The Barbara Bush Children's Hospital
At Maine Medical Center

Malnutrition in Pediatrics

Maine AAP Spring Conference 2023

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Disclosures

- None

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Objectives

- Describe the criteria that define malnutrition and undernutrition
- Brief review of abnormal growth patterns reflected in established growth charts
- Brief review of pathologic disease processes in children that can lead to malnutrition
- Discuss risk factors for malnutrition that can be more subtle and escape detection

Malnutrition

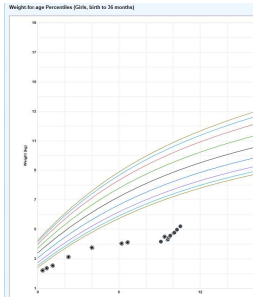
- A state of the body in which due to insufficient supply or incorrect absorption of essential nutrients, the body composition changes and the body's function is impaired

Obesity Facts 2022

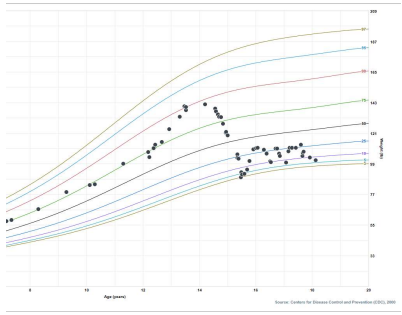
General Trends to Recognize

- Decline in weight centiles over time (precipitous or very gradual)
- Decline in height centiles over time (gradual)
- Failure to follow expected height accrual pattern based on mid-parental height prediction
- Unexpected change in BMI with increased stature

Recognizing Patterns: Sometimes It's Obvious..

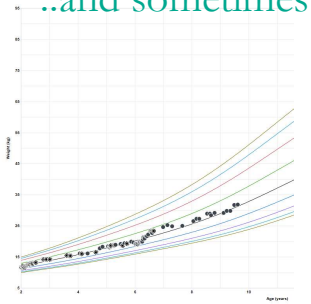


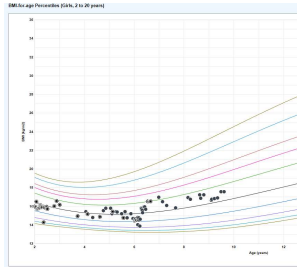
10 month old breastfed twin



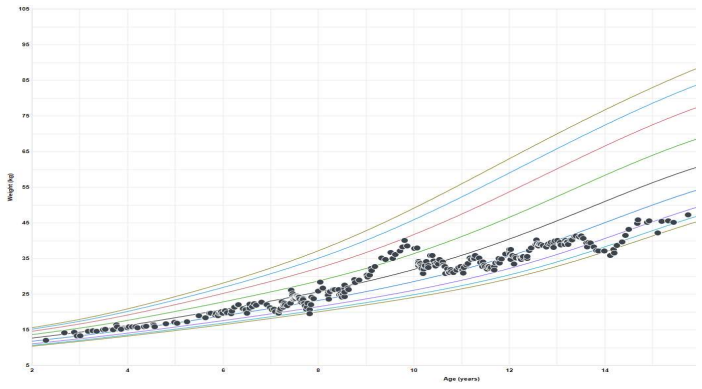
Patient diagnosed at 15 with Ulcerative Colitis

..and sometimes it is not so obvious





6 yo with ASD and feeding difficulties. Intake consisted solely of Banana Blueberry puree and yogurt.



Patient with Cystic Renal Dysplasia/renal failure diagnosed at 3 yo

Decreased absorption of nutrients

- Celiac disease
- Crohn's disease
- Eosinophilic enteropathy
- Protein losing enteropathy
- Pancreatic insufficiency
- Cystic Fibrosis

Increased Energy Expenditure

- Cardiac disease
- Renal disease
- Systemic inflammatory disorders
- Cystic fibrosis

Definitions/cut offs

- Undernutrition:
- Weight for height z score of less than -2
- Height for age z score of less than -2
- BMI of less than 18 for women

- Overweight:
- BMI z score of greater than 2 for 0-18yo
- BMI of greater than 25 for adults

Lancet 2020

Initial Approach

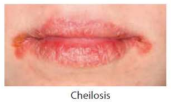
- Detailed dietary history
- Detailed history around eating behaviors/preferences/aversions/restrictions
- Screening labs: CBC, CMP, CRP, TTG IgA, total IgA
- Stool testing: Fecal calprotectin, fecal elastase

