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# AUTISM: NUTRITION MAKES A DIFFERENCE

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# AUTISM: NUTRITION MAKES A DIFFERENCE

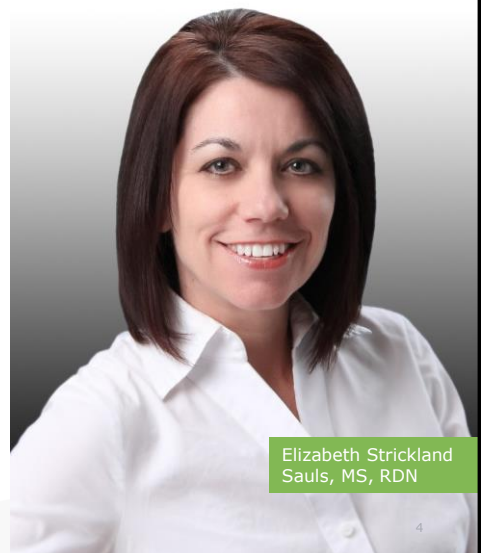
Elizabeth Strickland Sauls, MS, RDN

## Your Presenter



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- Holds a master's in foods and nutrition from University of Georgia
- Owner, ASD Nutrition
- Author, speaker, and nutrition consultant regarding nutrition for ASD, ADHD, and related disorders.



Elizabeth Strickland  
Sauls, MS, RDN

## Goal and Learning Outcomes



The goal of this presentation is to examine the current evidence-based research related to **nutritional treatment** of autism spectrum disorder.

Upon completion of the webinar, learners will be able to:

- **Identify** how nutrition impacts learning, behavior, speech, and brain function.
- **Describe** the possible role of various nutraceuticals to treat Autism Spectrum Disorder.
- **Explain** the role of the SLP, OT, nurse, pharmacist, MD and other health professionals in nutrition interventions.

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## Autism: Nutrition Makes a Difference

- What is autism spectrum disorder (ASD)
- ASD – nutrition connection
- Nutraceuticals to treat ASD
- Special elimination diets
- Nutrition therapy and the registered dietitian nutritionist (RDN)
- Role of the interdisciplinary team



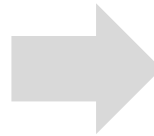
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## Autism Spectrum Disorder (ASD)



### Once diagnosed separately:

- Autistic disorder
- Asperger's syndrome
- Pervasive developmental disorder not otherwise specified



### Revised Diagnosis:

Autism spectrum disorder

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorder. 5th ed. Washington, DC: American Psychiatric Publishing; 2013.

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## Autism Spectrum Disorder



### Lifelong developmental disorder

- Diagnostic criteria:
  - Deficits in social communication and interaction
  - Repetitive patterns of behavior, interest, or activities



Repetitively stacking or lining up objects are associated with autism.

American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorder. 5th ed. Washington, DC: American Psychiatric Publishing; 2013.

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# Autism Spectrum Disorder



## Identified Prevalence of Autism Spectrum Disorder ADDM Network 2000–2012 • Combing Data from All Sites

### Prevalence of ASD in U.S:

- 1 in 68 children
- 1 in 42 boys
- 1 in 189 girls

Surveillance Year	Birth Year	Number of ADDM Sites Reporting	Prevalence per 1,000 Children (Range)	This is about 1 in X Children....
2000	1992	6	6.7 (4.5-9.9)	1 in 150
2002	1994	14	6.6 (3.3-10.6)	1 in 150
2004	1996	8	8.0 (4.6-9.8)	1 in 125
2006	1998	11	9.0 (4.2-12.1)	1 in 110
2008	2000	14	11.3 (4.8-21.2)	1 in 88
2010	2002	11	14.7 (5.7-21.9)	1 in 68
2012	2004	11	14.6 (8.2-24.6)	1 in 68

