

Blenderized Diets and Food Based Formulas: Research, Innovations, and Applications to Practice

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1

Learning Objectives

- Summarize literature regarding food based formula and impact on GI health
- Determine optimal patient population for use of food based formula
- Identify barriers to use of food based/home blended formula
- Develop a home blended tube feeding formula

2

Presentation outline

- Discuss why food based formulas have become popular in pediatric population
- Review literature regarding the safety and efficacy of blenderized and food based formulas
- Determine optimal patient population for use of food based formula
- Identify barriers to use of food based, or blenderized formula
- Brief review of current commercial products on the market
- Clinical Application: How to create a home blended tube feeding formula
- Questions

3

Disclosures

- No professional disclosures
- There will be a short discussion of current commercially produced formulas on the market. This is for educational purposes only and should not be considered an endorsement of any products or companies mentioned in this presentation.

4

Why the recent reemergence of blenderized diets?^{2, 6, 11, 13}

- Tolerance Benefits
 - Reduced reflux
 - Reduced retching and gagging
 - Improved stooling patterns
 - Improved volume tolerance
 - Reduction in oral aversion
- Psychosocial
 - Meal time
 - Family and caregiver participation
 - Nurturing
- Nutrition Benefits
 - Allergen free
 - Organic, non GMO foods
 - Diet Specific
- Financial
 - Less expensive if commercial formula not covered
 - Specialty formula

Bobo, Elizabeth (2016) Reemergence of Blenderized Tube Feedings: Exploring the Evidence. *Nutrition in Clinical Practice*. 41 (6).

5

Are blenderized diets safe?

- Nutritionally balanced
 - Meta analysis of 4 studies showed
 - No significant differences between fat and protein content between blenderized and commercial
 - Commercial formula was significantly higher in energy and CHO content
 - Blenderized was lower in calcium, phosphorous, magnesium, zinc, iron and vitamin C
 - Blenderized formula was more viscous and higher osmolality
- Higher potential for food born pathogens
 - Unable to determine based on available evidence

Ojo, O. et al. An Evaluation of the Nutritional Value and Physical Properties of Blenderized Enteral Nutrition Formula: A Systemic Review and Meta-Analysis. *Nutrients: Vol 12 6 2020* 1-21

6

Are blenderized diets safe?

Table 1

Macronutrients and energy according to the type of the enteral diet.

	NCD n = 33	PCC n = 13	LCD n = 20	Statistical Analysis
Water (g/100 g)	91.1 88.2/93.2	75.7 71.0/82.6	79.2 75.5/80.2	p < 0.001 ^a PCD = LCD < NCD ^c
Protein (g/100 g)	2.1 1.4/3.4	4.1 3.2/5.0	4.1 3.8/4.4	p < 0.001 ^a NCD < PCD = LCD ^c
Fat (g/100 g)	1.9 ± 1.2	4.3 ± 1.8	3.0 ± 1.2	p < 0.001 ^b NCD < LCD < PCD ^c p = 0.702 ^a
Minerals (g/100 g)	0.7 0.4/0.8	0.7 0.6/0.8	0.6 0.6/0.7	p = 0.025 ^c
Dietetic Fiber (g/100 g)	0.8 0.6/1.6	1.2 0.4/1.4	1.9 1.5/2.4	NCD < LCD; NCD = PCD; PCD = LCD
Carbohydrate (g/100 g)	3.4 2.4/5.6	13.2 11.0/15.6	11.6 10.2/15.6	p < 0.001 ^a NCD < PCD = LCD ^c
Energy (Kcal/100 g)	40.5 26.0/49.4	113.5 75.0/124.0	110.0 98.0/120.0	p < 0.001 ^a NCD < PCD = LCD ^c

^a Kruskal–Wallis, median and percentiles 25 and 75.

^b One Way Analysis of Variance, mean and SD.

^c Multiple comparisons analysis.

Vierra MMC, Santos VFN, Borroni , Morais TB. (2018) Nutritional and microbiological quality of commercial and homemade blenderized whole food enteral diets for home-based enteral nutrition therapy in adults. 37 177-181

7

Are blenderized diets safe?

