

What To Know About Diet and MS

CAN DO
MULTIPLE SCLEROSIS

WEBINAR 
WEDNESDAYS

THIS WEBINAR IS
SPONSORED BY:



SEPTEMBER PROGRAMS

Thursday, September 14

JUMPSTART

Nutritious, Delicious, and Doable
Cooking with MS

Tuesday, September 19

YOUR QUESTIONS ANSWERED

Nutrition for You

Thursday, September 21

BLACK COMMUNITY MEETUP

Wednesday, September 27

MS MOVES MEETUP



[CANDO-MS.ORG](https://cando-ms.org)

Can Do MS is coming to Seattle!

Saturday, September 30th 9:00am-12:30 pm PT (8:30 am check-in)

**5 in-person attendees
will have the chance
to be gifted a
one-on-one
coaching session!**

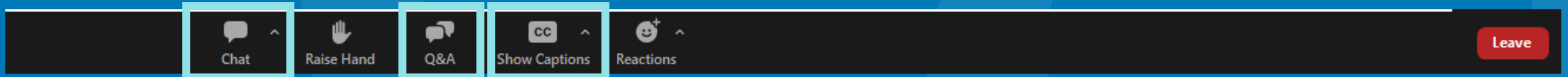


Register today! [Cando-ms.org](https://cando-ms.org)

CAN DO
MULTIPLE SCLEROSIS

How to Ask Questions During the Webinar

Type in your questions using the Questions Box



Provide comments and engage with the speakers and audience using the **Chat Box**

NEW! Closed captioning

YOUR SPEAKER



Ilana Katz Sand, MD

Neurologist

New York, NY

LEARNING OBJECTIVES



1

Understand what we know about diet and MS

2

Learn how MS symptoms impact eating and how what we eat can impact MS symptoms

3

Practical tips and strategies

Why Are We Interested in Diet?

People living with MS are asking!

- Desire to be proactive
- “Natural” approach to complement traditional DMT

Guidance should be based on evidence

Healthcare providers need to advocate for resources to help with access and implementation



Why Are We Interested in Diet?



Strong environmental component to MS + considerable variability in outcomes

- Continued search for modifiable factors that impact prognosis

There is increasing scientific evidence that diet can help manage MS symptoms and may act as a disease modifier

- Mechanistic studies
- Observational studies
- Early clinical trials

Potential Mechanisms for Dietary Effects



Indirect effects mediated by comorbidities associated with worse outcomes

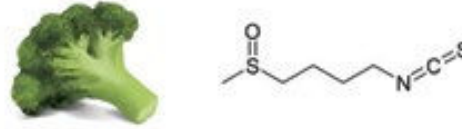
- Obesity
- Cholesterol levels
- Other vascular risk factors

Effects directly related to diet

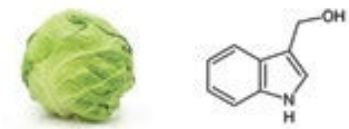
- Direct effects of dietary metabolites
- Effects mediated through the gut microbiota
 - Effects on microbial composition
 - Induction of metabolite production by gut microbiota