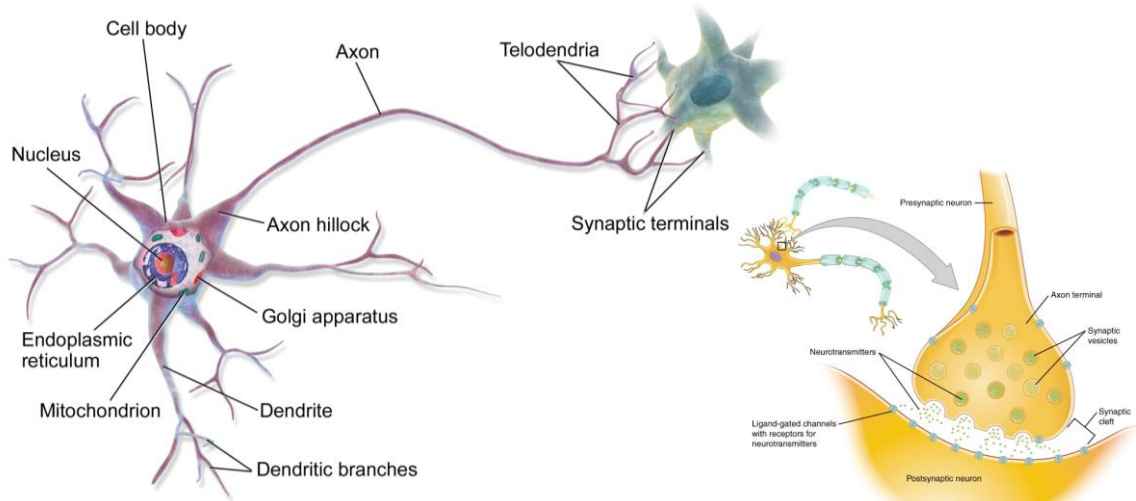
Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring Network, 2012 data.

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## ASD – Nutrition Connection



## ASD – Nutrition Connection



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## ASD – Nutrition Connection

- Support the function of the child's brain and body to perform at his or her optimum level.
- Maximize the child's brain function to enhance his or her response to other treatment approaches (SLP, OT, PT, behavior, medical, special education instruction, etc.).

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## ASD – Nutrition Connection



- ✓ Clean up the diet
- ✓ Incorporate healthy whole foods
- ✓ Treat feeding problems
- ✓ Treat GI problems
- ✓ Identify and treat food reactions
- ✓ Special diets
- ✓ Nutraceuticals

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## What are Nutraceuticals?



- The term “nutraceutical” is derived from the words “nutrition” and “pharmaceutical.”
- Defined as a food, dietary supplement, or medical food that has medical or health benefits.
- Depending on the ingredients, a product may be regulated as a drug, dietary supplement, food ingredient, or food.

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## Nutraceuticals



The use of **nutraceuticals in the treatment of ASD** is becoming recognized as a promising approach.

- Multi – V/M
- Methyl B-12
- Vitamin B-6
- Carnitine
- Omega-3 Fatty Acids

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## Multi-Vitamin/Mineral Supplement

### Benefits:

Reduction in autism symptoms and metabolic indicators.

- Sleep
- Hyperactivity
- Tantrums
- Receptive language

### Benefits:

Improvement in nutritional biomarkers.