Clinical Signs of Malnutrition

- Weight loss, lack of gain (acute malnutrition)*
- Lack of height accrual (chronic malnutrition)*
- Fatigue
- Dizziness
- Abdominal pain
- Constipation
- Cold intolerance
- Amenorrhea
- Dry skin, hair loss
- Bradycardia
- Orthostatic tachycardia/hypotension
- Lanugo
- Pallor*

*Easy to miss with well child only visits

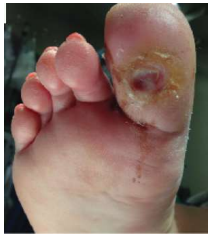
Vitamin B_2-Deficiency



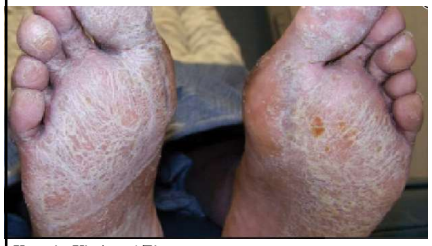
Cheilosis

Itching and burning eyes

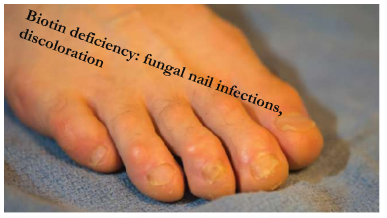
B12 deficiency

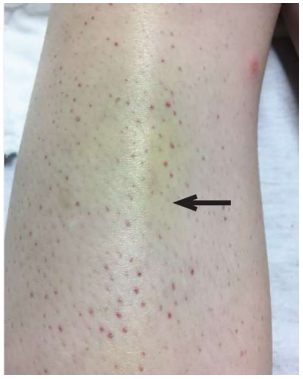


Vitamin C, Zinc deficiency- poor wound healing

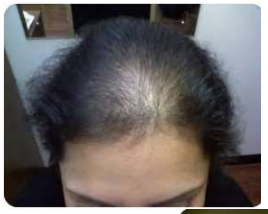


Xerosis: Vit A and Zinc deficiency





Scurvy/Vit C deficiency



Iron deficiency

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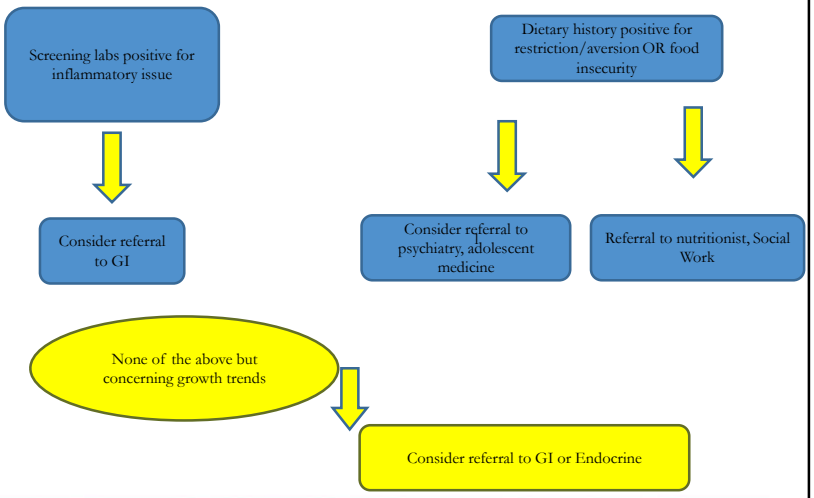

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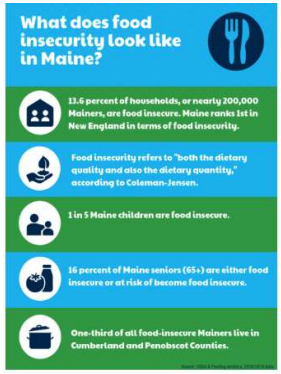
What Lies Beneath the Obvious

Other things to consider

Food Insecurity



Credit Caitlin Troutman / Maine Public / Maine Public

FEEDING AMERICA

What Hunger Looks Like in Maine

In Maine, 139,410 people are facing hunger - and of them 39,990 are children.

1 in 10 people face hunger.