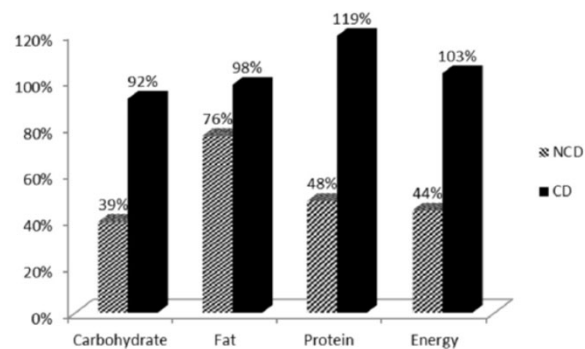


Fig. 1. Percentages ratios of expected values/ measured values for macronutrients and energy in non-commercial and commercial diets.

Vierra MMC, Santos VFN, Borroni , Morais TB. (2018) Nutritional and microbiological quality of commercial and homemade blenderized whole food enteral diets for home-based enteral nutrition therapy in adults. 37 177-181

8

Are blenderized diets safe?

Table 4
Number of samples complying with microbiological standards, according to the type of diets.

Colony-forming units/mL	NCD (n = 33)	PCD (n = 13)	LCD (n = 20)	Statistical analyses
Mesophilic	7 (21%)	8 (62%)	20 (100%)	$p < 0,001^a$ NCD < PCD = LCD ^c
Coliform	2 (6%)	4 (31%)	17 (85%)	$p < 0,001^a$ NCD = PCD < LCD ^c
<i>Escherichia coli</i>	23 (70%)	11 (85%)	18 (90%)	$p = 0,18^b$

^a Chi-square test.
^b Fisher exact test.
^c Partition.

Vierra MMC, Santos VFN, Borroni , Morais TB. (2018) Nutritional and microbiological quality of commercial and homemade blenderized whole food enteral diets for home-based enteral nutrition therapy in adults. 37 177-181

9

Safe food handling reduces microbial contamination



- Sanitizing using high temperature or bleach solution
- Air drying
- Washing all utensils, measuring, and cooking equipment
- Blender disassembly
- Hand washing
- Proper food cooking to recommended temperatures
- Checking expiration dates
- Proper and prompt cooling and storage

Milton, D. L., Johnson, T. W., Johnson, K., Murphy, B., Carter, H., Hurt, R. T., Mundi, M. S., Epp, L., Spurlock, A. Y., & Hussey, J. (2020). Accepted Safe Food-Handling Procedures Minimizes Microbial Contamination of Home-Prepared Blenderized Tube-Feeding. *Nutrition in Clinical Practice*, 35(3), 479–486.

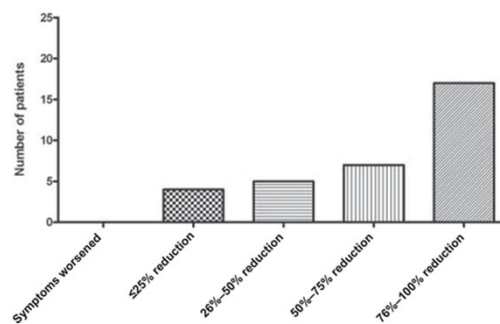
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Are blenderized diets effective?

11

Improved retching and gagging

- 33 children started on PBGT diet
- 56% reported reduction in symptoms of retching or gagging

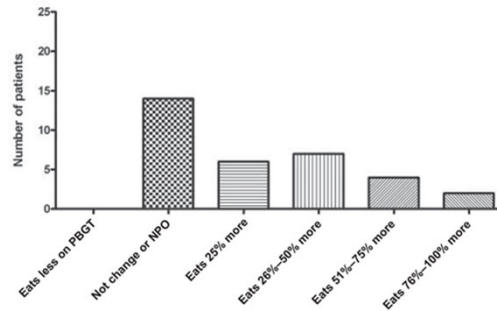


Pentiuk, S, et al. (2011) Pureed by gastrostomy tube diet improved retching and gagging in children with fundoplication. *Journal of Enteral and Parenteral Nutrition*, 35(3), 375-379

12

Improved in oral intake

- 14 patients remained NPO
- 57% had improved oral intake



Pentiuk, S, et al. (2011) Pureed by gastrostomy tube diet improved retching and gagging in children with fundoplication. *Journal of Enteral and Parenteral Nutrition*. 35(3). 375-379

13

Lower healthcare associated costs

- Fewer ED visits
- Fewer admissions
- Fewer respiratory admissions
- Improved satisfaction
- Reduction in symptoms of GERD

Hron, B. et al. (2018) Health outcomes and quality of life indices of children receiving blenderized feeds via enteral tube. *The Journal of Pediatrics*. 211. 139-145