- Biotin
- Vitamin K

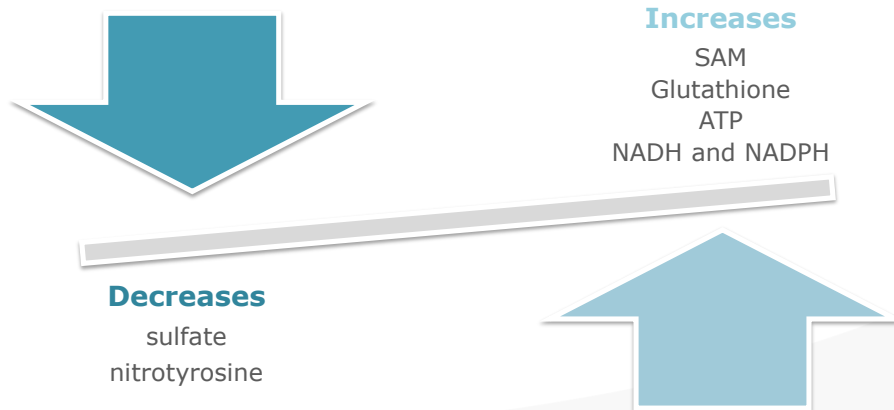


## Multi-Vitamin/Mineral Supplement



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**Benefits:** Significant improvements  
in biomarkers for metabolic status



Adams. 2011

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## Multi-Vitamin/ Mineral Supplement

### Summary

**Research data supports** that a vitamin/mineral supplement can improve or normalize nutritional and metabolic problems, and result in significant improvements in symptoms of children with autism spectrum disorder.



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## How to get child to take a supplement?



1. Incorporate into behavior therapy program
2. Oral flo pill swallow cup
3. Negotiation
4. Learn to swallow capsules
5. Add to food/beverages



Strickland EL. 2009

## Vitamin B12



### Deficiency of Vitamin B12

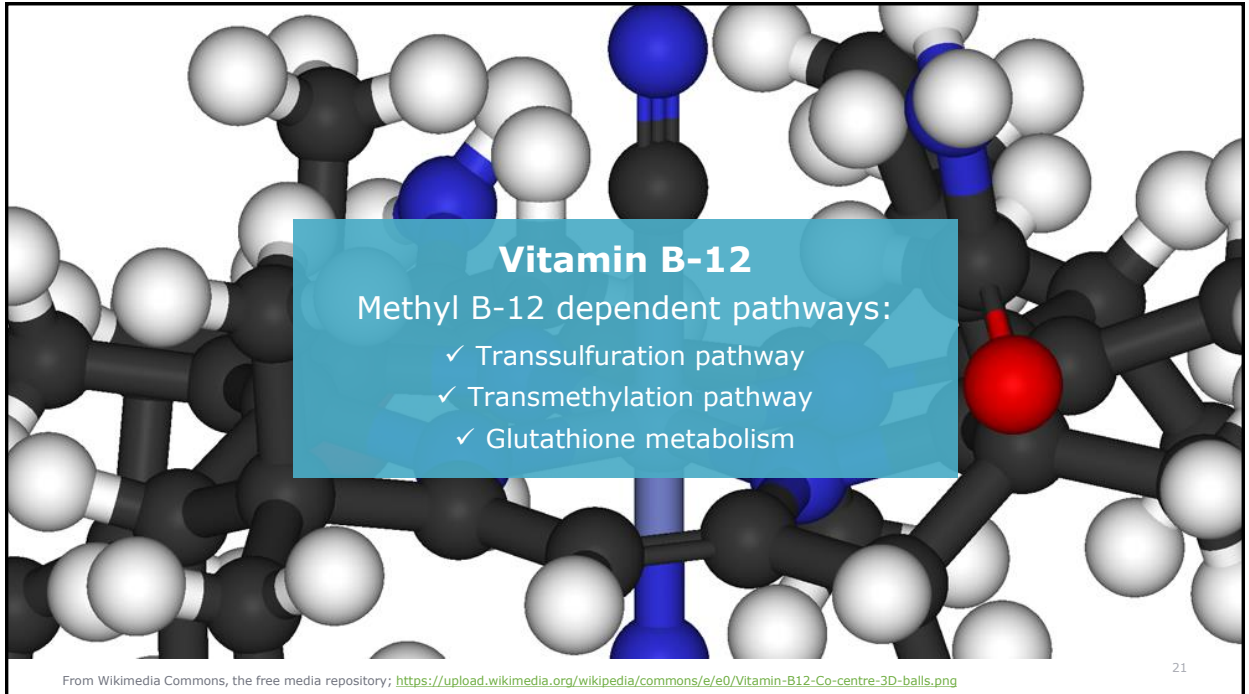
May result in neurologic damage beginning with an inability to produce myelin and progressing to degeneration of the axon and nerve head.

