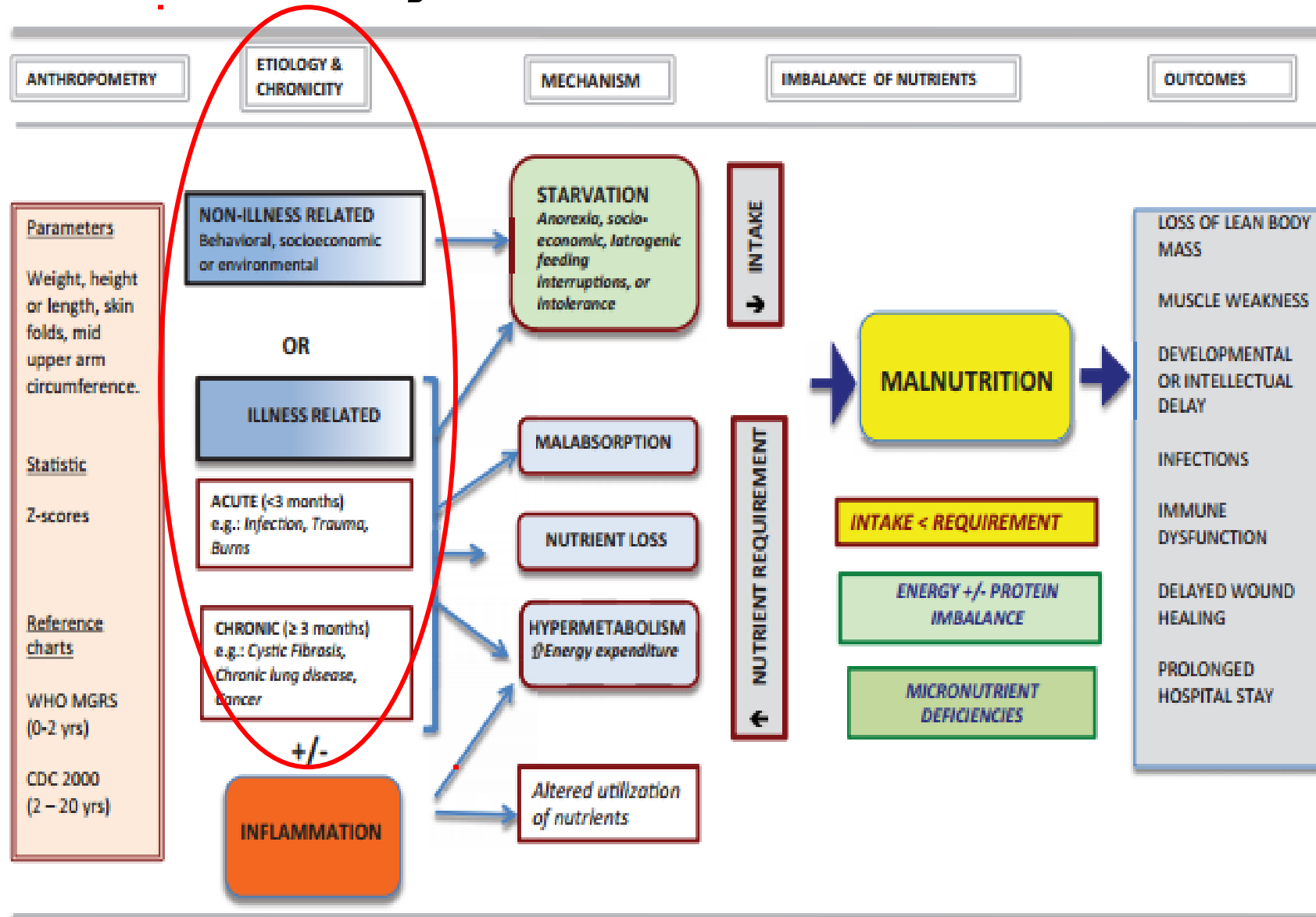
Definition of pediatric malnutrition

Mehta NM et al. JPEN 2013

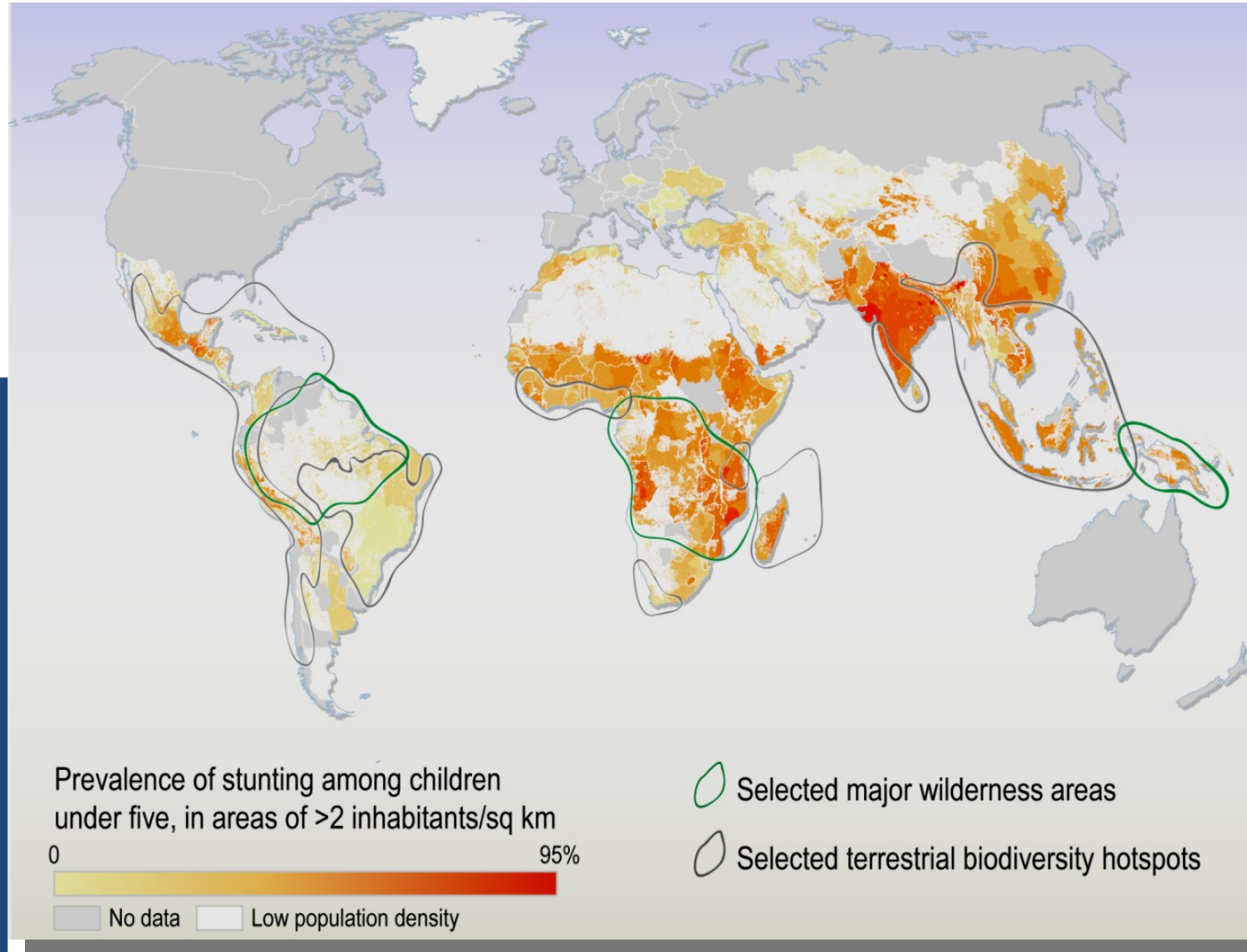
***▶ Imbalance between
nutrient requirements & intake***

- cumulative deficit of energy, protein & micronutrients
- negatively affects growth, development & clinical outcome

Mehta NM, et al. Defining Pediatric Malnutrition...*JPEN* 2013



Prevalence of stunted growth in children



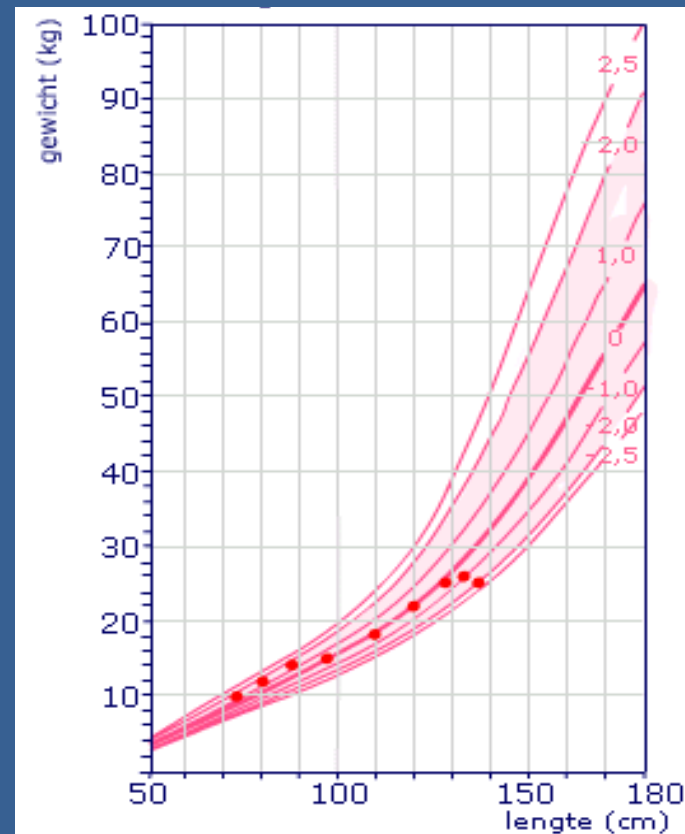
Sources: *FAO 2004, Landscan 2002, Conservation International 2004*