1 in 6 children face hunger.

People facing hunger in Maine are estimated to report needing

$82,539,000

more per year to meet their food needs.

The average cost of a meal in Maine is $3.68. Data from Feeding America's Map the Meal Gap study. Learn more.

Supplemental Nutrition Assistance Program (SNAP) in Maine

Charitable programs are unable to fully support those facing hunger. The combination of charity and government assistance programs are necessary to help bridge the meal gap.

SNAP, formerly food stamps, provides temporary help for people going through hard times – providing supplemental money to buy food until they can get back on their feet.

In Maine,

33.2% of households receiving SNAP benefits have **children**

$203,630,527 distributed through SNAP generated **$346,171,896** in economic activity*.

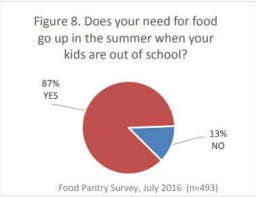
*Economists estimate that every dollar a household redeems through SNAP generates about $1.70 in economic activity.

Food Insecurity in Maine

- Often difficult to find work: closure of paper mills, downsizing of fisheries
- Summer Food Service Program: USDA funds meals for eligible children, but the SFSP reaches only a small number of eligible children
- Maine's labor market does not provide adequate wages to meet basic needs
- Higher paying jobs are geographically far from rural areas where factory jobs are disappearing

Hunger Pains Research Report 2017

Food Insecurity in Maine



Respondents to survey identified three key factors affecting hunger:

1-Ailing labor market/insufficient wages
2-Lack of access to SNAP benefits
3-Lack of transportation options/cost of gas to get to the store

Hunger Pains Research Report 2017

From Survey Respondents

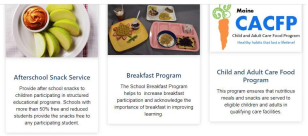
- "*I feed my children before I feed myself. And I hate this, but I have to limit the portions that my children can have for a meal.*" (middle aged mother, Lakes Region)

- "*South Portland has some places to get food, but I can't get there on the buses, and walking is hard because I have to carry all of the stuff by myself*" (Single mom, Portland)

Hunger Pains Research Report 2017

USDA Programs Monitored by Maine Department of Education

The Maine Department of Education oversees several USDA Food and Nutrition Services programs and initiatives that provide healthy food to children. Each of these programs helps fight hunger and obesity.
Below are brief descriptions of the programs and initiatives.



Afterschool Snack Service

Provide after school snacks to children participating in structured educational programs. Schools with more than 50% free and reduced students provide the snacks free to any participating student.

Breakfast Program

The School Breakfast Program helps to increase breakfast participation and acknowledge the importance of breakfast in improving learning.

Child and Adult Care Food Program

This program ensures that nutritious meals and snacks are served to eligible children and adults in qualifying care facilities.

Culinary Classroom

The Culinary Classroom promotes scratch cooking throughout all Child Nutrition programs. We offer the opportunity to brush up on your culinary skills or even learn new ones. Recipes, instructional videos and more can be found here.

Farm and Sea to School

The Farm and Sea to School Program promotes the use of Maine grown, raised, and caught ingredients in the delivery of meals to students throughout the state. Harvest of the Month program information found here.

Fresh Fruit and Vegetable Program (FFVP)

FFVP provides fresh fruit and vegetables to children outside of the school meals, often served as a snack. This program has helped students try new foods and increases their consumption of fruits and vegetables during the day.

Lunch Program (NSLP)

The National School Lunch Program provides low-cost or free healthy meals to children. Schools must follow federally established guidelines.

Summer Food Service (SFSP)

The National School Lunch Program provides low-cost or free healthy meals to children. Schools must follow federally established guidelines.

Food Distribution Program (USDA Foods Program)

The USDA Foods Program support domestic nutrition programs and American agricultural producers through purchases of 100% American-grown and produced foods.