### Neurologic symptoms

- Depression
- Memory loss
- Personality changes
- Mood changes
- Ataxia
- Paresthesias
- Impaired cognitive performance

Natural Medicines Comprehensive Database: [www.naturaldata.com](http://www.naturaldata.com)

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## Vitamin B-12



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### Functions of glutathione:

- Antioxidant
  - Protects brain cells against oxidative stress
- Detoxifies heavy metals

## Methyl B-12 Research



- Children with ASD had decreased blood levels of:
  - Glutathione
  - Glutathione peroxidase
  - Methionine
  - Cysteine
- Increased levels of:
  - Oxidized glutathione (inactive)



Frustaci A. 2012

23

## Methyl B-12 Research



### **Injectable Dosage:**

Methyl B12: 75 mcg/kg  
 Folic acid: 400 mcg/kg  
 (twice per week)

### **Study results:**

- Increase in cysteine, cysteinylglycine, and glutathione.
- Increased glutathione redox ratio.

### **Researchers concluded:**

*It appears that a subgroup of children with ASD may have deficits in methylation and detoxification capacity, so methyl B-12 and folic acid may be a clinical benefit in some children with autism.*

James SJ. 2009

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## Methyl B-12 Research



### Injectable Dosage:

64.5 mcg/kg  
(Every three days for six weeks)

### Study results:

- Increased glutathione plasma levels
- Increased glutathione redox ratio

### Researchers concluded:

*Methyl B12 may alleviate symptoms of autism in a subgroup of children by reducing oxidative stress.*

Bertoglio K. 2010

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## Methyl B-12 Research



### Injectable Dosage:

75 mcg/kg  
(Every three days for eight weeks)

### Study results:

- Increased methionine plasma levels
- Decrease in S-adenosyl-I-homocysteine
- Clinician rated CGI-I score was significantly better.

### Researchers concluded:

*Methyl B12 improved clinician-rated symptoms of ASD and also improvements in measures of methionine metabolism and cellular methylation capacity.*

Hendren RL. 2016

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Before a trial-response of methyl B-12, parents should **consult** with a RDN and/or physician



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## Vitamin B-6 Functions



### Synthesis:

- Hemoglobin
- Histamine
- Serotonin
- Dopamine
- Epinephrine
- Norepinephrine
- GABA

### Cofactor:

- Glutathione production
- Metabolism of amino acids, glucose, and lipids
- Gene expression

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## Vitamin B-6 & Magnesium



Meta analysis of **18 studies** revealed that supplementation with high-dose vitamin B6 in combination with magnesium showed improvement in children with ASD.

Kidd PM, 2002

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## Vitamin B-6 and Magnesium



### **11 double-blind, placebo-controlled studies:**

- One study reported no significant improvement between the treatment and placebo groups.
- Other studies found that some children with ASD benefited with significant improvements in many areas of their ASD symptoms.

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## Vitamin B-6 and Magnesium



### Clinical symptom improvement:

- Social interactions
- Communication
- Stereotyped behavior
- Abnormal functioning

### Biological parameters improvement:

- Increased levels of intraerythrocyte magnesium (Erc-Mg) levels

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## Vitamin B6 and Magnesium Research



- Children with ASD compared to controls exhibited lower levels of Erc-Mg.
- Vitamin B-6 and magnesium improved clinical symptoms and Erc-Mg.
- When vitamin B-6 and magnesium was stopped, the ASD symptoms reappeared with a decrease in Erc-Mg level.

Mousain-Bosc M. 2006

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## Vitamin B-6 and Magnesium



The **dosages** in the studies for vitamin B-6 and magnesium varied greatly.

