

Pediatric Food Insecurity and Malnutrition: Etiology, Diagnosis, and Treatment

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Scientific and Medical Affairs

DISCLOSURES

- The content of this program has met the continuing education criteria of being evidence-based, fair and balanced, and non-promotional
- This educational event is supported by Abbott Nutrition Health Institute, Abbott Nutrition
- I am an employee of Abbott Nutrition

OBJECTIVES

- Overview of food insecurity and malnutrition
- Long term outcomes
- Diagnosis and treatment of malnourished children and those at risk for malnutrition
- Impact of oral nutrition supplements on the prevention and treatment of malnutrition

OVERVIEW Food Insecurity

USDA DEFINITIONS OF FOOD SECURITY

High Food Security	<ul style="list-style-type: none"> • No indication of food access problems/limitations
Marginal Food Security	<ul style="list-style-type: none"> • One or two reported indications—typically of anxiety over food sufficiency or shortage of food in the house. • Little or no indication of changes in diets or food intake.
Low Food Security	<ul style="list-style-type: none"> • Reports of reduced quality, variety, or desirability of diet. • Little or no indication of reduced food intake.
Very Low Food Security	<ul style="list-style-type: none"> • Reports of multiple indications of disrupted eating patterns and reduced food intake.

Coleman-Jensen, A., & Gregory, C. (2016, October 4). Definitions of food security. United States department of agriculture economic research service. Retrieved from <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security/>

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Food Insecurity	Low Food Security	<ul style="list-style-type: none"> • Reports of reduced quality, variety, or desirability of diet. • Little or no indication of reduced food intake.
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FOOD INSECURITY IN THE U.S.

- 30% of families who identify as food insecure indicated that they had to choose between
 - Paying for food and paying for medicine or medical care
 - Can lead to
 - less productive workforce
 - increased health care costs.

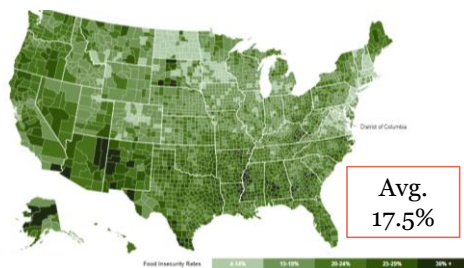
Mahli, J., Cohen, R., Potter, F., & Zhao, Z. (2010). *Hunger in America 2010 National Report Prepared for Feeding America*. Mathematica Policy Research.

FOOD INSECURITY IN THE U.S.

- Risk factors:
 - Unemployment or underemployment, working poor
 - Children in immigrant families; families headed by single women, with less education, and/or parental separation/divorce.
 - Households with smokers, or those that abuse alcohol/drugs

Mahli, J., Cohen, R., Potter, F., & Zhao, Z. (2010). *Hunger in America 2010 National Report Prepared for Feeding America*. Mathematica Policy Research.

2016 – CHILDHOOD FOOD INSECURITY IN THE US



Feeding America. (2017). [interactive map illustration]. *Child food insecurity in America*. Retrieved from <http://map.feedingamerica.org/county/2016/child>.

2017 – CHILDHOOD FOOD INSECURITY IN NORTH DAKOTA



Feeding America. (2017). [interactive map illustration]. *Child food insecurity in America*. Retrieved from <http://map.feedingamerica.org/county/2016/child> retrieved 2/20/19.

2017 – CHILDHOOD FOOD INSECURITY IN SOUTH DAKOTA



Feeding America. (2017). [interactive map illustration]. *Child food insecurity in America*. Retrieved from <http://map.feedingamerica.org/county/2016/child> retrieved 2/20/19.

IMPLICATIONS OF FOOD INSECURITY

- Food insecure children ≤ 36 months:
 - More illness/slower recovery
 - More frequent hospitalizations
 - Higher risk for developmental problems
- Food insecure adolescents are more likely to have:
 - Iron deficiency
 - Lower bone density
 - Suicidal ideations

Gitterman RA, et al. *Pediatrics*. 2015;136(5):e1431-e1438. Hanson KL, et al. *The American journal of clinical nutrition*. 2015;100(2):684-692. -Jyoti DV, et al. *The Journal of nutrition*. 2009;139(12):2831-2839.