GSFB/Preble Street Policy Recommendations

- Require high need schools to serve breakfast after the bell
- Invest in more summer meals sites across the state
- Eliminate the reduced-price category for school meals
- Create a statewide online application for school-based meals

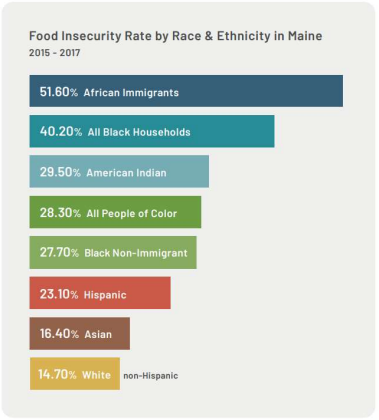
Hunger Pains 2017

Food Insecurity Defined:
Lack of consistent access to enough food for an active and healthy life for all household members due to the inadequate economic resources at the household level. (USDA)

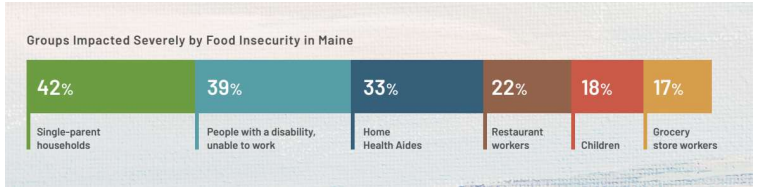
Maine has been an outlier, nationally and regionally, with above average rates of household food insecurity every year since 2005 (USDA, Feeding America). Even as the national food insecurity rate recovered following the 2008 recession, the problem in Maine grew worse, reaching a high of 16.4% for 2014-2016. Since at least 2005, Maine has had the highest rate of food insecurity in New England, a region otherwise notable for its low food insecurity.

Maine's Roadmap to End Hunger by 2030

Among food-insecure Mainers, 43% have incomes higher than the eligibility threshold for SNAP and WIC, the most effective anti-hunger programs available.[8] The phenomenon of struggling with food insecurity yet being ineligible for anti-hunger programs afflicts far fewer families nationally, indicating that the way poverty is defined and calculated is particularly ill-suited for capturing the economic realities and living costs in Maine.



Maine's Roadmap to End Hunger by 2030



Maine's Roadmap to End Hunger by 2030

Policy Changes in Action

THE PLAN IN ACTION:

Scaling Benefits to Match Economic Realities is Critical

On October 1, 2021, Maine residents who qualify for the Supplemental Nutrition Assistance Program got a boost in their buying power. The US Department of Agriculture announced a 21% permanent increase to the program after re-evaluating the cost of healthy meals. It took into account convenience foods, like pre-cooked canned beans and pre-cut salads, chopped frozen vegetables, and pre-cut salads have been added to help increase nutrition values for each meal.

THE PLAN IN ACTION: Universal School Meals Lowers Barriers to Child Nutrition

The federal government made breakfast and lunch free for all students during the coronavirus pandemic, and Maine will continue to offer free meals at least through 2023. The effort has highlighted the importance of providing meals to all students, not just those who meet income eligibility requirements. Making school meals free for all students dramatically improves access to healthy food for thousands of Maine children.

Maine's Roadmap to End Hunger by 2030

D Change the Narrative of Food Insecurity to Focus on Collective Responsibility & Amplify the Voices of Impacted People

Poverty and hunger in our communities are the result of systemic failures and structural inequities.

Strategy 1:
Reframe Hunger and Food Insecurity and their Costs as a Collective Responsibility to Be Addressed with Urgency and Ones That Impact All Maine People

Strategy 2:
Empower and Invest in the Leadership & Inclusion of Impacted People

Proposed Initiatives & Investments:

Maine's Roadmap to End Hunger by 2030

In ME: 40% of households with children reported using a pantry > once per month

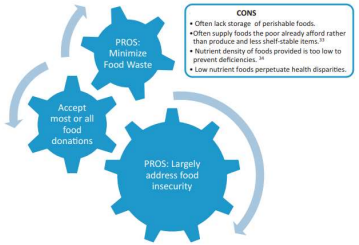


Fig. 1. Pros and cons of non-profit organizations in the US. (Bazerghi et al., 2016; Sharma et al., 2015) Fig. 1.