Undernutrition

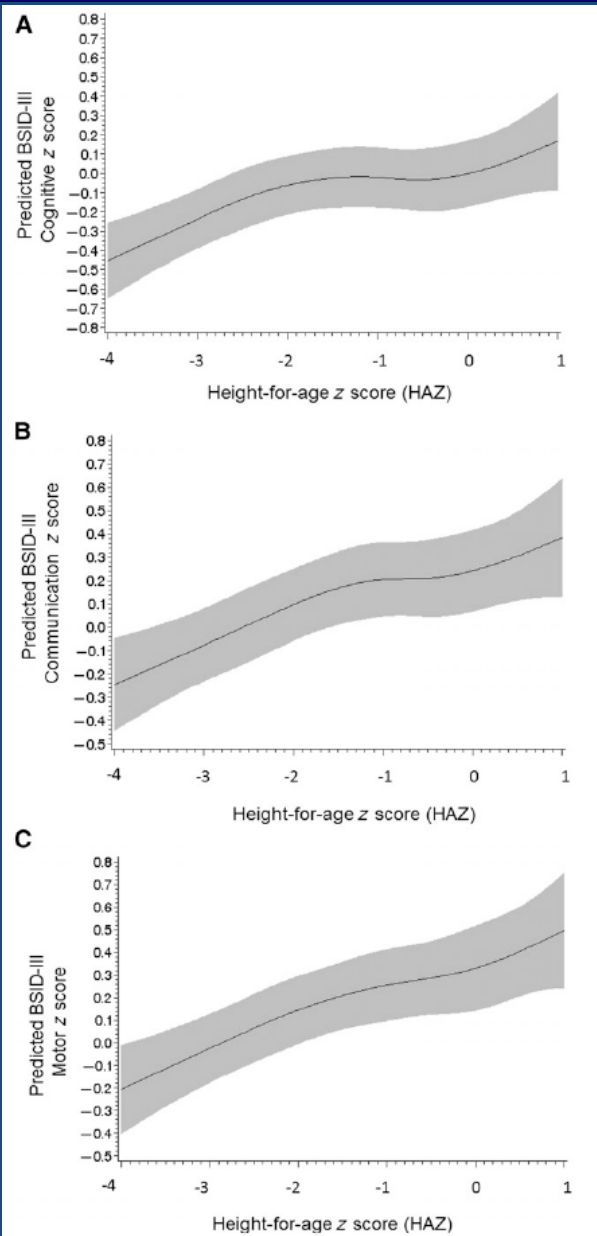
LONG-TERM OUTCOME ON GROWTH

At 8 y of age, children who failed to thrive as infants - were 6 cm shorter than those who grew normally

Black M et al 2007



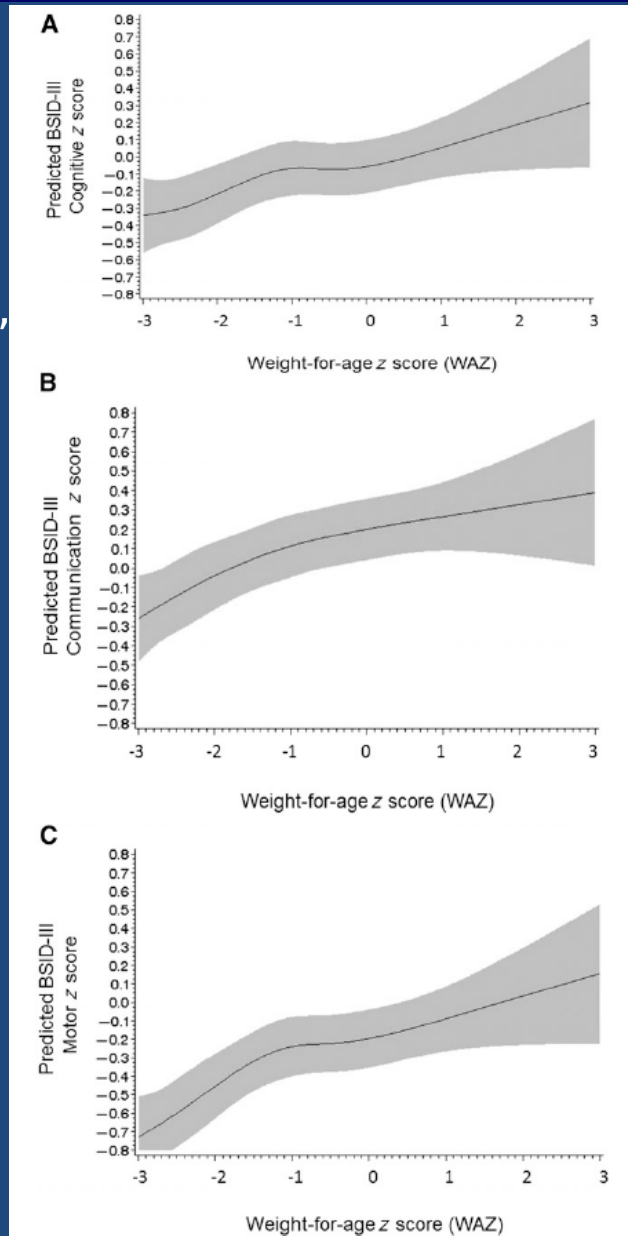
Undernutrition & cognition



Linear relation of Ht/age & Wt/age z score with cognitive, communication, and motor development in 1036 Tanzanian children 18-36m

(adjusted for age, sex, maternal education, wealth...)

Sudfeld CR et al. J Nutr 2015 (epub)



IMPORTANCE OF UNDERNUTRITION

→ 30%-50% of mortality in children < 5y is directly or indirectly related to undernutrition




→ children with 3 indicators of malnutrition at 3y had 15.3 decrease in IQ at 11 years*

→ 1% decrease in malnutrition results in 4%

Black RE, et al. Lancet 2008, *Lio J, et al. Arch Ped Adolesc Med 2003, AAP. Failure to thrive. In: Kleinman RE, Greer, eds. Pediatric Nutrition 2013

For decades, prevalence of malnutrition remains high in hospitalized children

Report , year	Malnutrition and risk
Parsons, 1980 ¹	12% stunted; 15% wasted
Moy, 1990 ²	16% stunted; 14% wasted
Hendrikse, 1997 ³	15% stunted; 16% wasted
Pawellek, 2008 ⁴	24% malnourished
Joosten, 2010 ⁵	19% chronic malnutrition
Aurangzeb, 2012 ⁶	14% malnourished; 48% at risk for malnourished
Hecht, 2015 ⁷	4.0-9.3% at high risk, based on country
Chourdakis, 2016 ⁸	10-24% at high risk, based on screening tool



1. Parsons HG, et al. *Am J Clin Nutr.* 1980;33:1140-1146. 2. Moy et al. *J Hum Nutr Diet.* 1990;3:93-100.
 3. Hendrikse W, et al. *Clin Nutr.* 1997;16:13-18. 4. Pawellek I, et al. *Clin Nutr.* 2008;27:72-76.
 5. Joosten KF, et al. *Arch Dis Child.* 2010;95:141-145. 6. Aurangzeb B, et al. *Clin Nutr.* 2012;31:35-40.
 7. Hecht C, et al. *Clin Nutr.* 2015;34:53-59. 8. Chourdakis M, et al. *Am J Clin Nutr.* 2016;103:1301-1310.

Disease related undernutrition

PREVALENCE *Pawellek et al. Clin Nutr 2008*

Table 3 Prevalence of malnutrition among paediatric patients upon hospital admission by diagnoses based on national reference data for median weight for height⁷ and cut-off points after Waterlow.⁶

Diagnosis	Malnutrition total weight for height/length <90th centile (%)	Mild malnutrition weight for height/length 81–90th centile (%)	Moderate malnutrition weight for height/length 70–80th centile (%)	Severe malnutrition weight for length/height <70th centile (%)
Patients with multiple diagnosis (<i>n</i> = 32)	43.8	21.9	18.9	3.1
Mental retardation (<i>n</i> = 25, subgroup of patients with neurological diseases)	40.0	16.0	8.0	16.0
Infectious diseases (<i>n</i> = 55)	34.5	30.9	0.0	3.6
Cystic fibrosis (CF) (<i>n</i> = 12)	33.3	25.0	8.3	0.0
Cardiovascular disease (<i>n</i> = 14)	28.6	28.6	0.0	0.0
Other non-specific diseases (<i>n</i> = 26)	28.6	11.5	11.5	3.8
Oncological diseases (<i>n</i> = 22)	27.3	18.2	9.1	0.0
Gastrointestinal diseases (<i>n</i> = 110)	23.6	17.3	6.4	0.0
Accidents (<i>n</i> = 50)	18.0	16.0	2.0	0.0
Neurological diseases (incl. mental retardation) (<i>n</i> = 81)	17.3	9.9	2.5	4.9
Respiratory diseases (<i>n</i> = 15)	13.3	13.3	0.0	0.0
Haematological diseases (<i>n</i> = 8)	12.5	12.5	0.0	0.0
Urogenital diseases (<i>n</i> = 29)	10.3	10.3	0.0	0.0
Metabolic diseases (<i>n</i> = 10)	10.0	10.0	0.0	0.0
Dermatological diseases (<i>n</i> = 11)	9.1	9.1	0.0	0.0

Disease related undernutrition

PREVALENCE *Cao, et al 2013*

70%
moderate
to high
risk of
malnutriti
on

Table 2

Risk category distributions of patients with different diseases.

Diagnosis	Low risk (n = 630)	Moderate risk (n = 574)	High risk (n = 121)
Cardiac disease	30 (19.2%)	96 (61.5%)	30 (19.2%)
Respiratory disease	67 (62%)	22 (20.4%)	19 (17.6%)
Oncologic disease	39 (41.5%)	45 (47.9%)	10 (10.6%)
Gastrointestinal disease	34 (24.8%)	90 (65.7%)	13 (9.5%)
Surgery	227 (51.9%)	173 (39.6%)	37 (8.5%)
Neurologic disease	58 (58%)	38 (38%)	4 (4%)
Trauma	24 (38.7%)	36 (58.1%)	2 (3.2%)
Infection	112 (71.3%)	43 (27.4%)	2 (1.3%)
Other disease	39 (52.7%)	31 (41.9%)	4 (5.4%)

DISEASE RELATED UNDERNUTRITION

Prevalence: TAKE HOME MESSAGE

▶ **Prevalence is high: 10% to 30%**

▶ **is not substantially different in:**

- affluent *versus* less affluent European countries
- medical *versus* surgical patients

▶ **Prevalence did NOT change for 30 years**

▶ **Doctors are not aware how common it is?**

Does it matter if the diseased child is loosing weight ??