Foods Have Different Molecular Components With Varying Structures

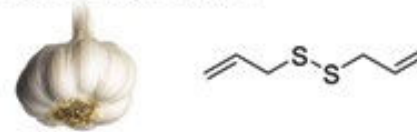
Broccoli *Sulphoraphane*



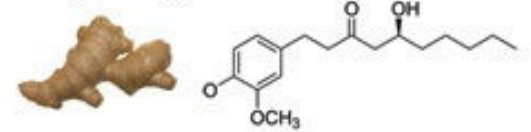
Cabbage *Indole-3carbinol*



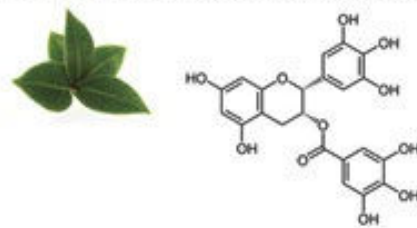
Garlic *Diallyl sulphide*



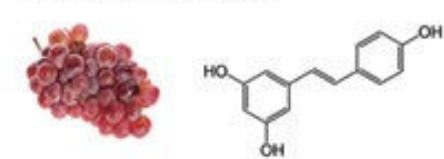
Ginger *Gingerol*



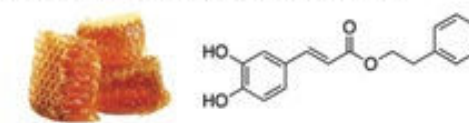
Green Tea *Epigallocatechin-3gallate*



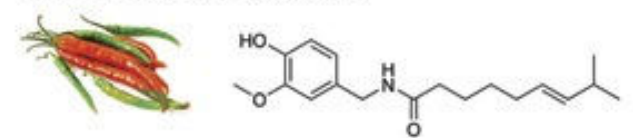
Grapes *Resveratrol*



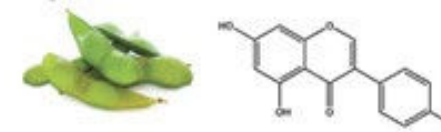
Honey *Caffeic acid phenethyl ester*



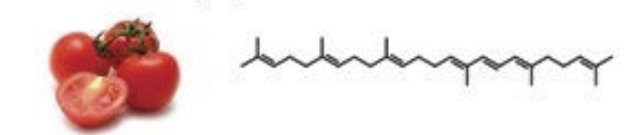
Chilli peppers *Capsaicin*