Preventive Medicine Reports 2018

Refugee/Asylum Seeking Population

- Often difficult to access food that is culturally appropriate (Halal, etc)
- Halal foods are often difficult to find, much more expensive
- Compensatory behaviors-parents offering calorie dense/nutritionally poor foods so children do not experience hunger
- Children may not ask for non-pork items at school, refuse to eat home cooked meals at school: go hungry instead

Food Insecurity among African/ME migrants

- Obesity/overweight associated with food insecurity
- 2018 study of food insecure migrant children: Alasagheirin and Clark
  - 46% of children had lean mass index >1 SD below normal
  - 1/3 of children had very low bone mineral content
  - 38% had low spinal bone density
  - 21% of children demonstrated wasting
  - 26% were overweight or obese
  - ¼ of children had elevated cholesterol levels
  - No child over 12 years reached recommended 10,000 steps per day

MIXED PICTURE OF MALNUTRITION

Intl Journal of Env Research and Public Health 2020

Malnutrition: Does not always = Thin

- Obesity: a paradoxical state of malnutrition, which despite excessive energy consumption is associated with a shortage of individual microelements

Obesity Facts 2022

Double Burden Malnutrition

- When obesity occurs alongside malnutrition in the same individual, family, or community
- USA: 53% of households with an underweight individual also house on obese individual

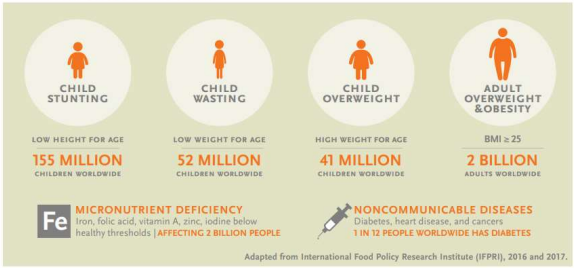
Preventive Medicine Reports 2018

Household Level DBM

- One or more individuals with wasting, stunting or thinness AND
- One or more individuals with overweight or obesity in the same home
  - Child is stunted and overweight
  - Mother is overweight, young child is wasted
  - Mother is overweight, young child is stunted
  - Mother is thin, child is overweight

Lancet 2020

FIGURE 1. GLOBAL SCOPE OF MALNUTRITION



The Barbara Bush Children's Hospital At Maine Medical Center PATIENT CENTERED | RESPECT | INTEGRITY | EXCELLENCE | OWNERSHIP | INNOVATION

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Micronutrient deficiencies in Obesity

- USA: 27-30% of daily calorie intake comes from low nutrient foods, desserts, added sugars
- Diet >30% fat: lower levels of Vit A, C, and folic acid
- Vit D deficiency associated with obesity (stored in adipose tissue)
- B Vitamin deficiency (Thiamine, B12)
- Vitamin C deficiency
- Vitamin E deficiency

Obesity Facts 2022

The Barbara Bush Children's Hospital At Maine Medical Center PATIENT CENTERED | RESPECT | INTEGRITY | EXCELLENCE | OWNERSHIP | INNOVATION

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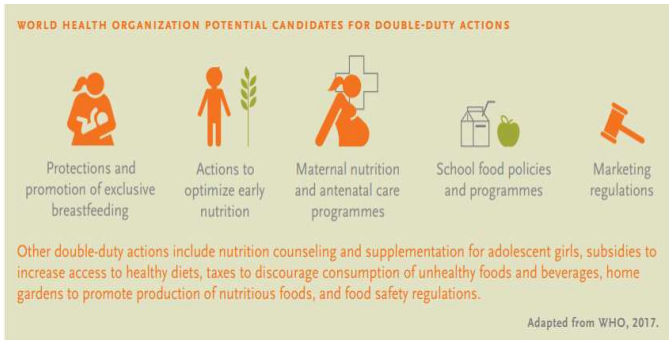
"Double Duty Actions"

- WHO Definition:
  - Interventions, programs and policies that have the potential to simultaneously reduce the risk or burden of both undernutrition (including wasting, stunting, and micronutrient deficiency or insufficiency) AND overweight, obesity, or diet related non-communicable diseases

USAID's multisectorial nutrition project/WHO 2017



USAID's multisectorial nutrition project

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ARFID

Avoidant Restrictive Food Intake Disorder

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Avoidant Restrictive Food Intake Disorder (ARFID)

Table 1. Diagnostic criteria for ARFID according to DSM V [1].

A. An eating or feeding disorder (e.g., an apparent lack of interest in food or eating; avoidance of foods because of their sensory characteristics; concern about the consequence of eating), which manifests as an inability to get adequate nutrients and/or energy into the body with food and links to at least one of the following: 1. Significant weight loss (or lack of expected weight gain or growth in children); 2. Significant nutritional deficiencies; 3. Dependence on enteral feeding or oral food supplements; 4. Disturbances in psychosocial functioning.
B. The disorder cannot be explained by lack of food availability or cultural and religious reasons/practices.
C. This disorder does not occur exclusively in the course of anorexia nervosa or bulimia nervosa and is not the result of abnormalities in the experience of body weight and shape.
D. This disorder cannot be explained by the current state of health or other co-occurring mental disorders.