- ▶ **For clinical outcome**
- ▶ **Cost-benefit of health care**



Consequences of hospital malnutrition on clinical outcome of the disease

- in surgical patients
- cystic fibrosis patients
- patients with pneumonia
- oncology patients
- critically ill....

Outcome after major surgery

Abdominal & thoracic in children

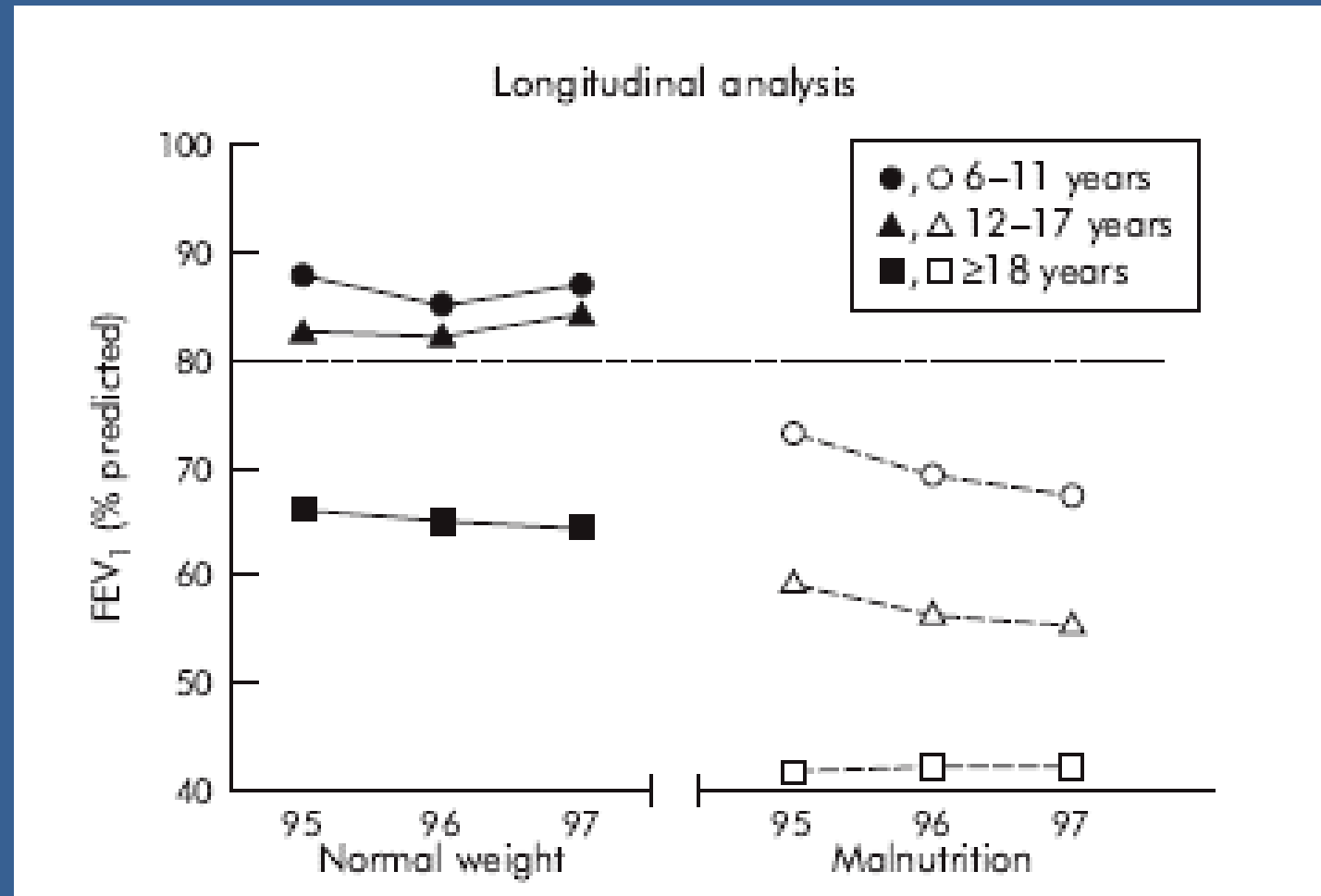
Secker, et al. Am J Clin Nutr 2007

175 ped. patients evaluated with SGNA preoperatively and 30 d after surgery

▶ **Malnourished paediatric patients had:**

- significantly higher rate of infective complications
- significantly longer duration of hospitalization

Relationship between nutritional status and lung function in Cystic Fibrosis



The importance of nutrition in children with *Cystic Fibrosis (CF)*

**ESPEN-ESPGHAN-ECFS guidelines on nutrition
care for infants, children and adults with CF - 2016**

→ „Malnutrition is both a frequent feature & comorbidity of CF, with nutritional status strongly associated with pulmonary function”

→ „Nutritional management is therefore standard of care in CF patients”

Turck D et al. Clinical Nutrition 2016;35:557-77

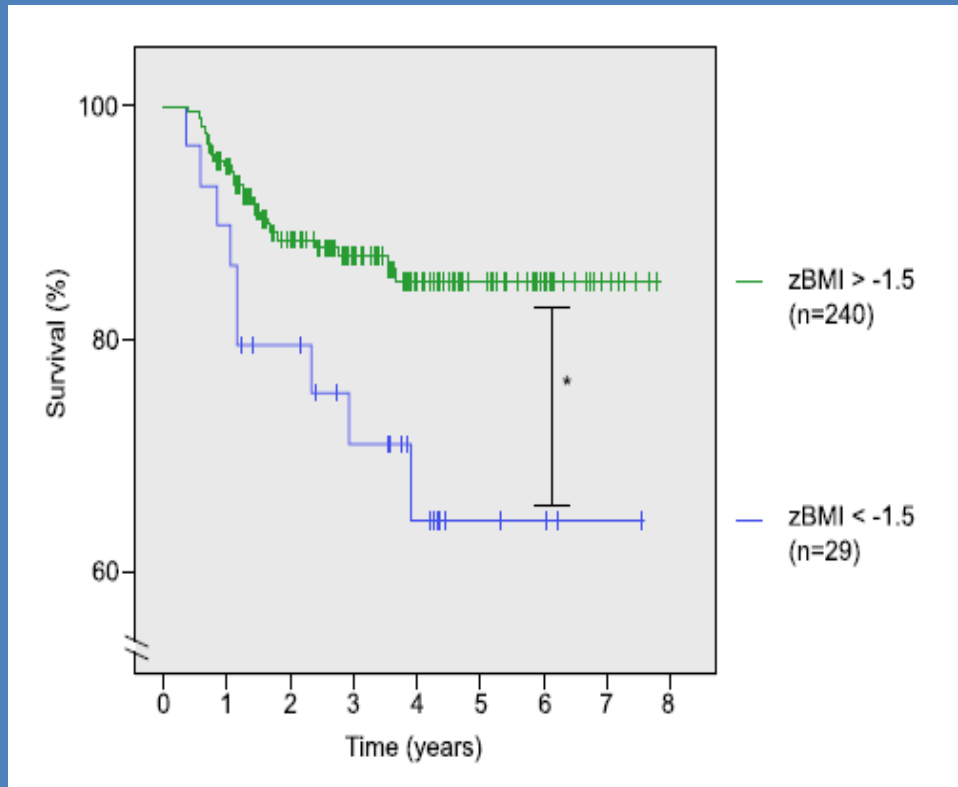
Undernutrition: negative effect on respiratory tract

In malnourished paed. patients

-Significantly higher rates of severe pneumonia (OR 4.5) (*Jackson S et al. Croat Med J 2013;54*)

-Significantly increased risk of death from pneumonia (OR 4.3) (*Sonego M et al. PloS one 2015;10*)

Consequences of undernutrition in oncology patients



1. Undernutrition in initial phase of therapy is associated with worse survival in paed. cancer patients
2. Weight loss during therapy is associated with increased presence of febrile neutropaenia

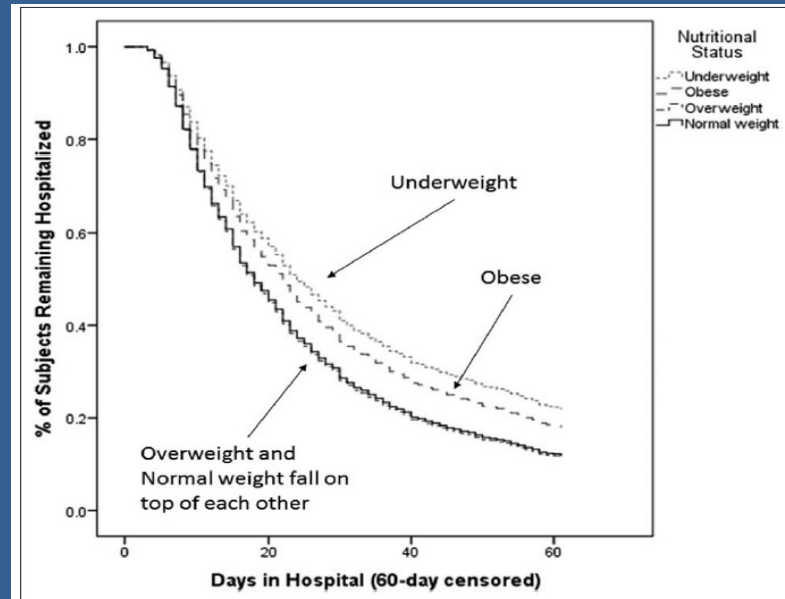
This underlines importance of optimal feeding in paed. cancer

Negative effect of malnutrition in critically ill

Bechard LJ et al. Crit Care Med; 2016

Clinical Outcomes Risk in Critically Ill Children in PICUs

Outcomes	OR	95% CI	p
Mortality ^a			
Underweight	1.53	1.24–1.89	< 0.001
Overweight	1.44	0.94–2.19	0.09
Obese	1.55	0.87–2.76	0.14
Infections			
Underweight	1.88	1.18–3.01	0.008
Overweight	1.42	0.99–2.05	0.06
Obese	1.64	1.33–2.03	< 0.001



Participants:

1622 patients from 90 PICUs/16 countries;
mean age 4.5y

Results

- 1.60 days mortality is 53% higher in undernourished
2. Infections are more common in underweight & obese
3. Length of hospital stay signif. longer in undernourished & obese
4. Underweight patients spend significantly more days on ventilation