IMPLICATIONS OF FOOD INSECURITY

- Food insecure children of all ages are more likely to have:
 - Obesity due to energy dense-nutrient poor foods.
 - Impaired concentration/ school performance
 - More behavioral/emotional problems, preschool-adolescence

Gitterman BA, et al. *Pediatrics*. 2015;136(5), e1431-e1438

AAP RECOMMENDATION: “WHAT CAN PEDIATRICIANS DO?”



- ▶ Screen and identify children at risk for food insecurity
- ▶ Connect families with needed resources
- ▶ Advocate for federal and local policies that support access to adequate healthy food for all children and families

Gitterman BA, et al. *Pediatrics*. 2015;136(5), e1431-e1438

FOOD SECURITY SCREENING

- Within the past 12 mo, we worried whether our food would run out before we got money to buy more. (Yes or No)
- Within the past 12 mo, the food we bought just didn't last and we didn't have money to get more. (Yes or No)

Gitterman BA, et al. *Pediatrics*. 2015;136(5), e1431-e1438

AAP POLICY STATEMENT – PROMOTING FOOD SECURITY FOR ALL CHILDREN

- Utilize 2 question screening tool
- Become familiar with local and federal programs to help alleviate food insecurity
- Be aware of nutritional content of foods that are offered with local and federal programs
- Consider factors that increase vulnerability of food insecure populations to obesity and address these issues during office visits/ when making treatment plans

Gitterman BA, et al. *Pediatrics*. 2015;136(5), e1431-e1438

WHEN SPEAKING WITH ADOLESCENTS

- Adolescents describe food insecurity in terms of:
 - Quantity – eating less than usual, eating more or faster when food is available
 - Quality – having only a few low-cost foods
 - Affective states – worry, anxiety, or sadness about the family's food, shame or fear of being labeled “poor,” feelings of having no choice or of adults trying to shield them from food insecurity
 - Social dynamics – using social networks to get food or being socially excluded

Gitterman BA, et al. *Pediatrics*. 2015;136(5), e1431-e1438

NUTRITION SAFETY NET

- SNAP/Food Stamps:
 - Very poor households receive larger benefits than households closer to the poverty line since they need more help affording an adequate diet
 - Broadly available to almost all households who have low incomes ($\leq 130\%$ of the poverty line)
 - Helped 45 million low-income Americans to afford a nutritionally adequate diet
 - Almost 70% of all food stamp participants are in families with children
 - The average recipient received about \$127 a month (or about \$4.23 a day) in fiscal year 2015

Coleman-Jensen, A., Gregory, C., & Singh, A. (2016, September). Household food security in the United States in 2015. Retrieved from https://www.ers.usda.gov/webdocs/publications/79761/err245_summary.pdf?v=42569

POVERTY GUIDELINES – ALL STATES EXCEPT AK, HI

Household /Family Size	50%	*100%*	130%	185%	
1	6,245	\$12,490	16,237	23,107	Per year
2	8,455	\$16,910	21,983	31,284	
3	10,665	\$21,330	27,729	39,461	
4	12,875	\$25,750	33,475	47,638	
5	15,085	\$30,170	39,221	55,815	
6	17,295	\$34,590	44,967	63,992	

Household /Family Size	50%	*100%*	130%	185%	
1	520	\$1,041	1,353	1,926	Per month
2	705	\$1,409	1,832	2,607	
3	889	\$1,778	2,311	3,288	
4	1,073	\$2,146	2,790	3,970	
5	1,257	\$2,514	3,268	4,651	
6	1,441	\$2,883	3,747	5,333	

U.S. DHHHS Poverty Guidelines accessed 3/22/2020 at <https://aspe.hhs.gov/poverty-guidelines>

NUTRITION SAFETY NET

- Women, Infants, and Children
 - Provides nutritious foods, nutrition education, and referrals to health and other social services to low-income pregnant, postpartum and breastfeeding women, and infants and children up to age 5 who are at nutrition risk
 - 6.4 million infants and children under five and 2 million women received benefits in 2014
 - Participants family income must fall ≤185% of the U.S. Poverty Income Guidelines

Coleman-Jensen, A., Gregory, C., & Singh, A. (2016, September). Household food security in the United States in 2015. Retrieved from https://www.ers.usda.gov/webdocs/publications/29761/err243_summary.pdf?v=42836