14

Hron B. et al

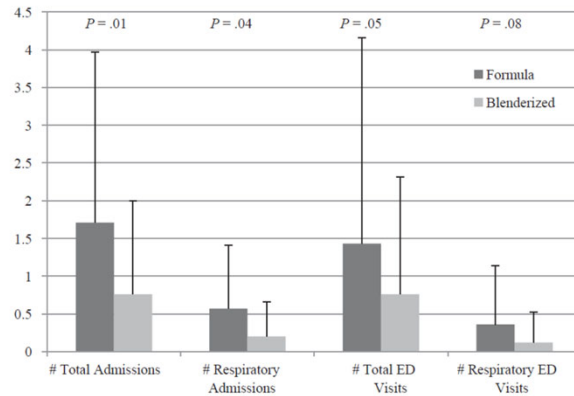


Figure. Healthcare use at Boston Children's Hospital in 2017 by diet type, adjusted for age and propensity score for comorbidities. Dark gray bars indicate conventional formula; light gray bars indicate blenderized feeds.

Hron, B. et al. (2018) Health outcomes and quality of life indices of children receiving blenderized feeds via enteral tube. *The Journal of Pediatrics*. 211. 139-145

15

Hron B. et al

Table V. Differences in quality of life measures between participants on formula and blenderized feeds*

	Formula	Blenderized	P value
Likert scale			
Satisfaction with feeding regimen	3.3 ± 1.2 (n = 26)	4.3 ± 1.0 (n = 32)	<.001
PGSQ			
Total symptoms	1.2 ± 1.1 (n = 23)	0.7 ± 0.8 (n = 29)	.007
Every day impact	1.3 ± 1.0 (n = 21)	0.9 ± 0.9 (n = 29)	.06
School items	0.6 ± 1.0 (n = 13)	0.7 ± 0.9 (n = 17)	.83
Total score	1.2 ± 1.0 (n = 23)	0.8 ± 0.8 (n = 29)	.02
PedsQL			
Physical	53.1 ± 30.3 (n = 24)	63.7 ± 31.3 (n = 28)	.31
Psychosocial	62.2 ± 20.1 (n = 23)	63.7 ± 20.1 (n = 28)	.85
Total	58.0 ± 20.4 (n = 24)	63.4 ± 22.5 (n = 28)	.34
GI-PedsQL			
Stomach pain	56.4 ± 33.9 (n = 22)	65.0 ± 26.8 (n = 28)	.04
Stomach upset	58.9 ± 32.7 (n = 22)	71.1 ± 26.0 (n = 26)	.02
Food and drink limits	18.6 ± 27.6 (n = 22)	46.1 ± 29.6 (n = 26)	.006
Trouble swallowing	48.4 ± 29.8 (n = 21)	55.9 ± 27.5 (n = 26)	.45
Heartburn/reflux	63.9 ± 26.5 (n = 22)	67.4 ± 23.9 (n = 28)	.28
Nausea/vomiting	49.0 ± 37.9 (n = 20)	64.0 ± 22.6 (n = 27)	.02
Gas	61.6 ± 31.1 (n = 22)	66.1 ± 14.3 (n = 28)	.19
Constipation	74.5 ± 24.5 (n = 20)	73.7 ± 28.4 (n = 28)	.96
Blood in stool	88.7 ± 20.1 (n = 21)	95.1 ± 13.8 (n = 28)	.19
Diarrhea	73.6 ± 26.3 (n = 21)	87.9 ± 15.5 (n = 28)	.004
Total symptoms	59.7 ± 21.7 (n = 22)	69.7 ± 16.9 (n = 28)	.01
Worry about stool	81.4 ± 30.0 (n = 18)	91.5 ± 12.8 (n = 23)	.05
Worry about abdominal pain	79.6 ± 33.6 (n = 19)	88.1 ± 24.2 (n = 21)	.10
Medications	74.6 ± 17.6 (n = 17)	78.8 ± 25.1 (n = 19)	.48
Communication	36.5 ± 39.1 (n = 20)	39.3 ± 41.3 (n = 23)	.68
Total GI score	62.3 ± 19.6 (n = 22)	70.2 ± 16.3 (n = 28)	.03

GI: gastrointestinal.
 Results are mean ± SD.
 P value adjusts for age and propensity score.
 For Likert, greater scores indicate improved satisfaction (scale 1-5).
 For PGSQ, greater scores indicate greater symptom burden.
 For PedsQL and GI-PedsQL, greater scores indicate less limitation.
 *A subset of questions in the PGSQ, PedsQL, and GI-PedsQL may not be appropriate for all ages and/or developmental abilities.