UNDERNUTRITION AS RISK FACTOR FOR NOSOCOMIAL INFECTIONS

Niseteo T, Kolaček S. Publication in process

	Nourished patients N = 367	Malnourished patients TM/TV < -2 SD, N = 47	p
Gastrointestinal infections	2 - 0,62%	2 - 4,26%	0,025*
Respiratory infections	9 - 2,81%	9 - 17,02%	<0,001*
Total No. of infections	11 3,44%	11 - 23,4%	<0,001*

Malnourished patients have 5 x bigger risk for development of nosocomial infection

RR 5.1 (95% CI 2,276-11,485)

MALNUTRITION, LENGTH OF HOSPITAL STAY AND NOSOCOMIAL INFECTIONS

Niseteo T, Kolaček S. Publication in process

	<u>Not malnourished</u>		
	Without nosocomial infection	With nosocomial infection	
Hospital stay	7,2 d (4-29)	10,2 d (6-19)	P=0,003
	Malnourished patients		
	Without nosocomial infection	With nosocomial infection	
Hospital stay	7,9d (4-47)	15,9d (7-34)	P=0,008

Negative financial implications of disease related undernutrition

Negative financial effect

-Patients coded as malnourished had longer hospital stay (9.7d vs 3.8 d)

-Significantly higher mean costs → \$ 55,255 vs \$17,309
(Abdelhadi RA. JPEN 2016)

Effect of disease-related undernutrition

SUMMARY

- ▶ *Negatively affects growth & cognitive development*
- ▶ *Independent risk factor for higher morbidity & mortality due to:*
 - higher rate of infections
 - impaired wound healing
 - increased length of hospital stay
 - increased readmission rates
- ▶ *Markedly increased cost of health care*

Summarized in: Corkins MR. Nutr Clin Prac 2017;32:15-18

Disease-related undernutrition

LECTURE OUTLINE

"Food is medicine, let your medicine be your food"