NUTRITION SAFETY NET

- National school lunch program
 - Open to all children enrolled in a participating school
 - Free lunch household: income ≤130% of the federal poverty level
 - Reduced price lunch: income between 130% and 185% of the poverty level
 - During the 2012-13 school year 30.7 million children in more than 98,433 schools and residential child care institutions participated
 - On a typical school day, 21.5 million of these 30.7 million total children (70.5%), were receiving free or reduced price lunches

Coleman-Jensen, A., Gregory, C., & Singh, A. (2016, September). Household food security in the United States in 2015. Retrieved from https://www.ers.usda.gov/webdocs/publications/29761/err243_summary.pdf?v=42836

OVERVIEW Pediatric Malnutrition

TRADITIONAL DEFINITIONS OF FAILURE TO THRIVE

Weight <75% of median weight-for-age
 Weight <80% of median weight-for-length
 BMI for age <5th percentile
 Weight for age <5th percentile
 Length for age <5th percentile
 Weight deceleration across >2 major percentiles since birth
 Conditional weight gain in the lowest 5% using WHO growth velocity standards

Larson-Nath C and Blank VP. Clinical Review of Failure to Thrive in Pediatric Patients. *Pediatr Ann.* 2016;45(2):e46-e49.

DEFINING PEDIATRIC MALNUTRITION (UNDERNUTRITION)

- “An imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein or micronutrients that may negatively affect growth, development and other relevant outcomes.”

Mehta NM, et al. *Journal of Parenteral and Enteral Nutrition.* 2013;37(4): 460-481.

WHO IS AT RISK?

- Increased risk of undernutrition related to:
 - Homelessness
 - Abuse or neglect
 - Residing in urban or rural areas with limited access to high-quality food
 - Hospitalized acute and/or chronically ill children or children with special health care needs

Becker PJ, et al. *Journal of the Academy of Nutrition and Dietetics*. 2014;314(12), 1988-2000. Mehta NM, et al. *Journal of Parenteral and Enteral Nutrition*. 2013;37(4), 460-481.

LONG TERM IMPACT

- Long term undernutrition places long term “human capital” at risk by impacting:
 - Brain development
 - Academic performance → less schooling
 - Job success → reduced economic productivity
 - Physical health
 - Immune function
 - Increased risk of chronic disease
 - Mental health

Victora CG, et al. *The Lancet*. 2008;371(9609), 340-357.

NEUROCOGNITIVE DEVELOPMENT

- Brain development is sequential and integrated
- Critical period of brain growth is 9-24 months
- Nutrition is a crucial factor in ensuring optimal structure and function of the immature brain.
- Better diet quality in early childhood yields:
 - Improved verbal, nonverbal ability
 - Greater neurocognitive development
 - Helps prevent growth faltering

Nyaradi A, et al. *Acta Paediatrica*. 2013;102(12), 1165-1173. Prentice AM, et al. *The American journal of clinical nutrition*. 2013;97(5), 911-918.

ACADEMIC PERFORMANCE

- Early, prolonged undernutrition can negatively affect a child's future growth and cognitive development
- By Age 3 decreased:
 - Verbal ability
 - Cognitive ability
- By Age 11 decreased:
 - Spatial IQ
 - Full scale IQ
 - Reading ability
 - Scholastic ability
 - Neuropsychologic performance



Rudolf MC, et al. *Archives of disease in childhood*. 2005;90(9), 925-931. Waterlow JC. *British medical journal*. 1974;4(5836), 88. Prado EL, et al. *Nutrition reviews*. 2014;75(4), 267-284. Liu J, et al. *Archives of pediatrics & adolescent medicine*. 2003;157(6), 593-600.

MENTAL HEALTH

- As adults, people who experienced childhood undernutrition have increased incidence of:
 - Anxiety and depression
 - ADHD
 - Psychiatric and health problems
- Future research may better describe the long-term behavioral consequences of early undernutrition

Jaffe AC. *Pediatrics in Review-Eli Lilly*. 2011;32(3), 100. Drewett RF. *Journal of Child Psychology and Psychiatry*. 2006; 47(5), 524-531. Galler JR, et al. *The Journal of nutrition*. 2012;142(4), 788-794. Galler JR. *Journal of Child Psychology and Psychiatry*. 2013; 54(8), 911-919.