ARFID: Avoidant/Restrictive Food Intake Disorder. DSM V: Diagnostic and Statistical Manual of Mental Disorders 5th ed.

Nutrients 2022,14,1739

Avoidant Restrictive Food Intake Disorder (ARFID)

- ICD-11: disorder characterized by avoidance or restriction of food intake, resulting in the intake of insufficiency quantity or variety of food to meet energy OR nutritional requirements
- Subcategories:
  - Selective eating since early childhood (infantile anorexia)
  - Generalized anxiety
  - GI symptoms
  - Insufficient/low interest in eating
  - Restriction due to sensory issues
  - Aversive/traumatic experiences

Nutrients 2022

ARFID

- Younger
- More common in males
- Longer duration of illness before treatment
- More comorbidities
- 5-12% of patients in ED clinics, 22-24% of patients in day ED programs meet criteria for ARFID
- NO body image disturbance
- Co occurrence of ASD can complicate the diagnosis

Nutrients 2022

ARFID

- Eat smaller portions of food
- Want to avoid *unpleasant sensations*
- Early satiety signaling, lack of appetite, *lack of interest in food*, anxiety during eating, fear of consequences of eating
- Don't like the look, taste, smell, texture, temperature of food
- Prevalence: largely unknown (5-20%, more often boys)

Nutrients 2022

Infantile Anorexia (IA)

- Food refusal, growth deficiency
- No communication of hunger
- Lack of interest in food
- Difficult temperament/fussy baby + mom with anxiety, depression, dysfunctional eating attitudes
- True dyad, can lead to interactional conflict
- Long term outcome not well understood
  - Potential risk factor for eating disorder later in life
  - Potential risk for anxiety/behavioral difficulties

Frontiers in Psychology 2018

ARFID: Longitudinal study of malnutrition and Psychopathological risk factors from 2-11 years

- 80% were severely or moderately malnourished at dx
- Steady improvement over time but only 27% showed no malnutrition at age 11
- Most mothers had significant eating difficulties, anxiety and depression
- Striking correlation between symptoms of mom and child
- Mom's anxiety, depression, and dysfunctional attitudes around eating are best predictor of child's emotional/behavioral issues

Frontiers in Psychology 2018

Table 3. NIAS questionnaire [39]. Nine Item Avoidant/Restrictive Food Intake disorder screen (NIAS)—Child.

		STRONGLY DISAGREE	DISAGREE	SLIGHTLY DISAGREE	SLIGHTLY AGREE	AGREE	STRONGLY AGREE
1	I am a picky eater	□	□	□	□	□	□
2	I dislike most of the foods that other people eat	□	□	□	□	□	□
3	The list of foods that I like and will eat is shorter that the list of foods I won't eat	□	□	□	□	□	□
4	I am not very interester in eating/ I seem to have a smaller appetite than other people	□	□	□	□	□	□
5	I have to push myself to eat regular meals throughout the day, or to eat a large enough amount of food at meals	□	□	□	□	□	□
6	Even when I am eating a food I really like, it is hard for me to eat a large enough volume at meals	□	□	□	□	□	□
7	I avoid of put off eating because I am afraid of GI discomfort, choking, or vomiting	□	□	□	□	□	□
8	I restrict myself to certain food because I am afraid that other foods will cause GI discomfort, choking, or vomiting	□	□	□	□	□	□
9	I eat small portion because I am afraid that other foods will cause GI discomfort, choking, or vomiting	□	□	□	□	□	□

As feeding and eating disorders are multifactorial, it is recommended that a team of specialists work on a disorder such as ARFID. Due to the current lack of management standards, it is necessary to cooperate, among others, with a family doctor/pediatrician, gastroenterologist, psychiatrist, psychologist, dietician, neurologist, and sensory integration therapist [41]. Due to the complex nature of the disorder that is ARFID, it would be advisable for the whole team of specialists to participate in the diagnosis process, analyzing the patient's symptoms, each in their field. The next step should be the joint development of an effective and individual therapeutic management plan. Any therapeutic management carried out in patients with ARFID should be coherent and adapted both to its age, bearing in mind the child's development, and the severity of the course of the disease. An integral part of therapy is cooperation with the patient's parents or caregivers and in defining the goals and expectations of each party [28].