Hippocrates, 400 y BC

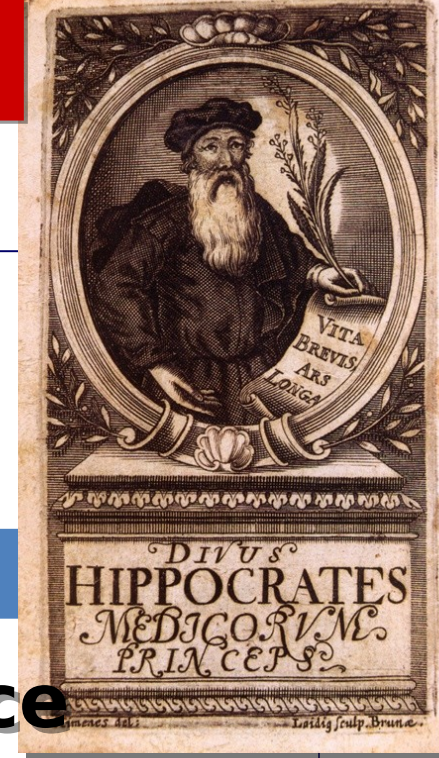
▶ **Definition, criteria, prevalence**

▶ **Influence of undernutrition**

- **on clinical outcome**
- **on costs of health care**

▶ **Causes & pathogenesis & diagnosis**

▶ **Treatment & benefits of nutr. support**



MALNUTRITION AS A KEY DETERMINATOR IN THE VICIOUS CIRCLE

**Acute & chronic
disease**

```
graph TD; A[Acute & chronic disease] --> B[Progression of the disease]; B --> C[Specific nutrient deficiencies]; C --> D[Immune compromise (!)]; D --> E[Malnutrition]; E --> A;
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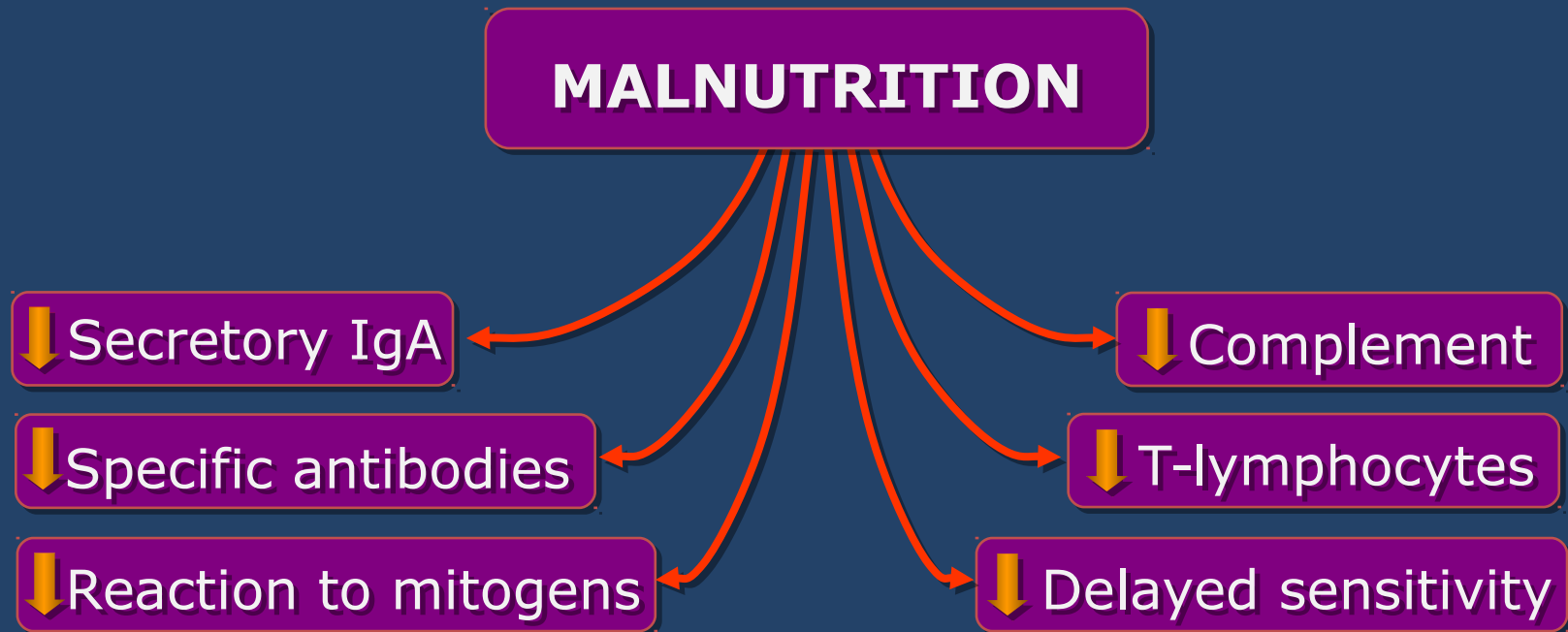
Progression of the disease
Specific nutrient deficiencies
Immune compromise (!)

Requirements (inflammation)
Anorexia
Utilization of nutrients
Absorption of nutrients

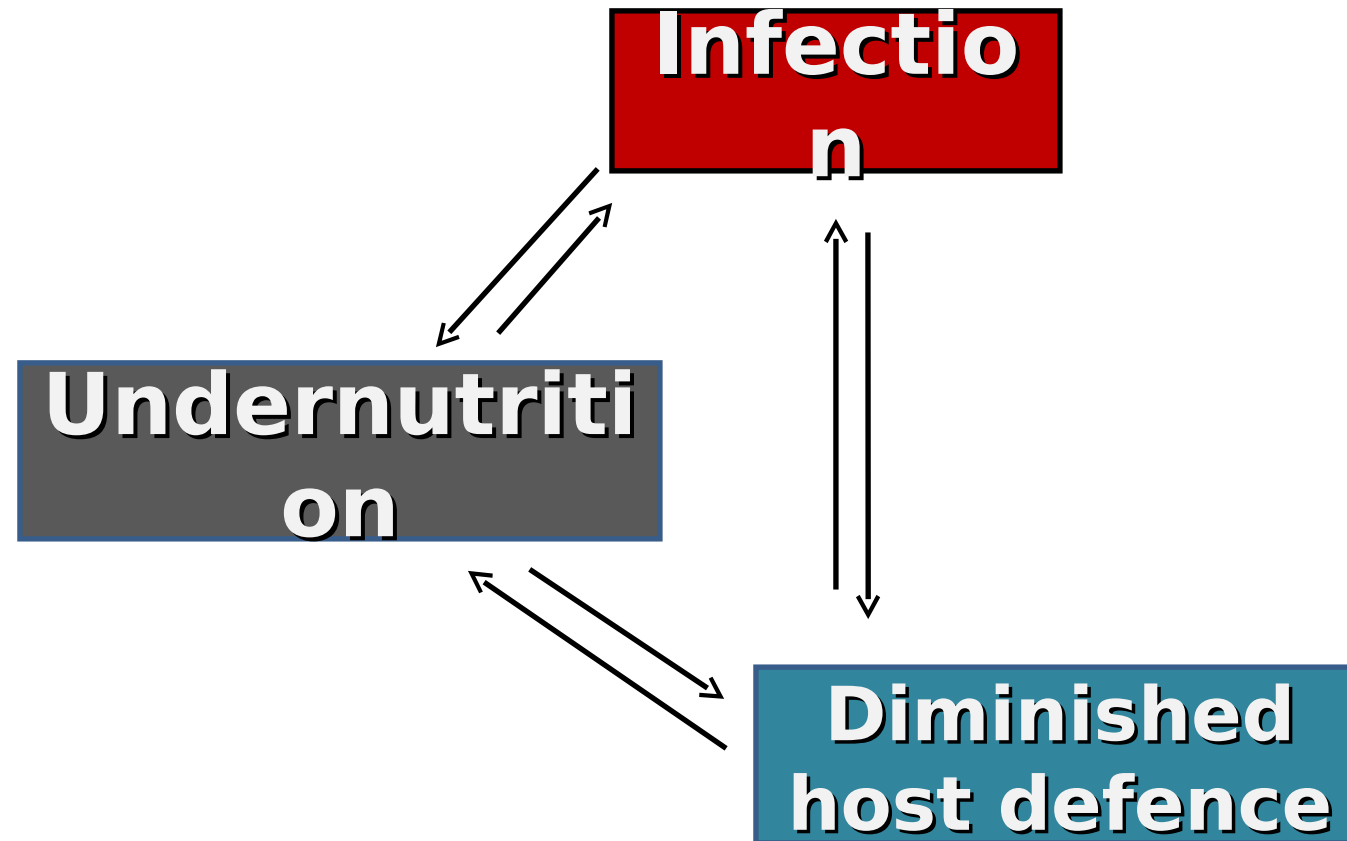
Malnutrition

Immune deficiencies in *paediatric malnutrition*

(reviewed in: Cunningham-Rundles S, et al. JACI 2005; 115:1119-28)



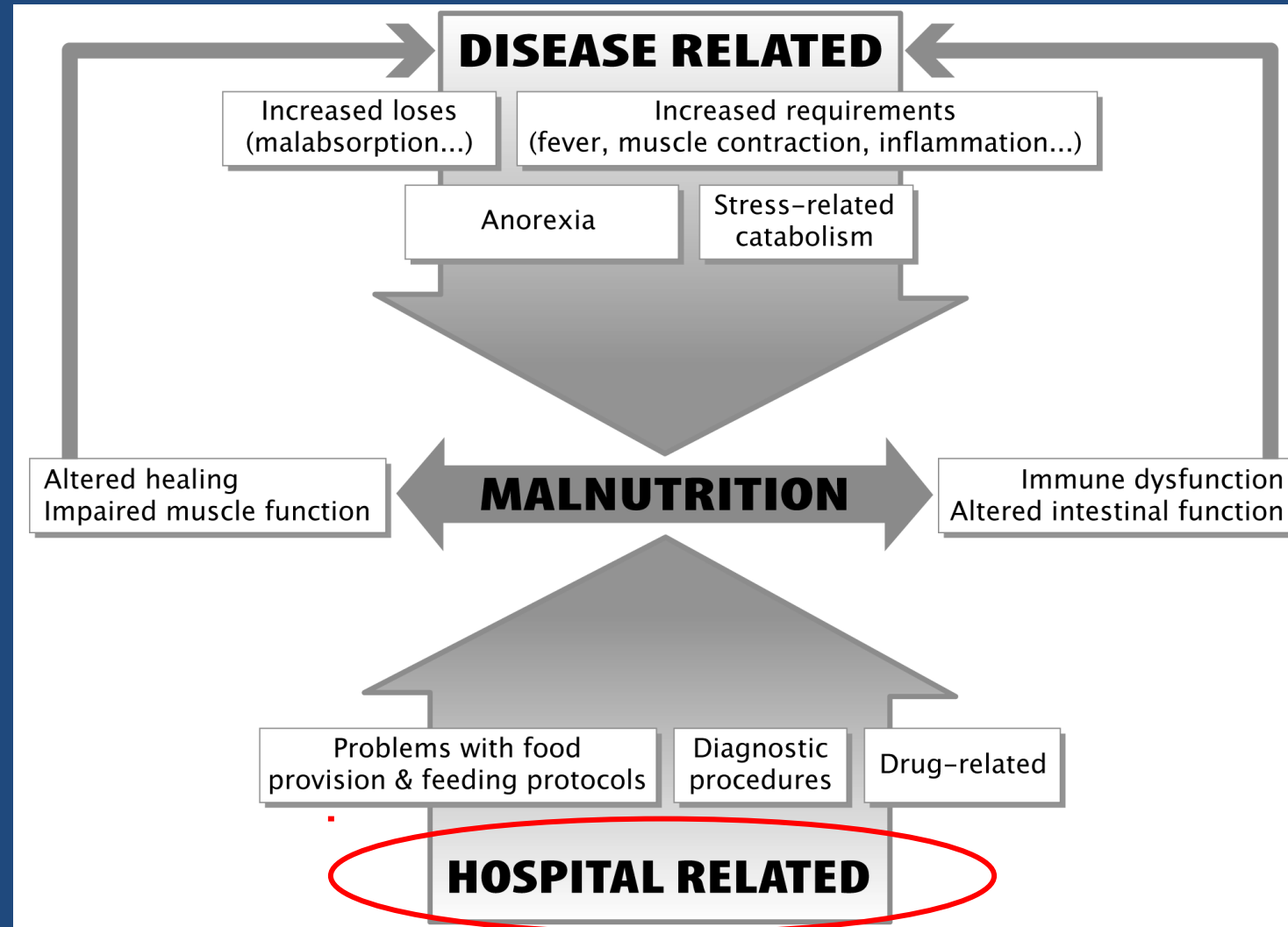
Malnutrition & infection relationship



Adapted from: Calder PC, Jackson AA. Undernutrition, infection and immune function. Nutrition Research Review 2000; 13:3-29

Pathogenesis of disease-related undernutrition

(Kolaček S. 2009)



Hospital acquired undernutrition in children

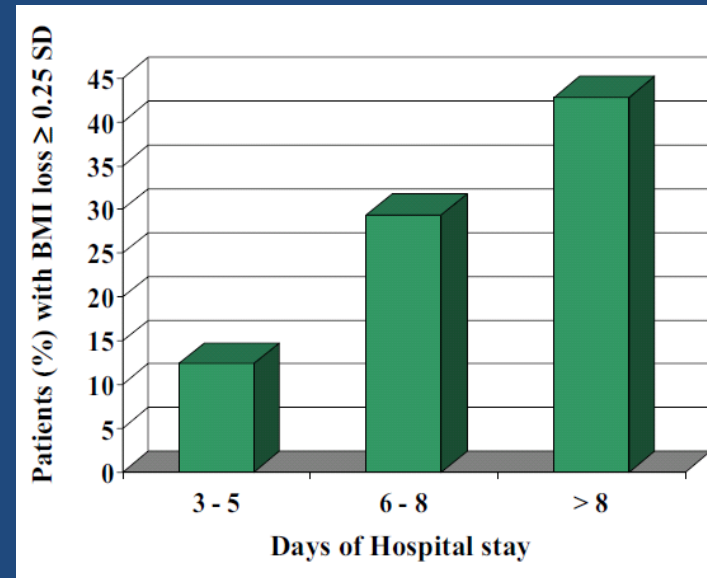
In 20% to 50% of children, nutritional status deteriorates during admission to the hospital

Reviewed in: Joosten KFM et al. Clin Nutr 2014

*Campanozzi A, et al.
Nutrition 2009*

*496 children hospitalized
due to „mild” clinical
condition*

*Results: the longer the stay
the higher percentage of
children with BMI
decrease ≥ 0.25 SD*



Etiology of hospital

undernutrition: feeding practice in European hospitals

▶ *5 major barriers to better nutritional care in European hospitals*

- Lack of education among hospital staff
- Lack of clearly defined responsibilities
- Lack of influence of patients
- Lack of cooperation among different staff members
- Lack of involvement of hospital management/administration



Disease-related undernutrition pathogenesis

“Take home message”

▶ Disease related

- increased losses & requirements
- decreased intake

▶ Hospital related

- diagnostic procedures & therapy
- inappropriate food provision



Can we just look and diagnose undernutrition and stunted growth?

- ▶ To measure ability of 3 experienced childcare professionals to grade nutritional status of patients of varying ages and nutritional status.
- ▶ All patients (n=44) were in hospital for at least 3 days to enable complete assessment, and were unknown to the panel of assessors.

Can't we just look and diagnose?

▶ Children were grouped (according to MUAC measurement) to one of 4 categories:

A. **severe malnutrition**

B. **mild malnutrition**

C. **normal**

D. **obese**

Percent of correct observations of nutritional status by clinical assessors classed according to age group

	0-12 months	1-5 years	5-16 years
Total correct observation	10%	55%	60%
Unanimously correct	10%	47%	44%

**NO, we can't just look and diagnose,
we have to do the assessment!**

- ▶ **Nutrition assessment must be an integral part of the medical evaluation of sick children**
- ▶ **Nutritional status should be monitored regularly in children**

Disease-related undernutrition

LECTURE OUTLINE

"Food is medicine, let your medicine be your food"

Hippocrates, 400 y BC

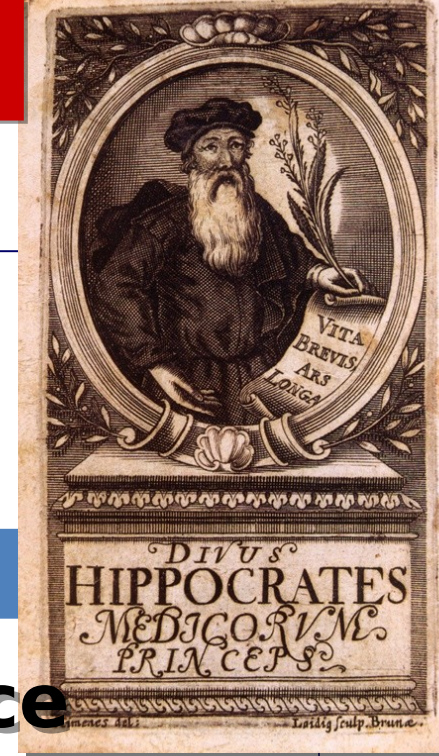
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▶ **Causes & pathogenesis & diagnosis**

▶ **Treatment & benefits of nut. support**



BASIC PRINCIPLES OF NUTRITIONAL SUPPORT

To provide optimal amount of energy & nutrients:

- to support optimal growth & development
- to preserve body composition
- to avoid nutrition related complications
- to promote age-appropriate feeding habits

Should aim primarily on prevention

Best approach is, the most simple one

ESPGHAN Committee on Nutrition Comment. Practical Approach to Enteral Nutrition in Children. J Pediatr Gastroenterol Nutr 2010

Nutritional Interventions in Sick / Malnourished Children

Depend on:

- ◆ **Age**
- ◆ **Clinical picture**
- ◆ **Possibility of oral intake**
- ◆ **Absorptive & digestive capacity**
- ◆ **Dietary habits**
- ◆ **Costs**

Goals of treatment of undernourished pediatric patients

▶ *Stages of nutritional rehabilitation are:*

1. To restore cellular function

short-term goal

2. To replete lost tissue

intermediate goal

3. To achieve catch-up growth

long-term goal

WHO Guidelines for Energy and Protein Intake for Optimal Catch-up Growth

(WHO/FAO/UNU Expert consultation. Protein and amino acid requirements in human nutrition; Vol. 935. WHO: Geneva 2007, pp. 1-265)

WHO guidelines for energy and protein intake for optimal catch-up growth

Rate of gain (g/kg/day)	Protein (g/kg/day)	Energy (kcal/kg/day)	Protein energy ratio (PE %)
10	2.82	126	8.9
20	4.82	167	11.5

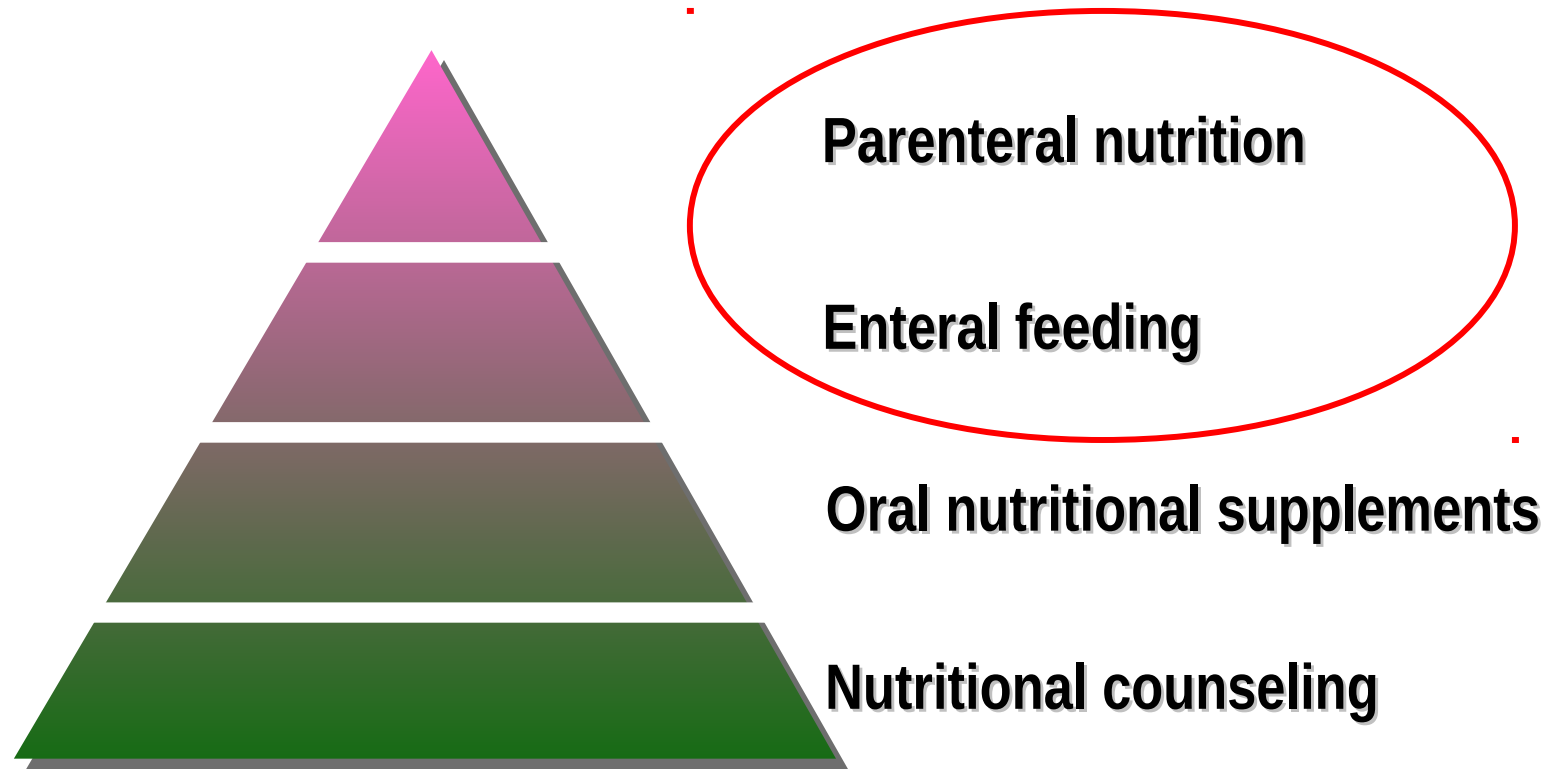
Average increase in energy and protein in diseased children

(Taken from: Koletzko B. Nutritional needs of children and adolescents.
In: Sobotka L, ed. Basics in Clinical Nutrition, Prague: Galen;2011)

Condition	Clinical diagnosis	Energy (%)	Protein (%)
Healthy child	Normal population	100	100
Mild stress	Anaemia, fever, mild infection, elective small surgery	100-120	150-180
Moderate stress	Skeletal trauma, chronic disease (e.g. cystic fibrosis with dyspnea)	120-140	200-250
Marked stress	Sepsis, severe skeletal/muscular trauma, major surgery	140-170	250-300
Critical stress	Severe burn injury, quick rehabilitation after malnutrition	170-200	300-400

Management strategy

for disease-related malnutrition



Nutritional intervention should increase in stepwise manner in respects to severity of underlying condition and impairment of nutritional status

Indications for PN

Reserved for patients with

- ▶ **dysfunctional**
- ▶ **inaccessible**
- ▶ **inexistent GUT**

PN is
life-saving

PN compared to EN

▶ **Much more complicated**

▶ **Lower safety profile**

▶ **PN associated complications**
(CV related sepsis & thrombosis...)

▶ **Two to fourfold higher costs**

Enteral Nutrition

DEFINITION ■ ■ ■ ■

■ Feeding directly into
stomach
or duodenum / jejunum
over tube **or / and** stoma

■ Oral provision of dietary foods
for special medical purposes

EN in Paediatrics

WHEN??

A.

**Not growing well on oral intake +
GIT function sufficiently preserved**
Not growing well ???

- ◆ Growth failure >1 months in child <2 y
- ◆ Growth failure >3 months in child >2 y

B.

EN used as treatment of the disease (allergy, Crohn,

C.

Total feeding time >4 h/day in a disabled child

EN in Paediatrics: How

Diamanti A, et al. Home EN in children: a 14-year multicenter survey. Eur J Clin Nutr 2013

common??

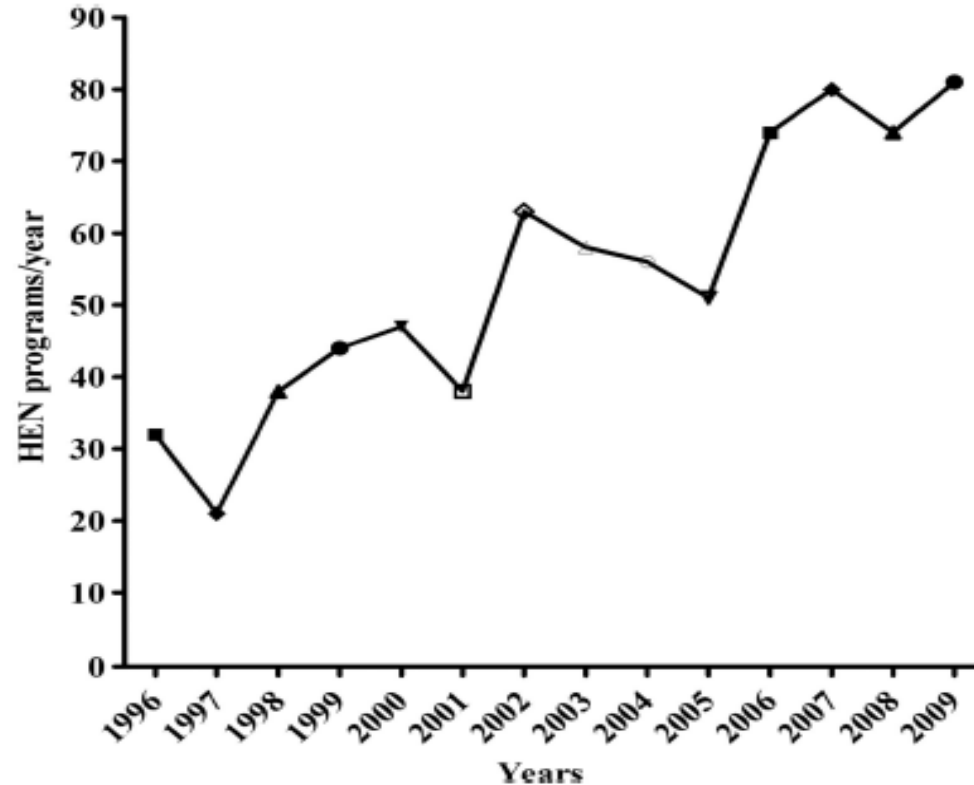
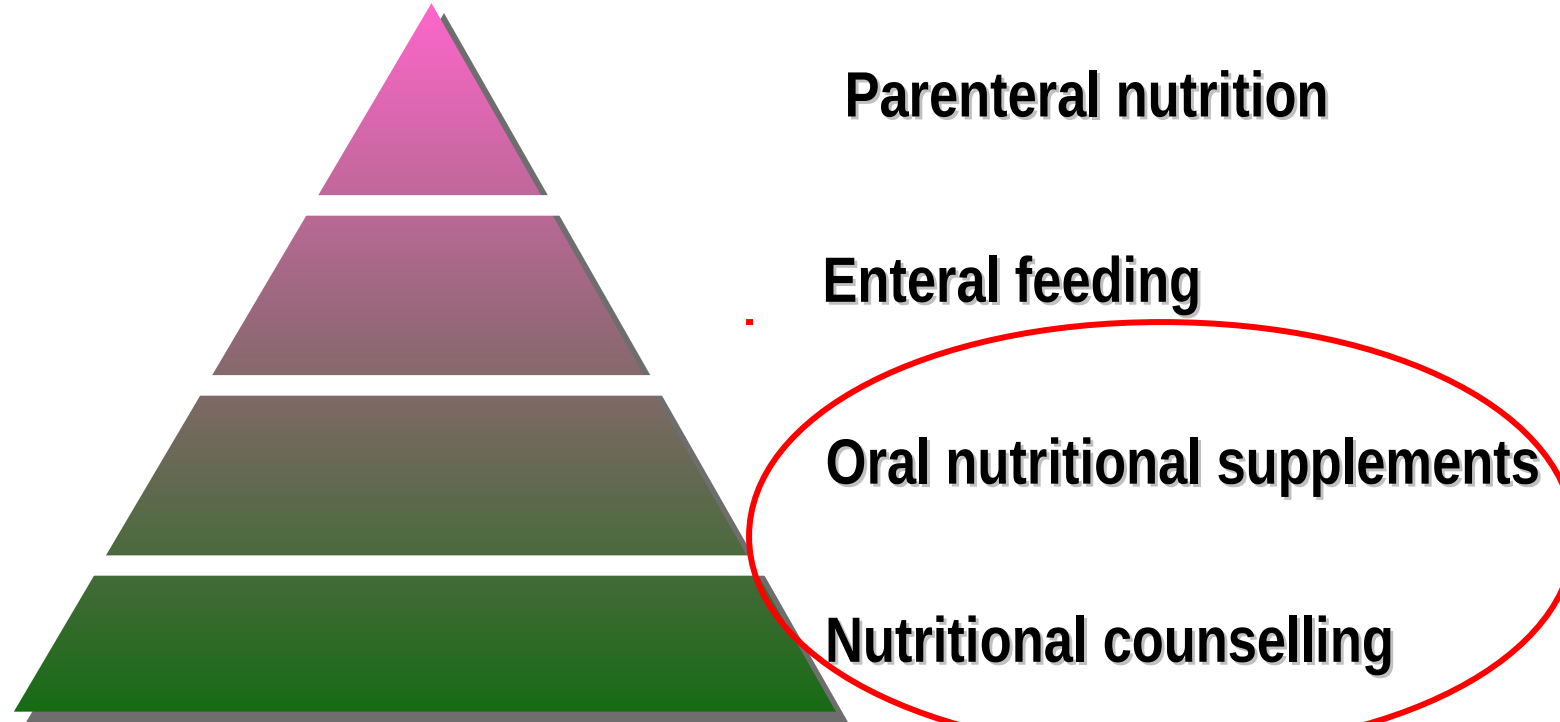


Figure 1. Number of HEN programs for each year.

757 recorded cases 1996 – 2009 on HEN

Prevalence 3.5 / 100 000, incidence 2.45 / 100 000 children 1-18y

Management strategy for disease-related malnutrition



Nutritional intervention should increase in stepwise manner in respects to severity of underlying condition and impairment of nutritional status

Management strategy

Nutritional counselling

*Get children to eat more
without unnecessary
restriction*

▶ the simplest, cheapest and safest
nutritional support

Management strategy:

Oral nutritional supplements

If dietary advice does not suffice
/ child is not growing well



*add paediatric formula as
a nutritional supplement
- sip feed*



**HOW TO SELECT
A TYPE OF FEED?**

Selection of Formulae



Age specific nutritional requirements

▶ infants ▶ small children ▶ adult formulae

Intestinal, liver & pancreatic function

Food intolerances or allergy

▶ allergens, gluten, lactose, phenyl-alanine...

Formula features:

▶ osmolality, viscosity, costs, taste

Site & route & mode of delivery

Selection of EN formulae **S**tandard paediatric formula

**Age adapted nutritional composition:
paediatric formula to be used \leq 10-12 years of age**

**Iso-caloric (1 kcal/ml), iso-osmolar (300-350),
mostly gluten & lactose free**

**Polymeric formula: source of nitrogen
are whole peptides**

▶ Addition of fibres??

Enteral Formula Selection: **addition of fibres**

Elia M et al. Clinical effects of fibre containing enteral formulae - systematic review & meta-analysis. Aliment Pharmacol Ther 2008

- **Significant benefit of fibre supplemented
versus unsupplemented EN formula in:**
 - a. patients and healthy controls
 - b. predominant symptom diarrhoea & constipation

Indications to formulae in respect to nitrogen source

	POLYMERIC	SEMI-ELEMENTAL	ELEMENTAL
Nitrogen (casein, lactalb., soy)	whole proteins	small peptides	amino-acids
Carbohydrates	glucosae polymers		
Fats	LCT or LCT & MCT		
Osmolarity	300	300 - 450	300 - 600
Indications	multiple	allergy, malabsorption	multiple allergies, severe malabs.
Advantages	palatable, cheap	hypoallergenic rapid absorption	non-allergenic immunomodulatory
Disadvantages	intact GIT	bitter, expensive	expensive, bad taste, hyperosmolar

Selection of **disease specific** EN formulae

MCT based	<ul style="list-style-type: none">• requires no lipase & bile• absorbed to portal blood (not lymph)
High energy (1.3 - 2.0 kcal/ml)	<ul style="list-style-type: none">• fluid restriction• increased energy requirements
High nitrogen (>15%)	<ul style="list-style-type: none">• catabolic patients• wound healing
High lipids (>35%)	<ul style="list-style-type: none">• respiratory problems, high energy requir.
Addition of immunonutrients	<ul style="list-style-type: none">• glutamin, arginin, n-3 FA, nucleotides, TGF-beta & probiotics, prebiotics
Other disease specific	<ul style="list-style-type: none">• liver, renal, lung, diabetes

Enteral Formulae Selection

role of disease-specific formulations


- **Could be beneficial in certain clinical conditions**
- **Good controlled studies in children are lacking**

**CLAIMS SHOULD BE
EVALUATED CRITICALLY**

Selection of appropriate enteral formula



Standard polymeric formula can be safely used in majority patients, irrespective of their basic clinical condition, but with functioning GUT.



BEST

COST-BENEFIT RATIO

CLINICAL NUTRITION IN CHILDREN

**EFFECT OF NUTRITION
SUPPORT
ON THE PROGNOSIS OF
THE
UNDERLYING DISEASE**

Therapeutic effect of nutritional support in adults

▶ 7-11 RCT: nutr. supplements

- mortality..... **26% vs. 17%**
- mortality..... **27% vs. 12%**
- complications..... **28 d vs. 19 d**

▶ 9-12 RCT: tube feeding

- length of hospitalization..... **23% vs. 11%**
- mortality..... **48% vs. 33%**
- complications..... **46% vs. 23%**

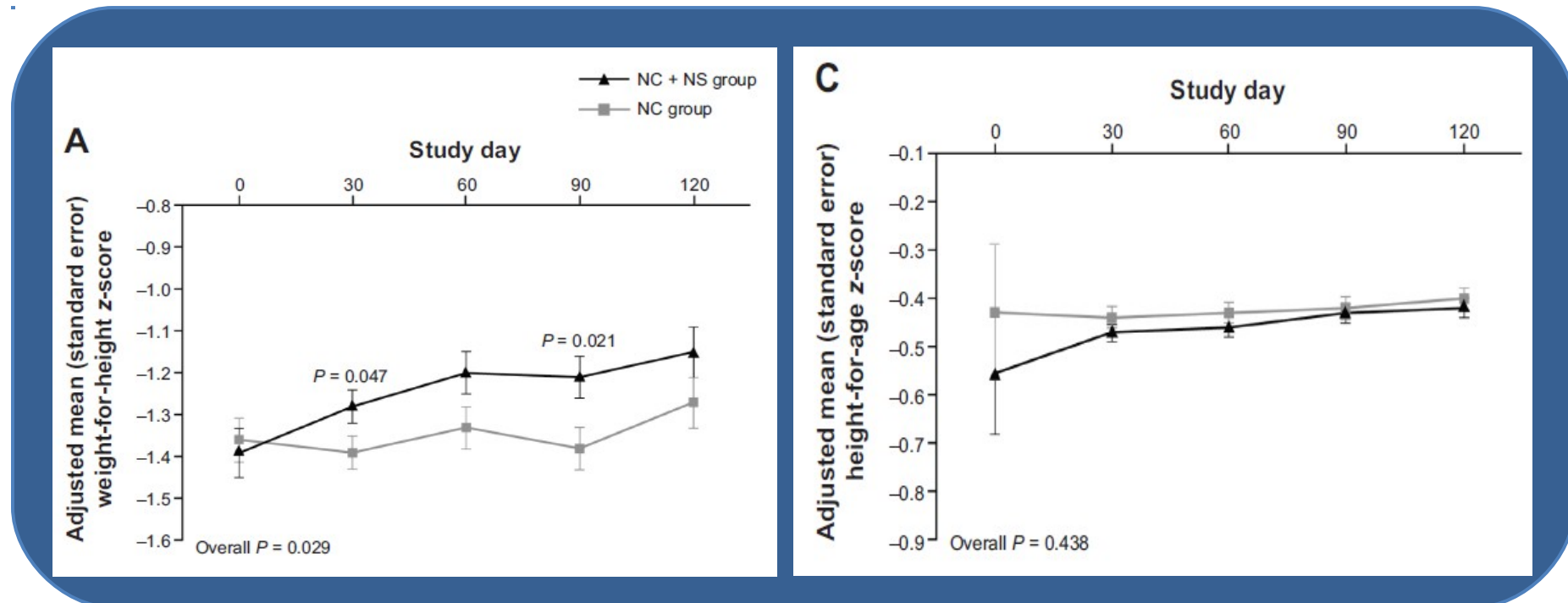
NUTRITIONAL COUNSELING (NC) VS. COUNSELING + ORAL NUTRITIONAL SUPPLEMENTS

Sheng X, et al. *Nutrition and metabolic insights* 2014;7:85-94

RCT in children with picky eating, ages 30-60 months, receiving NC (n=76) or NC+ONS (n=77) for 120 days - examined at 30, 60, 90 and 120 d

Results:

1. In NC+ONS significantly greater intake of energy, protein, omega3 FA, Ca, P, Fe, Zn, & vit A, C, D, E and B6