16

In summary, worth considering for patients who:

- Intractable vomiting
- Retching and gagging
- Volume intolerance
- Failure to thrive
- Dumping syndrome/diarrhea/Short bowel syndrome
- Constipation
- Multiple food allergy*
- Paying out of pocket

17

Keeping in mind these considerations:

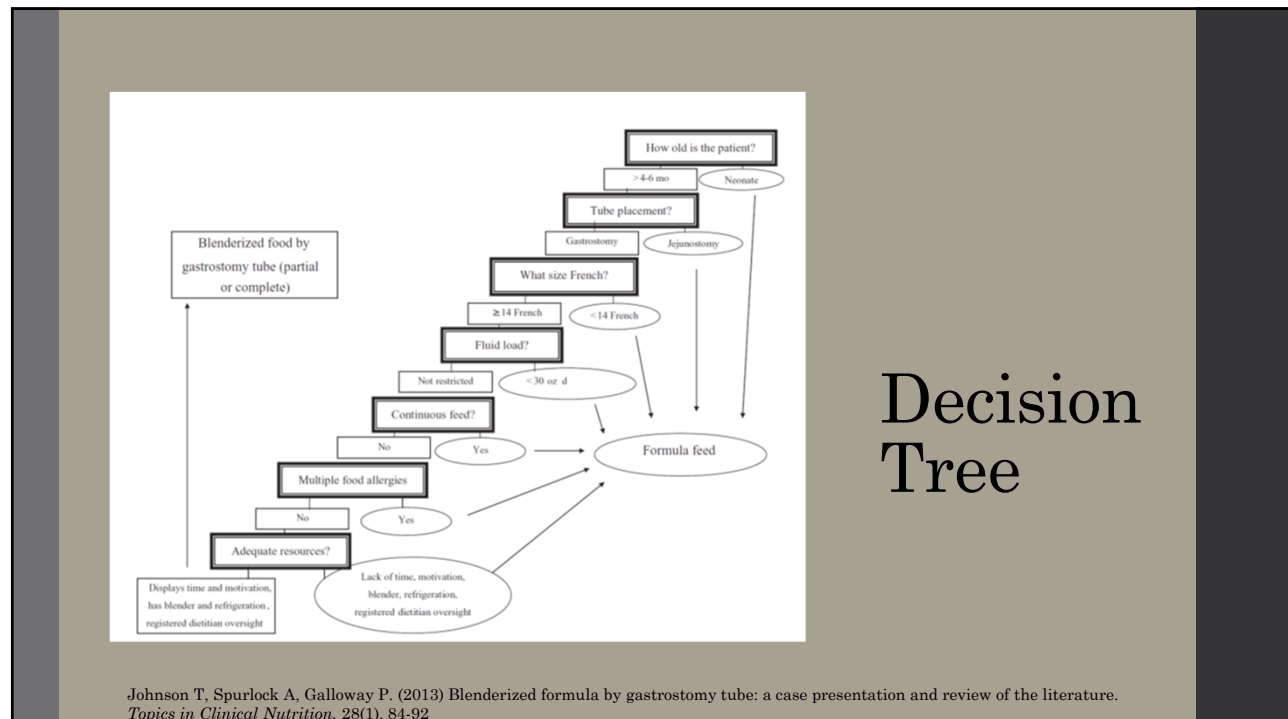
- Greater than 1 year of age
- Adequate tube size
- Food exposures
- Not immunocompromised
- Food secure
- Safe and adequate preparation and storage area

18

Blenderized diets do not work for:

- Continuous or GJ feeds
- Food insecure
- Need for lower fiber/residue diet*
- Caregiver limitations
- Access to reliable refrigeration
- Blending equipment

19



20

Commercial Whole Food Formulas

21



Functional Formularies

22



Real Food Blends

23



Compleat and Compleat Organic Blends

24



Pediasure Harvest

25

Clinical Application: Creating a Blenderized Diet

26

Three options for blends

- The shaker method (baby foods)
- Home blended foods option
 - Blenders that work
 - BlendTec
 - Vitamix
- Meal option

27



Pick a base

- For higher calorie needs
 - Formula (consider 1.5 kcal/ml)
- For lower protein or calorie needs
 - Can use water, or broth
- For standard
 - Milk or milk alternative

28

Add protein

- You have a liquid protein source from base
- Good choices:
 - Strained meats
 - Canned/soft meats
 - Eggs
 - Nut butters
 - Beans
- Aim for 80-90% of protein from these two sources



29

Get those fruits and veggies!