DIAGNOSIS

At risk for malnutrition vs mild, moderate, and severe malnutrition

AT RISK FOR MALNUTRITION

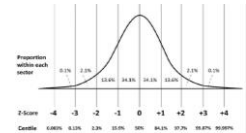
- Children should be considered at risk if they have any of the following:
 - Crossing z scores
 - Increased metabolic requirements
 - Impaired ability to ingest or tolerate oral feedings
 - Documented inadequate provision of or tolerance of nutrients
 - Inadequate weight gain or a significant decrease in usual growth percentile

Mehta NM, et al. *Journal of Parenteral and Enteral Nutrition*. 2013;37(4):460-481. Becker PJ, et al. *Journal of the Academy of Nutrition and Dietetics*. 2014;114(12):1988-2000.

PERCENTILES VS. Z SCORES

Z-score- a number that indicates how far a data point is from the mean (SD)

- Comparable across age and sex
- Quantify growth outside of percentile ranges
- More descriptive than "<2nd %ile or between the 25-50 %ile"
- Reflects small changes sooner than %ile
- Better defines severity of malnutrition



Centers for disease control and prevention – National center for health statistics. Z score data files. Retrieved from <https://www.cdc.gov/growthcharts/zscore.htm>

INTERPRETATION OF Z SCORES

Z-score (wt/ln or BMI)	Percentile (SD)
0	Mean
-1	2.5-15.9%
-2	0.2-2.3%
-3	<0.2%

Degree	Z-Score
Mild or at risk of malnutrition	-1 to -1.9
Moderate	-2 to -2.9
Severe	<-3

Centers for disease control and prevention – National center for health statistics. Frequently asked questions about the 2000 CDC growth charts. Retrieved from <https://www.cdc.gov/growthcharts/zscore.htm>

MALNUTRITION DIAGNOSIS (AND/ASPEN)

- Identifies basic set of indicators to diagnose and document undernutrition in the pediatric population ages 1 month to 18 years.
- Single data point: z scores for weight for height/length, BMI for age, length/height for age; mid-upper arm circumference

Primary indicators	Mild malnutrition	Moderate malnutrition	Severe malnutrition
Weight for height z score	-1 to -1.9 z score	-2 to -2.9 z score	-3 or greater z score
BMI ^a for age z score	-1 to -1.9 z score	-2 to -2.9 z score	-3 or greater z score
Length/height z score	No data	No data	-3 z score
Mid-upper arm circumference	Greater than or equal to -1 to -1.9 z score	Greater than or equal to -2 to -2.9 z score	Greater than or equal to -3 z score

Becker PJ, et al. *Journal of the Academy of Nutrition and Dietetics*. 2014;114(12):1988-2000.

MALNUTRITION DIAGNOSIS (AND/ASPEN)

- Identifies basic set of indicators to diagnose and document undernutrition in the pediatric population ages 1 month to 18 years.
- ≥ 2 data points: weight gain velocity, weight loss, deceleration in weight for length/height z score; inadequate nutrient intake

Primary indicators	Mild malnutrition	Moderate malnutrition	Severe malnutrition
Weight gain velocity (<2 y of age)	<75% ^a of the norm ^b for expected weight gain	<50% ^a of the norm ^b for expected weight gain	<25% ^a of the norm ^b for expected weight gain
Weight loss (2 to 20 y of age)	5% usual body weight	7.5% usual body weight	10% usual body weight
Deceleration in weight for length/height z score	Decline of 1 z score	Decline of 2 z score	Decline of 3 z score
Inadequate nutrient intake	51% to 75% estimated energy/protein need	26% to 50% estimated energy/protein need	≤25% estimated energy/protein need

^aFrom Garza et al.¹⁷

^bBased on health organization data for patients younger than 12 y old.¹⁸

Becker PJ, et al. *Journal of the Academy of Nutrition and Dietetics*. 2014;114(12):1988-2000.

DIAGNOSIS ASPEN Matrix

ASPEN MATRIX

- 5 domains:
 - Anthropometrics
 - Etiology/ Chronicity
 - Mechanism
 - Imbalance of nutrients
 - Outcomes

Beer SS, et al. *Nutrition in Clinical Practice*. 2015;30(5), 609-624.