**B-6:** 75–1,000 mg/d  
**Mg:** 100–500 mg/d

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**B-6:** 18 mg/kg/d  
**Mg:** 10–15 mg/kg/d

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**B-6:** 0.6 mg/kg/d  
**Mg:** 6 mg/kg/d

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## Vitamin B-6 and Magnesium

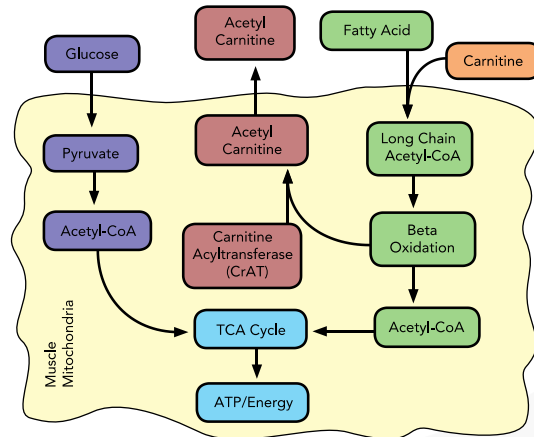


- Prior to a trial-response of vitamin B-6 and Mg, parents should seek assistance from their various providers – RDN, nurse, pharmacist, and physician.
  - Select an appropriate product
  - Determine the proper dosage
  - Conduct a safe trial-response
  - Assess whether treatment is effective

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## Carnitine Functions

- Energy production
  - Transports long-chain fatty acids into the mitochondria to produce ATP
- Waste removal
  - Transports waste out of the cell to prevent waste accumulation



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## Carnitine Research

- 50% of boys with ADHD had a positive response to L-carnitine supplements.
- Children with ASD had reduced levels of free and total serum carnitine.
- >17% of children with ASD had abnormal acylcarnitine levels consistent with abnormalities in fatty acid metabolism.

## Carnitine

- L-carnitine supplementation improved:
  - Hand muscle strength
  - Speech/language communication
  - Sociability
  - Cognitive function
  - Behavior

Geier, 2011

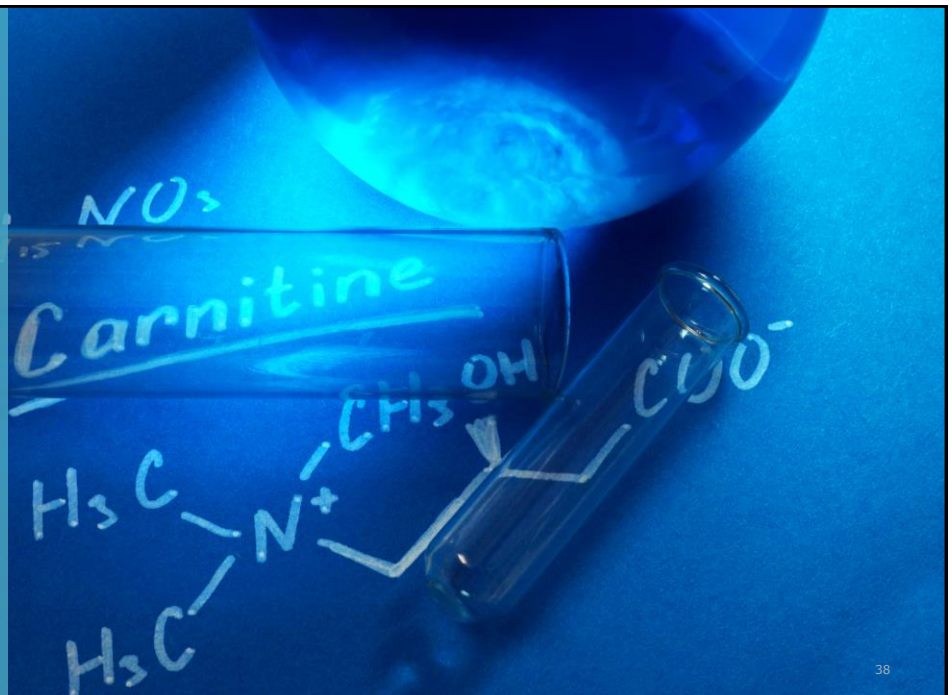
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### Carnitine