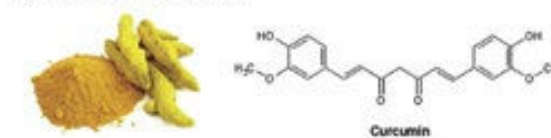
Soybeans *Genistein*



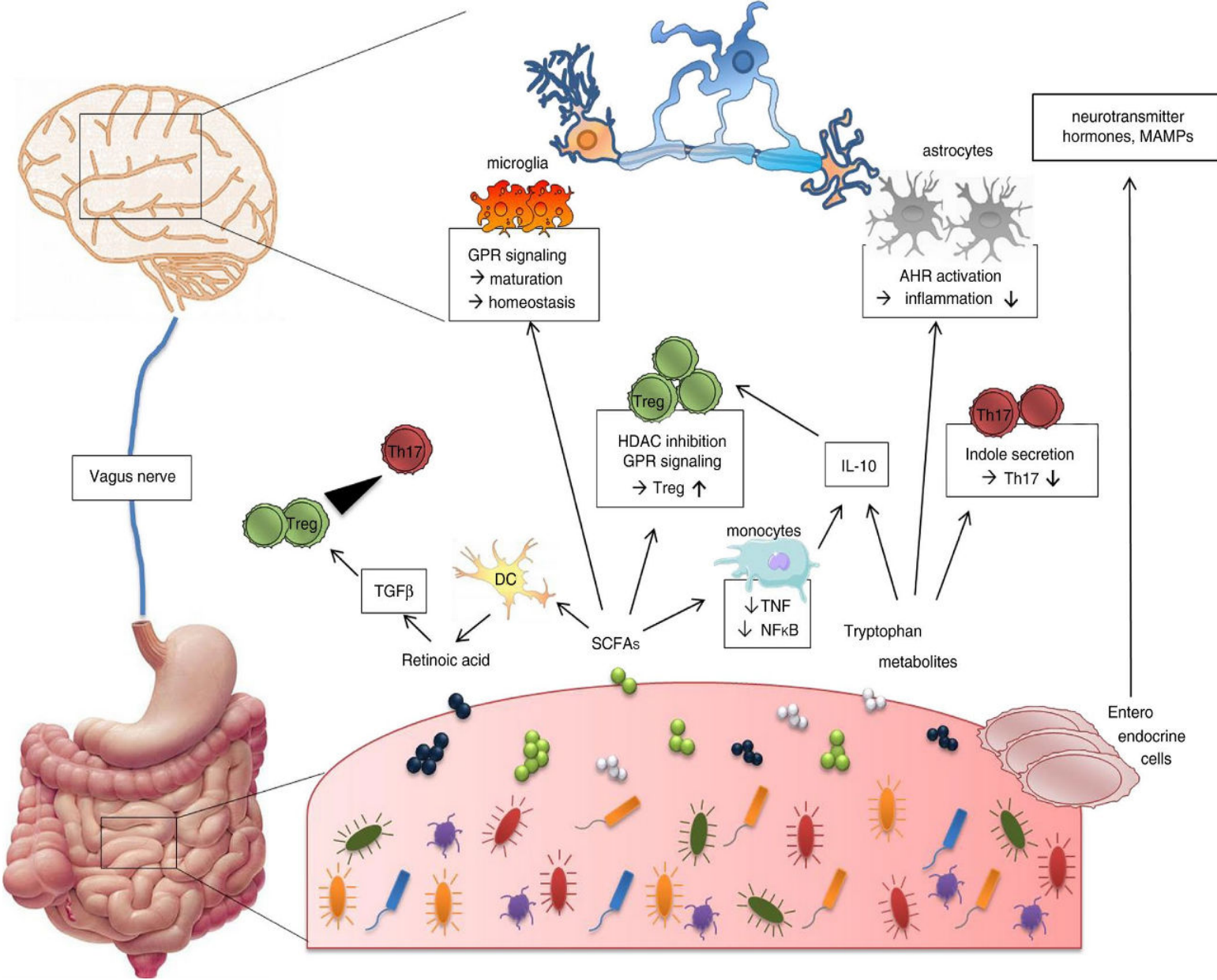
Tomatoes *Lycopene*



Tumeric *Curcumin*



Communication Pathways of the Gut-Brain Axis

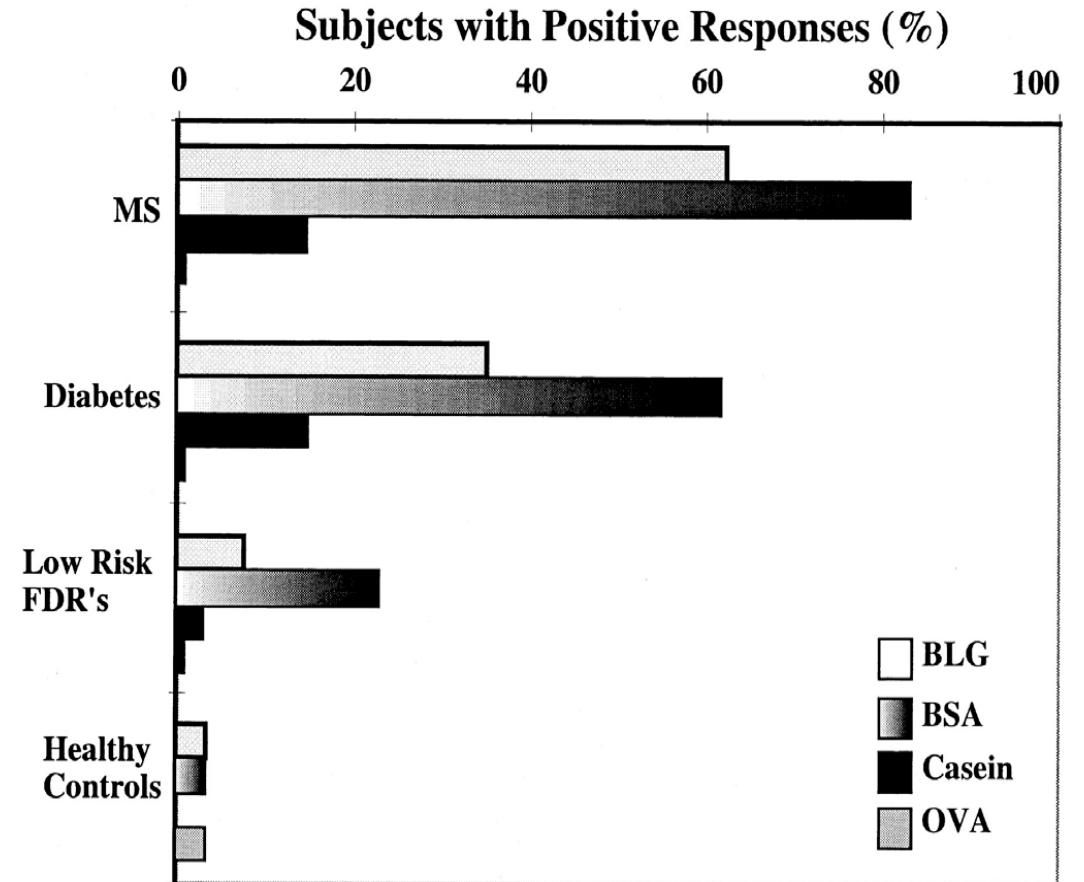


Evidence For Dietary Components in MS



Dairy

- A study of T cell reactivities in MS patients showed abnormally heightened responses to multiple milk antigens
- The milk protein butyrophilin has been implicated through antigenic mimicry with myelin Increased inflammation may also be mediated through the intestinal microbiome
- Registry studies with mixed results