ANTHROPOMETRICS

- Weight, length/ height, head circumference
 - WHO growth charts for birth-24 months
 - CDC growth chart for 2-20 years
 - WHO z score charts birth through 20 years
 - Reference tables on CDC.gov and WHO.int
- Mid-upper arm circumference

Beer SS, et al. *Nutrition in Clinical Practice*. 2015;30(5), 609-624.

WEIGHT

Weigh infants and children

- With minimal clothing
- No shoes
- Scales accurate to 100g
- Empty bladder
- Dry diaper

Be aware of

Measurements vs estimations

Fluid status

Disease states

Error (recall, equipment)

Differences between scales

Shoes/socks/clothing weight

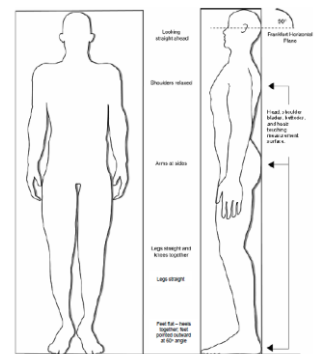
Melita et al. *JPEN*. 2013;37(4):460-481
Blackburn, et al. *JPEN*. 1977;1:11-22. 2
Klein S, et al. *JPEN*. 1997;21:133-136.

HEIGHT

Standing

2 yrs and older

Use wall mounted
stadiometer



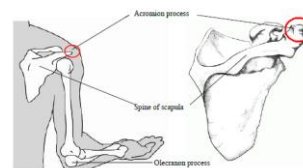
NHANES

LENGTH



NHANES

MUAC



Acromion
process



Midpoint of
upper arm
length

NHANES

DETERMINE THE ETIOLOGY

Illness Related

- Acute illness (<3 mos)
- Chronic disease (≥3 mos)
- Inflammation present
 - CRP, Cytokines

Non-Illness Related

- Limited resources
- Knowledge deficit
- Neglect
- Food aversion
- Food insecurity

¹Beer SS, et al. *Nutrition in Clinical Practice*. 2015;30(5), 609-624.

DETERMINE THE MECHANISM

Illness Related

- Malabsorption
- Nutrient losses
- Increased energy expenditure/hypermotabolism
- Altered utilization of nutrients

Non-Illness Related

Starvation due to:

- Eating disorder
- Socioeconomic status
- Iatrogenic feeding interruptions
- Feeding intolerance

¹Beer SS, et al. *Nutrition in Clinical Practice*. 2015;30(5), 609-624.

MICRONUTRIENT DEFICIENCIES

Nutrient	Deficiency symptoms
Iron	Fatigue, anemia, decreased cognitive function, headache, glossitis, nail changes
Vit B12	Weakness, sore tongue, and burning sensation in limbs
Folate	Glossitis, anemia (megaloblastic), and neural tube defects
Vit D	Poor growth, rickets, hypocalcemia
Vit A	Night blindness, poor growth, and hair changes
Zinc	Anemia, hepatosplenomegaly, hyperpigmentation, acrodermatitis, diminished immune response, poor wound healing

¹Beer SS, et al. *Nutrition in Clinical Practice*. 2015;30(5), 609-624.

OUTCOMES

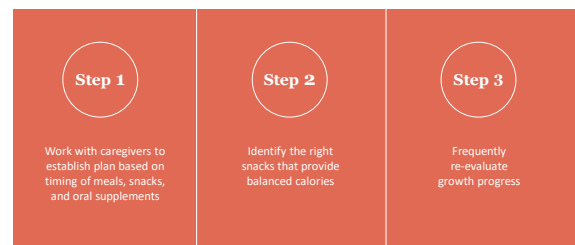
- Loss of lean body mass
- Muscle weakness
- Developmental or intellectual delay
- Infections
- Immune dysfunction
- Delayed wound healing
- Prolonged hospital stay

¹Beer SS, et al. *Nutrition in Clinical Practice*. 2015;30(5), 609-624.

TREATMENT

Etiology-based interventions

RECOMMENDATIONS FOR TX OF MALNUTRITION



¹Kernner B. *Clinical pediatrics*. 2009. ²Satter E. *The Journal of pediatrics*. 1990;117(2), S181-S189.