L-carnitine dosage:

50 mg/kg of body weight/day (three months)



Geier DA, 2011

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## Summary

Researchers indicate that **L-carnitine may be beneficial** in treating a subgroup of individuals with ASD, especially those with underlying acquired mitochondrial dysfunction or secondary carnitine deficiency.

Geier, 2011



## Polyunsaturated Fatty Acids



### Omega-6 Fatty Acids

Linoleic acid



Gamma-linoleic acid (GLA)



Arachidonic acid (AA)



Prostaglandin (PG1 & PG2)

### Omega-3 Fatty Acids

Alpha linolenic acid (ALA)



Eicosapentaenoic acid (EPA)



Docosahexaenoic (DHA)



Prostaglandin (PG1)

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## DHA & EPA



### Functions

- Major structural component of the brain
- Supports neurotransmission among brain cells
- Component of the retina of the eyes supporting visual acuity and vision processing
- Reduces tissue inflammation

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## Dietary Sources of EPA & DHA



### DHA + EPA (mg per ounce)

Salmon, Atlantic, farmed	608	Cod, Pacific	78
Herring, Pacific	602	Tuna, white (canned in oil)	69
Herring, Atlantic	521	Haddock	68
Salmon, Atlantic, wild	521	Catfish, wild	67
Tuna, fresh (blue fin)	426	Catfish, farmed	50
Mackerel, Atlantic	341	Cod, Atlantic	45
Trout, mixed species	265	Tuna, light (canned in oil)	36
Flounder	142	Tilapia	36
Halibut	132		

USDA National Nutrient Database for Standard Reference. <https://ndb.nal.usda.gov/ndb/>

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## EPA & DHA Supplements



### Sources of EPA & DHA

- Fish oil
- Krill oil
- Cod liver oil
- Algal oil

### Child Friendly Products

#### Coromega

- Omega-3 Squeeze 450 mg/1 tsp
- Omega-3 Gummies 30 mg/gummy

#### Nordic Naturals

- DHA Junior Liquid 840 mg/1 tsp
- DHA Junior Soft gels 50 mg/soft gel
- Omega-3 Gummies 34 mg/gummy
- Omega-3 Gummy Worm 51 mg/worm

#### Fortified Foods

Eggs, milk, soy milk, juice, yogurt, bread, margarine, pasta, peanut butter, and ....

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## Omega-3 Fatty Acids Deficiency





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- Total polyunsaturated fatty acids (PUFA) lower in autistic patients
- DHA and AA particularly decreased
- Pro-inflammatory metabolite prostaglandin E2 higher

Brigandi SA. 2015

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### Omega-3 Fatty Acids Research

**Omega-3 supplementation of children with ADHD reduced:**

- ✓ Emotional lability
- ✓ Oppositional behavior

Cooper RE. 2016

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## Omega-3 Fatty Acids



**Other improvements in children** with ASD supplemented with omega-3 included:

- Speech
- Eye contact
- Coordination
- Behavior
- Sensory function
- Hyperactivity
- Stereotypical behavior
- Social withdrawal

Amminger. 2007; Morris. 2009; Yui. 2012

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## Omega-3 Fatty Acids



### **Dosages used in research studies**

- DHA 700 mg + EPA 800 mg/day
- DHA + EPA: 580 mg/twice per day

Amminger. 2007; Bent. 2011

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## Recommendations for EPA & DHA Intake