Nutrients 2022

Consequences of ARFID

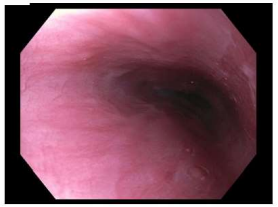
- Weight loss, lack of interval weight and height gain
- Obesity (juice or energy drinks given to kids to provide "vitamins" can lead to overweight)
- Deficiencies if minerals, vitamins, complete proteins, EFAs despite a normal weight
- Vit B1, B2, B12, C, K, zinc, potassium, iron are most commonly deficient in ARFID
- Social consequences

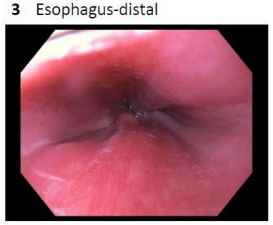
Nutrients 2022

ARFID Cases: TB

- Previously healthy 16 yo female
- Acute onset of dysphagia while eating scalloped potatoes
- Felt it was 'hard to breathe'
- Taking small bites of food at a time but has had episodes of panicking while trying to eat. Repeated forceful expiration during visit
- 30 pound weight loss in 2 ½ weeks
- No history of anxiety, no body image issues, extremely stoic child who never complains
- Admitted to BBCH for workup

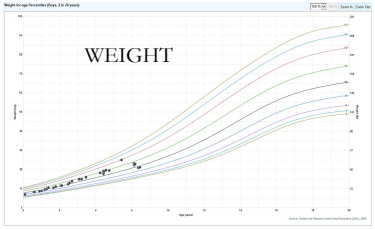
Endoscopy: normal



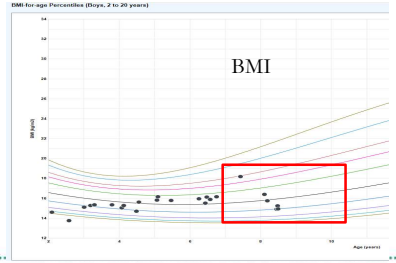


*PSYCHIATRY CONSULTATION: Acute ARFID
OUTCOME: Discharged home on full po

ARFID Cases: AW



8 yo with multiple food aversions, low volume food intake, poor appetite. Onset of dietary limitations was as a toddler