CALORIE NEEDS FOR GROWTH RESTORATION

Children with malnutrition require increased calorie and nutrient intake, and specific goals for them help in developing appropriate interventions

Calculated			
$\frac{[RDA \text{ for weight age (kcal/kg/d)} \times \text{ideal weight for height (kg)}]}{\text{Actual weight (kg)}}$	\div	$=$	Calorie requirements for catch-up growth (kcal/kg/d)

• Kleinmann R and Greer F editors. Pediatric Nutrition 7th edition, Chapter 27, 2014

CALORIE NEEDS FOR GROWTH RESTORATION

Children with malnutrition require increased calorie and nutrient intake, and specific goals for them help in developing appropriate interventions

Practical	
DRI Calories for age + 10-20% additional calories	Continue until child is gaining at normal growth rate for age

• Rathbun JM et al. Nutrition in failure to thrive. 1987

INTERVENTIONS TO IMPROVE INTAKE

Behavioral	Nutritional
Eliminate grazing	Assure proper prep of formula
Meals and snacks at appropriate frequency for age	Fortify formula of breast-milk to 22,24 or 27kcal/oz
Limit meal time to 20-30 min	Add oils and fats to foods
Provide meal in developmentally appropriate location	Provide increased caloric beverages with meals and/or snacks*
No juice or sugar-sweetened beverages	*Increased-calorie beverages should only be used when other interventions have failed and should be used for the shortest time possible.
Only water between meals and snacks	

Larson-North C and Blank VF. Clinical Review of Failure to Thrive in Pediatric Patients. *Pediatr Ann*. 2016;45(2):46-49.

IMPROVE MEALTIME BEHAVIORS

Preparation for Mealtimes			
Have child help with food preparation	Avoid distractions (e.g., TV, phones)	Try all kinds of foods	Maintain a neutral attitude during meals
During Mealtimes			
Make mealtime fun	Sit as a family to eat meals	Limit meals to 20-30 minutes	Tolerate age-appropriate mess

TREATMENT

The role of oral nutrition supplement in prevention and treatment

PROMOTING GROWTH IN CHILDREN AT RISK

- The earliest causes for growth concern in children are growth faltering and declines in weight
- An effective treatment plan can combat growth faltering and may consist of the following nutritional aspects:
 - Dietary counseling
 - Oral nutrition supplement (ONS)
- Optimal growth is best achieved when using a combination of dietary counseling and ONS.

• Mehta NM, et al. *Journal of Parenteral and Enteral Nutrition*. 2013;37(4), 460-481.

HUYNH ET AL, 2015

STUDY DESIGN

- Prospective, one-arm, multicenter study: children ages 3-4 years in the Philippines at risk of malnutrition
- Parents received 3 dietary counseling sessions at baseline, week 4, and week 8
 - Provided a list of recommended foods with example portion sizes and positive eating techniques
- Children consumed 2 servings of ONS daily (450 kcal)
- Assessments conducted at baseline and at weeks 4, 8, 16, 24, 32, 40, and 48
 - Weight
 - Height
 - Dietary intake (24-h dietary recalls)
 - Physical activity and appetite levels (visual analog scales)

•Huynh DT, et al. *Journal of Human Nutrition and Dietetics*. 2015;28(6), 623-635.

HUYNH ET AL, 2015

RESULTS

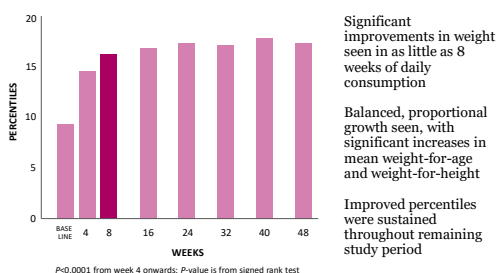
- In children with weight-for-height percentiles from 5th-25th, supplementation with 2 servings of ONS per day for 48 weeks resulted in:
 - Significant weight gain in the first 8 weeks
 - Maintenance of healthy weight through 48 weeks
 - Less than 1% of children being classified as overweight

OTHER FINDINGS

- # of sick days was significantly reduced
- Parents reported increased appetite and physical activity

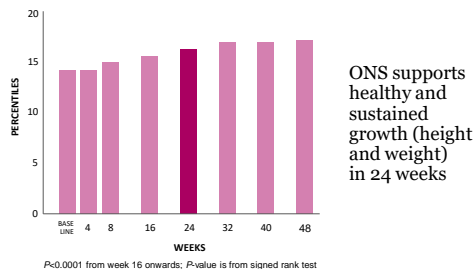
•Huynh DT, et al. *Journal of Human Nutrition and Dietetics*. 2015;28(6), 623-635.