Adequate Intakes	
Boys/girls 1–3 years:	70 mg
Boys/girls 4–8 years:	90 mg
Boys 9–13 years:	120 mg
Boys/men $\geq$ 14 years:	160 mg
Girls 9–13 years:	100 mg
Girls/women $\geq$ 14 years:	110 mg

Recommendations	
6–24 months:	DHA 10–12 mg/kg
2–4 years:	100–150 mg
4–6 years:	150–200 mg
6–10 years:	200–250 mg

*\*Based on adequate intake as ALA  
(10% as EPA + DHA)*

Food and Nutrition Board of the National Academy of Medicine; Food & Food & Agriculture Organization of the United Nations

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### Omega-3 Fatty Acid Summary

Key omega-3 fatty acids required for brain development and function are lower in children with ASD. Supplementation with omega-3 fatty acids may be a useful intervention to the management of ASD.

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## Special Diets



- There are numerous special diets "*popular*" in the autism community.
- Most of these special diets are considered controversial and not supported by the medical community.
- It is critical that the child's diet is **NOT** overly and unnecessarily restricted.
- Before a trial response of any elimination diet, the family should consult with a knowledgeable RDN or knowledgeable physician.

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## Special Diets



### GFCF

- Gluten Free Casein Free

### SCD

- Specific Carbohydrate Diet

### GAPS

- Gut & Psychology Syndrome Diet

- Feingold
- Antifungal
- Rotation
- Ketogenic
- Low Oxalate
- Low Phenol
- Body Ecology

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## Gluten Free Casein Free Diet



- The GFCF Diet is the single most common elimination diet recommended for children with autism.
- There is very little evidence-based scientific research that supports or refutes claims of the GFCF diet.

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## GFCF Diet and ASD Research



### Researchers concluded:

- GFCF diet was beneficial to children with GI symptoms, food allergies, and/or food sensitivities compared with children with none of these symptoms.
- Improvements reported in ASD behaviors, physiological symptoms, and social behaviors.

Pennesi CM. 2012

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## GFCF Diet and ASD Research



### Researchers concluded:

- GFCF diet may positively affect developmental outcome for some children diagnosed with ASD.
- Absence of a placebo condition, we are unable to disqualify potential effects from interventions outside of dietary changes.

Whiteley P. 2010

55

## GFCF Diet Research



### Research studies has been completed; no study results posted yet:

- A Study to Assess the Role of a GFCF Diet in the Dietary Management of Autism-Associated Gastrointestinal Disorders  
NCT01116388
- Diet and Behavior in Young Children With Autism  
NCT00090428
- Nutritional and Dietary Treatment Study for Children/Adults With Autism  
NCT02059577
- Pilot Study of Diet and Behavior in Children With Autism  
NCT01625299

Website: [www.clinicaltrials.gov](http://www.clinicaltrials.gov)

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## Summary

Current research on the GFCF diet for children with ASD suggest that some children may **positively respond** to the dietary intervention.

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## Nutrition Therapy

### Components of a Nutrition Assessment

- ✓ **A**nthropometrics
- ✓ **B**iochemical
- ✓ **C**linical
- ✓ **D**ietary
- ✓ **E**nvironmental
- ✓ **F**eeding

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## Nutrition Therapy



### Laboratory Tests

Complete blood count (CBC)
Comprehensive metabolic panel (CMP)
Blood lead and mercury
Thyroid (T3, T4, TSH)
Vitamin D
Serum carnitine
IgE RAST (wheat, milk, soy, egg, and peanuts)
IgE RAST (cat, dog, dust mite, dust, mold, cockroaches, grass, pollen, and trees)
Stool culture (fecal fat, bacteria, parasites, reducing substances)
Vitamin and minerals (based on meds, clinical history, and other factors)

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## Nutrition Therapy



- Nutrition assessment (ABCDEF)
- Recommend dietary changes
- Recommend nutritional supplements
- Treat nutritional deficiencies
- Heal the GI tract
- Treat feeding problems
- Treat food allergies/sensitivities/intolerances
- Refer to physician for diagnostic tests
- Refer to other therapists as needed
- Support parents in the decision process
- Incorporate nutrition services in IFSP and IEP