- Starchy vegetables
 - Peas, beans, lentils, winter squash, potatoes, sweet potatoes, pumpkin
- Non starchy vegetable
 - Spinach, green beans, summer squash, cruciferous vegetables
- Fruits
 - Limit seedy fruits, or stringy fruits
- Increase volume significantly



30



Get the grains

- Can use dry or well cooked
 - Infant cereal, pasta
- Cereal grains
 - Cooked oatmeal, or breakfast cereal soaked in liquid
- Feeling fancy
 - Quinoa, bulgur, couscous, amaranth, brown rice

31

Fatten it up

- Start low
 - 1-3 tablespoons oil
- Adjust up from there if necessary
- Think of other fat sources already in the blend
- Non oil high fat additions
 - Nut butters, avocado, coconut cream



32

Analyze it

- We use ESHA Food processor SQL
- Other options: NDSR , USDA nutrient database, CBOARD, Nutretics, etc.
 - Reliable, accurate
- Analyze using more than one blend

33

Goal ratio

- Protein 12-15%
- Fat 30-35%
- CHO 55-60%

- AMDR
 - CHO 45-65%
 - Protein* 10-30%
 - Fat* 25-35%

34

Adjust if necessary

- Modifiers CHO
 - Corn starch,
 - Table sugar, agave, honey
 - Rice cereal
- Commercial modifiers
- Fat modifiers
- Protein

35

Final touches

- Total volume
 - Divide into boluses
- Fluid
 - Minimal flushes directly after feeds
- Vitamins
 - See analysis: MVI, or individual nutrients
- Salt

36

Tips and tricks

- Consider having a few standard recipes on hand
- Ask for 3-5 days worth of recipes for analysis as a check point
- If something isn't right, don't be afraid to return to a commercial formula
- Patients may need commercial product on hand as backup in case of emergency

37

Additional resources

- Nestle Compleat Recipe Builder
 - <https://www.compleat.com/recipes>
- “Homemade Blended Formula Handbook” Marsha Dunn Klein, and Suzanne Evans Morris
- “Cooking for Tubies” Courtney Stinson and Sophia Hoslten

38

Self assessment

1. What are two potential benefits of using blenderized or whole food formula when compared to standard enteral nutrition formulas. (There are more than two potential benefits.)

39

Answer

- Improved tolerance of feeding volume
- Reduction in symptoms of retching and gagging associated with feeding
- Reduced constipation
- Reduction in diarrhea
- Caregiver involvement in meal time and nourishment of child
- Improved quality of life potential increased PO intake
- Opportunity to follow specific diet

40

Self assessment

1. What route of administration is best for administering blenderized formula
 1. Continuous administration via jejunal tube
 2. Administration via enteral pump over an hour
 3. Bolus feeding via syringe
 4. Gravity feeding

41

Answer

1. What route of administration is best for administering blenderized formula
 1. Continuous administration via jejunal tube
 2. Administration via enteral pump over an hour
 3. **Bolus feeding via syringe**
 4. Gravity feeding

42

Self assessment

1. Which patient is not suited for a home prepared blenderized diet?
 1. A 5 year old on immunosuppressive medication
 2. A 3 year old with multiple food allergies
 3. A 2 year old with a history of nissen fundoplication and retching/gagging
 4. And 18 month old with failure to thrive and emesis with tube feeds

43

Answer

1. Which patient is not suited for a home prepared blenderized diet?
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44

Self assessment

1. What are two possible qualifications that must be met before it is recommended to initiate a blenderized diet in a pediatric patient? (There are more than two acceptable answers.)

45

Answer

- Greater than 1 year of age
- Tube size greater than 14 French
- Caregiver is food secure
- Caregiver has access to adequate equipment to prepare food and store food
- Patient has had food exposure to multiple foods from all food groups

46

Self assessment

1. What are potential complications that may arise from using home blenderized formula?
 1. improper blending can cause tube clogs which may lead to further complications with deliver other medications
 2. unsafe food handling can cause increased microbial contamination
 3. deviation from recipe and use of different ingredients leads to less than optimal micro and macronutrient profile
 4. All of the above

47

Answer

1. What are potential complications that may arise from using home blenderized formula?
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 2. unsafe food handling can cause increased microbial contamination
 3. deviation from recipe and use of different ingredients leads to less than optimal micro and macronutrient profile
 4. **All of the above**

48

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49

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50

Questions