WEIGHT-FOR-AGE PERCENTILES AT BASELINE AND EACH FOLLOW-UP VISIT



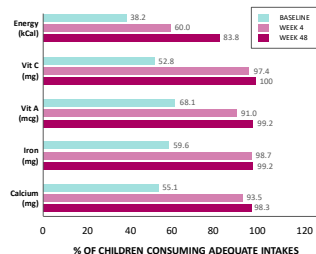
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HEIGHT-FOR-AGE PERCENTILES AT BASELINE AND EACH FOLLOW-UP VISIT



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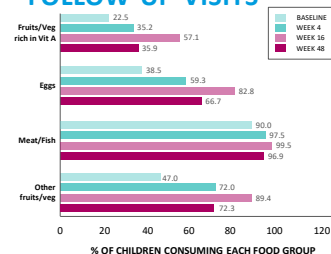
NUTRIENT INTAKE AT BASELINE AND 2 FOLLOW-UP VISITS



Integrating an ONS with counseling helped kids achieve dietary recommendations

•Huynh DT, et al. *Journal of nutritional science*. 2016;5:e20.

RECOMMENDED FOOD GROUP CONSUMPTION AT BASELINE AND 3 FOLLOW-UP VISITS

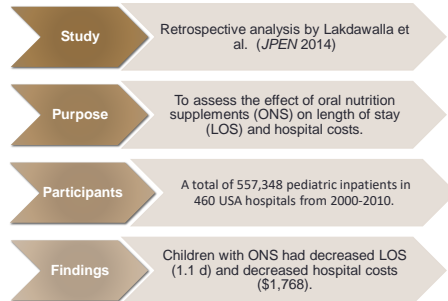


ONS did not replace consumption of table foods

More kids using ONS along with dietary counseling increased their intake of recommended food groups

•Huynh DT, et al. *Journal of nutritional science*. 2016;5:e20.

Nutritional therapy is cost-effective



Lakdawalla DN, et al. *JPEN J Parenter Enteral Nutr.* 2014;38:425-436.

Summary/ Conclusions

ADDRESSING UNDERNUTRITION

- Early intervention to prevent undernutrition may avoid growth attenuation in childhood and possible adverse consequences for later growth, cognition, and metabolism
- Improvements in weight seen with ONS in those with documented malnutrition and those at-risk children in as little as 8 weeks, and sustained for 48 weeks
- Improved variety of table food consumption was also observed in at-risk and malnourished children consuming ONS

Cole SZ et al. *Am Fam Physician.* 2011; 83(7): 829-834. Jeong SJ. *Korean Journal of pediatrics.* 2011;54(7): 277-281. Liu J et al. *Arch Pediatr Adolesc Med.* 2003;157(6):593-600. Sallis JC. *Pediatrics in Review.* Elk Grove. 2011;24(3):100. Shewell SF et al. *Journal of Child Psychology and Psychiatry.* 2006;47(2): 324-331. DeBoer MD, et al. *Nutr Rev.* 2012; 70(11):642-653. Barker DJ, et al. *N Engl J Med.* 2005;353(17):1802-1809. Bhargava SK, et al. *N Engl J Med.* 2004;350(9):869-875. Huynh DT, et al. *Journal of Human Nutrition and Dietetics.* 2015; 28(6): 623-635. Huynh DT, et al. *Journal of nutritional science.* 2016; 5: e20.

SUMMARY AND CONCLUSIONS

- Childhood malnutrition is associated with negative effects on long-term growth, and may result in later cognitive, behavioral, or overall health consequences
- It is critical to effectively identify and manage children with malnutrition, as well as those at risk of developing malnutrition
- Malnutrition may be addressed with strategies to improve meal structuring and a high-calorie diet for healthy growth

Questions?