2. Wt for Ht Z score significantly greater at NC+ORS over entire period
3. Ht/age Z score not different



Role of nutritio support in children with CF

Lai HC et al. Pediatrics 2009

- Catch-up in weight gain within the first 2y after diagnosis was the strongest predictor of lung function at the age of 6 y
- Improved lung function correlated with reduced morbidity and mortality

Nutritional care benefits neurologically impaired children

Children with neurologic impairments (such as cerebral palsy) have a lower caloric intake, altered metabolism and excessive nutrient losses. Improved nutritional support have shown the following benefits:



Fewer infections and decubitus ulcers

Decreased irritability and spasticity

Less use of health care facilities

Improved quality of life



Canadian Paediatric Society, Nutrition and Gastroenterology Committee. Nutrition in neurologically impaired children: Position statement. Pediatr Child Health 2009

The importance of nutrition support in children with inflammatory bowel disease

ECCO-ESPGHAN consensus guidelines on medical management of pediatric Crohn's Disease

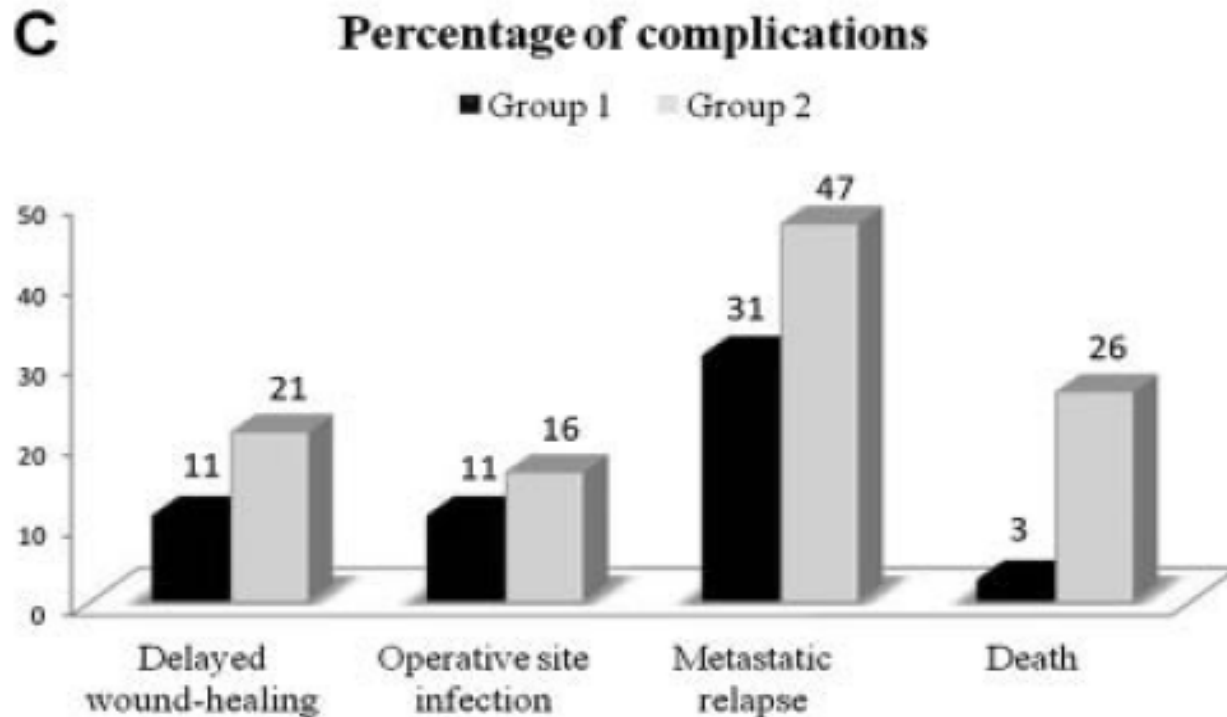
→ Linear growth impairment is present in almost 50% of children with Crohn's disease before any other symptom of the disease appear. It is a marker of disease activity_

→ Restoration of linear growth can be considered as an indicator of good disease control and of treatment success

Tolerance and efficacy of preventive gastrostomy feeding in pediatric oncology

(Schmitt F et al. *Pediatr Blood Cancer* 2012; 59:874-880)

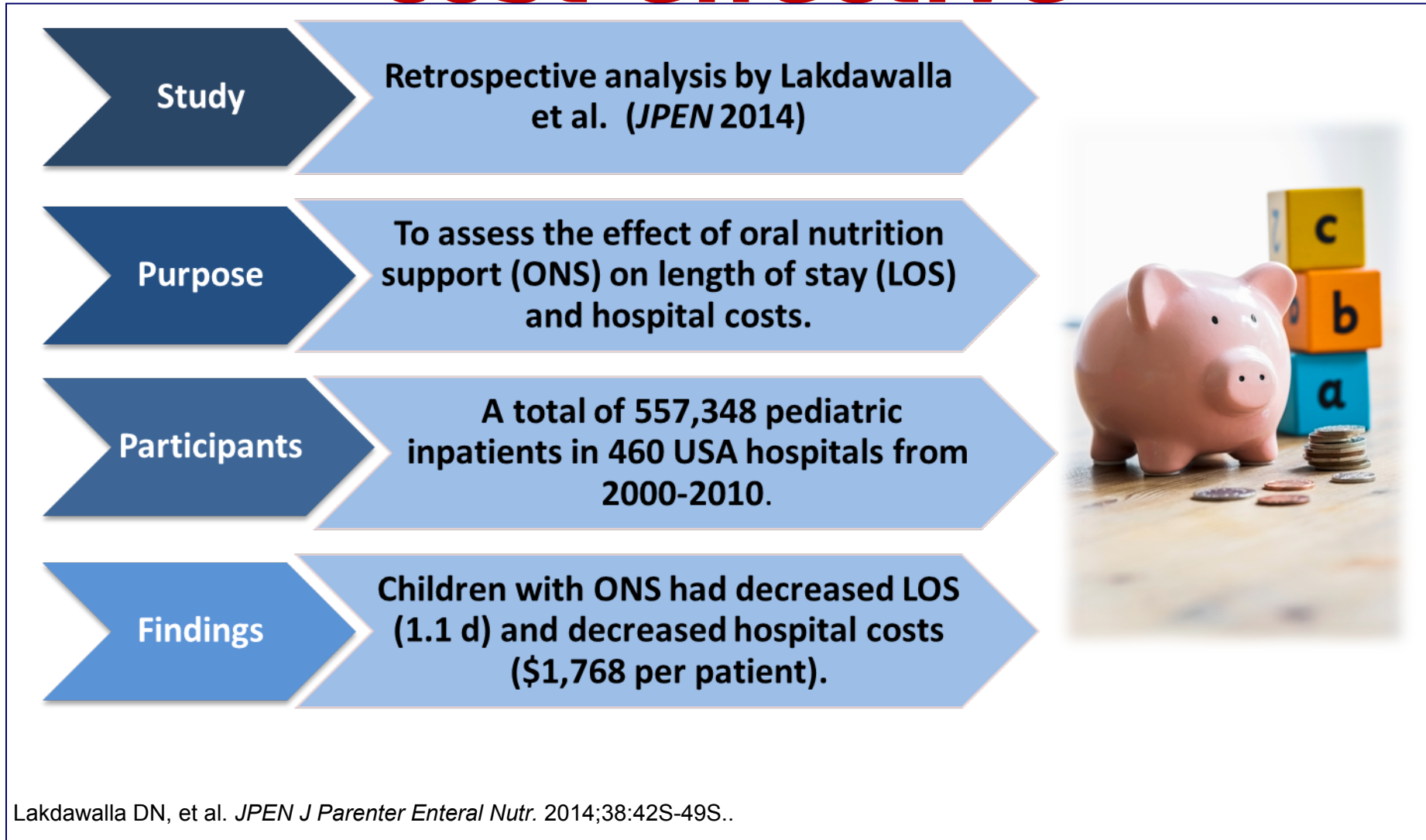
- Preventive PEG in 74 ped. cancer patients
- If EN started at beginning of treatment final height loss lower (-0.5 vs -1.2 SD of zH/A)
- Conclusion: EN over PEG prevents malnutrition; positive oncology outcome?



Group 1: EN received at start of chemotherapy

Group 2: No EN during chemotherapy

Nutritional therapy is cost-effective

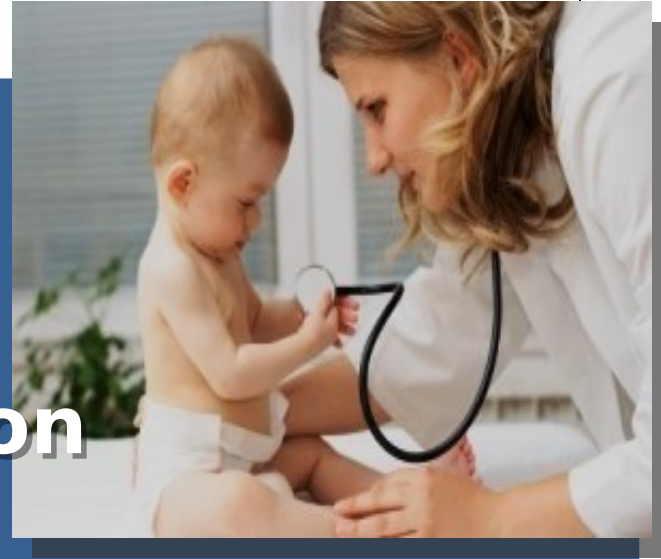


Lakdawalla DN, et al. *JPEN J Parenter Enteral Nutr.* 2014;38:42S-49S..

Disease-related undernutrition

KEY MESSAGES

- ▶ Serious impact on growth & development
- ▶ Deleterious effect on clinical outcome



▶ Looking for malnutrition should be integral part of paediatric care

- ▶ Timely established nutritional management improves clinical outcome & is cost-effective

Formulae: level of protein hydrolysis

Partially hydrolysed	Extensively hydrolysed oligomeric	Elemental, monomeric
Contain oligopeptides, molecular mass < 5 kDa	Contain di- and tri-peptides, very low molecular mass < 3.0 kDa	Mixture of crystalline amino-acids
Number of epitopes lowered	Most of the epitopes destroyed	No antigen sequence - epitopes
Can cause allergic reaction in children with CMPA	Tolerated by 90% of patients with CMPA	Often hyperosmolar
Good taste, cheaper	Bad taste, expensive	Very expensive

Classification of pediatric malnutrition

Mehta NM et al. JPEN 2013

Based on etiology

A. Due to environmental/behavioral causes

- no intake because of food unavailability
- no intake due to food aversion/behavioral problems

B. Due to disease - „disease-related undernutrition”

Based on duration

A. Acute: duration < 3 months

B. Chronic: duration > 3 months,
relevant for long-

term negative effect on growth and
development

Management strategy

how to make a choice of enteral formula?

ESPGHAN recommendations

ESPGHAN Committee on Nutrition. *JPGN* 2010;51:110-122

- should provide balanced mix of all essential nutrients - at least 100% of requirements
- nutrient composition should be age adapted
 - **paediatric enteral formulae**
 - **adult formula to be used after 10 years**