Food Diary

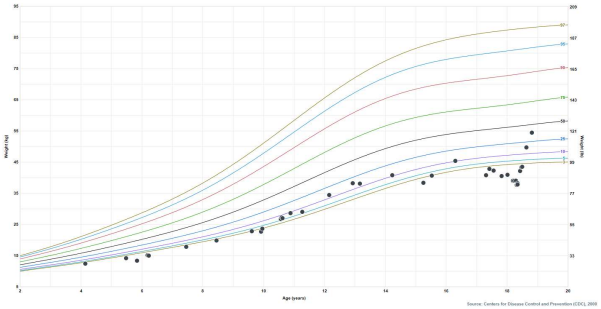
ITEM	NOTES
Lunch - Small Fries @ McDonald's w/Ranch & Sweet & Sour Sauce, 8 Oz Low Fat Milk	57 lbs
Breakfast - Handful Capt. Crunch Peanut Butter, 8 Oz Whole Milk	
8 Small spoonfuls of Gelato, 1/2 large chocolate chip cookie	Went to Jordan's Furniture ropes course. Break after 30 min for big poop (little hard) then sat in the obstacle course. Too worn out.
Dinner - 1 crust of a pizza, 2 bays chips, 8 Oz lemonade, 8 Oz water	Spit out first bite of pizza crust. Said he didn't want the pizza - too much sauce. Said he was full and used the small bite method to finish pizza crust.
Snack - 8oz whole milk, 4 ritz crackers, 4 Turkey pepperoni slices	Tried something new - ritz garden cracker. Didn't like it.
Breakfast - 2 little bites muffins, 4 oz hot cocoa	
Lunch - 1 little bite muffin, 3 green pepper slices with ranch dressing, 8 oz Milk	Looked at a pepperoni and saw green pepper seed now says will not eat ever again
Snack - 1 piece toast with butter, a few peanut butter milkins & 4 oz whole milk	Tried eat another piece of toast with peanut butter but only ate one bite
Dinner - 3 tablespoons of Mac & cheese, 8 ritz crackers, 1 teaspoon of sugared ham cubes, 3 green pepper slices with ranch dressing, 8 oz whole milk	Tried dipping a ritz cracker in ranch dressing at ate it. Didn't like it but tried something new. No poop today.
Breakfast - 2 brownie bite muffin & 4 oz Milk	
Snack - 2 little bite muffins	
Lunch - 1/2 small bowl of Cheerios	
Snack - 1 small bowl of Doritos, 8oz milk, bite of [illegible], bit of a candy pizza, and a little bit of a lollipop	
Dinner - 1/2 chicken nugget, small French fries, 4 oz apple juice, small bag apple slices	
Snack - 1 small bowl of tortilla chips	No poop today. Started Cyproheptadine.
Breakfast 1/4 bowl of Cheerios, 4 oz Whole milk	Sick with cold and fever.
Snack - 1 cotton candy yogurt, 1/2 bag popcorn, 12 oz pink lemonade, pack of gummies	
Dinner??? Forgot to log	
Breakfast - Gogurt & 4 oz milk	Sick with cold and fever. Had a hard time getting him to eat anything.
Snack - 2 bowls of Tostitos & 20 oz water	
Dinner - 1 strawberry waffle with butter, 8 oz hot cocoa with 1/3 cup pediasure gain & grow powder	
Breakfast - 1/2 lg chocolate chip muffin & 4 oz whole milk	Still sick
Snack - 1 pkg Gushers fruit snacks & 8 oz hot cocoa w/Pediasure Grow & Gain chocolate powder	
Lunch - 3 little bites muffins & 8 oz hot cocoa w/Pediasure grow & gain powder	
Snack - 1/2 small pkg of cheese its	
Dinner - 1/2 lg chocolate chip muffin	
Snack - 1 bowl of doritos	No poop
Breakfast - 1/2 lg chocolate chip muffin & 4 oz whole milk	
Snack - 8 oz hot cocoa w/Pediasure grow and gain	
Lunch - 1/2 lg chocolate chip muffins & 1 munchkin & 8oz milk	

Treatment: initially started on Cyproheptadine, but aversions worsened

Seen in follow up in GI clinic, discussion took place re: enteral feeding tube

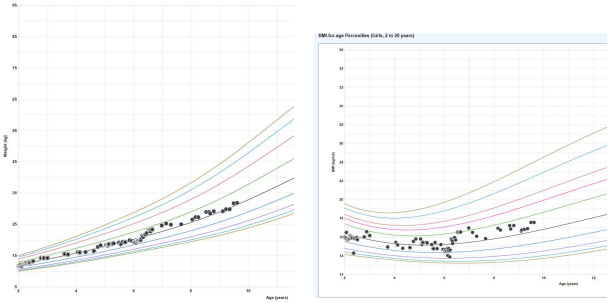
Started again on Cyproheptadine and made good progress

ARFID: MC



17 yo with one year of nausea, early satiety,10 pound weight loss, gastroparesis on gastric emptying scan. Failed all prokinetics and had NJ tube placed

ARFID: GV



6 yo with ASD and feeding difficulties.
Intake consisted solely of
Banana
Blueberry puree and yogurt.

Due to failure of years of feeding therapy, G Tube placed

Anecdotal Patient Outcomes

- 1- acute ARFID self resolved, no medical therapy
- 2- after discussion of enteral feeding tubes and restarting Cyproheptadine, symptoms resolved
- 3- Long Term NJ tube feeds necessary
- 4- Long Term Gastrostomy tube feeds necessary
- 5-many others treated in conjunction with child psychiatry, local counselors, Kaleidoscope program, adolescent medicine

Treatment Strategies

- Food Chaining
- Lowering emotions around eating
- Family Based Therapy
- CBT
- Multidisciplinary approach is the best approach (psychiatry, adolescent medicine, GI, RD, Pediatrician)

Nutrients 2022

Summary

- Malnutrition in pediatrics comes in various forms and can have a wide variety of causes
- Growth charts are very important but do not always tell the whole story
- Social Determinants of health are likely of equal importance to disease processes in placing children at risk of malnutrition
- Ask detailed dietary questions and be on the lookout for ARFID

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