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## Registered Dietitian Nutritionist



### How to locate a RDN

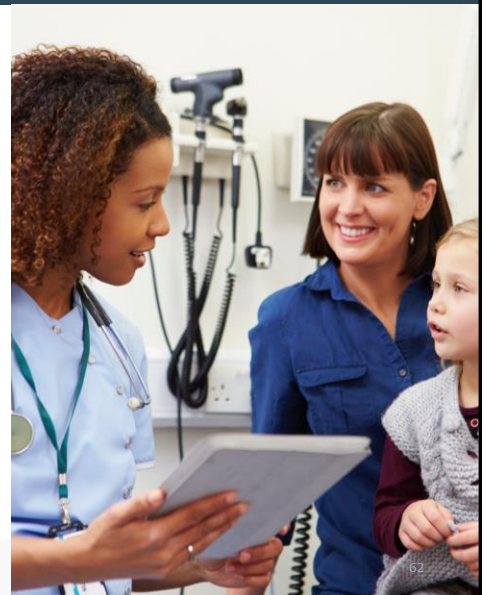
- Early Childhood Intervention Program (ECI)
- State Academies
- Academy of Nutrition and Dietetics  
[www.eatright.org](http://www.eatright.org) (click on "find an expert")
- Dietitians in Integrative and Functional Medicine  
[www.integrativeRD.org](http://www.integrativeRD.org) (click on "find an integrative RDN")
- Elizabeth Strickland Sauls, MS, RDN  
[www.ElizabethSauls.com](http://www.ElizabethSauls.com)

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## Role of the SLP, OT, PT, Nurses, Behavioral Specialist, etc.



- ✓ **Screen** child to identify a potential nutrition problem
- ✓ **Refer** to a RDN for nutrition therapy if needed
- ✓ **Inform** parents why nutrition is critical and role of the RDN
- ✓ **Educate** parents on basic nutrition information
- ✓ **Collect data** during the child's trial response of various nutritional interventions



## Role of the Pharmacist



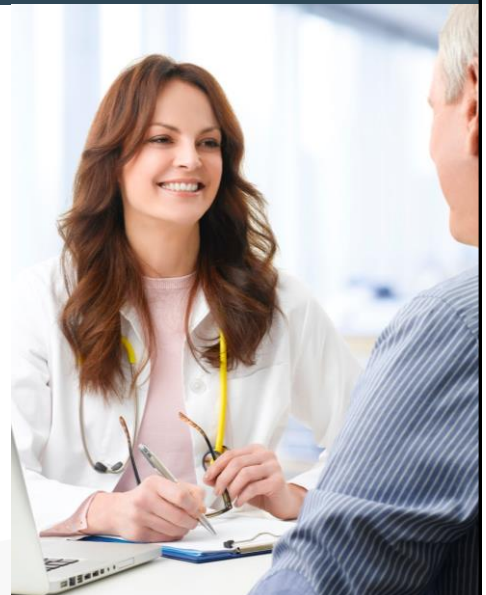
- **Assist** parents in selecting appropriate nutritional supplements
- **Inform** parents why nutrition is critical and role of the RDN
- **Compounding** of custom vitamin and mineral individualized order (or refer to compounding pharmacy)

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## Role of the Medical Doctor



- **Assess** diet in routine healthcare exams
- **Inform** parents why nutrition is critical and role of the RDN
- **Familiarize** self on the evidence on nutritional interventions to manage symptoms of ASD





## Autism ... Nutrition Makes a Difference



### SUMMARY

- Research investigating the role of nutraceuticals and diet to treat ASD continues to emerge.
- Evidence is very encouraging that nutrition interventions help treat ASD.
- The RDN and the entire interprofessional team have an important role to ensure nutrition is included in the child's treatment program.

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