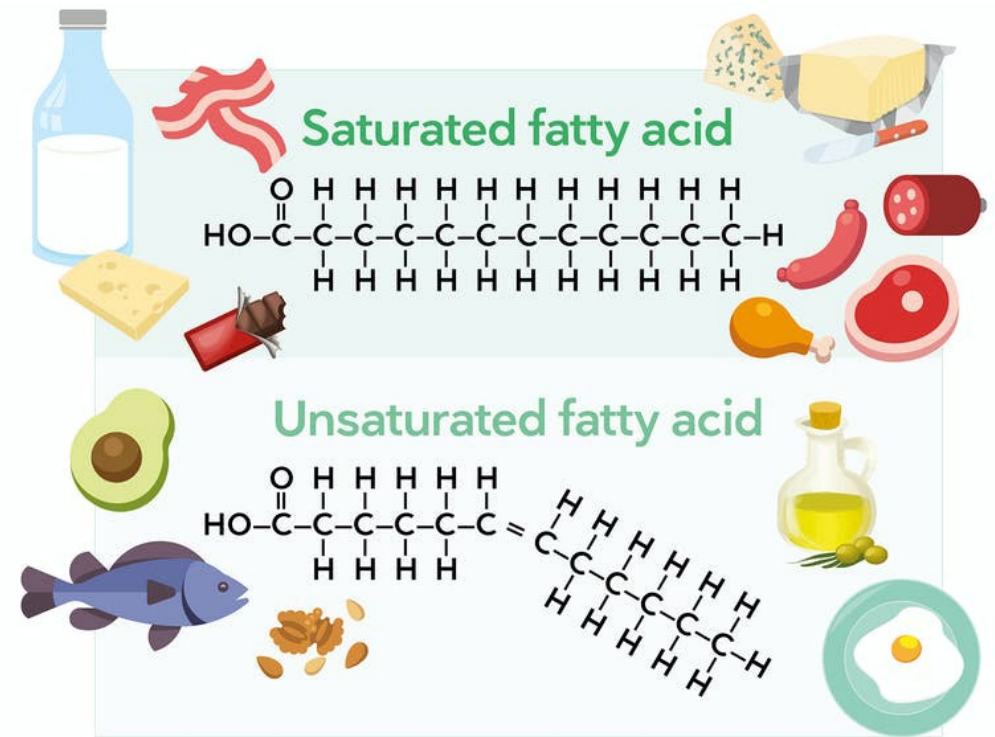
Fats Have Different Chemical Structures

Saturated fats: fatty acid chain is “saturated” with hydrogen atoms (no double bonds)

Polyunsaturated fats: fatty acid chain has multiple double bonds

- Of particular interest: **omega-3 fatty acids** (double bond at 3rd carbon of FA chain)

Monounsaturated fats: fatty acid chain has one double bond



Clinical Studies of Saturated Fat Intake In MS

Swank studies

- Observational studies regarding MS incidence
- **Interventional study of low saturated fat diet (Swank, Lancet 1990)**

Prospective pediatric MS study

- 219 children followed for an average of nearly 2 years
- For every 10% increase in energy intake from saturated fat the risk of relapse was increased 3.37 times

CLINICAL DETAILS		
	Good dieters	Poor dieters
<i>Minimum disability (grade 1)</i>		
Number (M:F)	23 (14:9)	6 (3:3)
Mean (SD) age (yr)	31.0 (8.4)	30.8 (7.3)
Mean (SD) duration of MS	31.0 (5.8)	25.9 (7.1)
Before trial	2.4 (2.1)	3.5 (2.4)
Diet period	28.6 (5.0)	23.8 (5.9)
Mean (SD) final neurological grade [change]	1.9 (2.2) [0.9]	5.3 (1.6) [4.3]
Deaths		
All causes	5 (21%)	5 (83%)
MS only	1 (5%)	4 (80%)
Mean lipid intake		
Fats	17.1 (2.4)	35.7 (11.5)
Oils	16.3 (4.3)	11.0 (2.2)
<i>Moderate disability (grade 2)</i>		
Number (M:F)	25 (9:16)	33 (16:17)
Mean (SD) age (yr)	31.8 (9.3)	34.4 (8.2)
Mean (SD) duration of MS (yr)	32.0 (7.2)	28.0 (9.0)
Before trial	4.9 (5.2)	5.3 (4.6)
Diet period	27.1 (6.8)	22.7 (8.0)
Mean (SD) final neurological grade [change]	3.6 (2.4) [1.6]	5.3 (1.3) [3.4]
Deaths		
All causes	10 (40%)	25 (76%)
MS only	8 (34%)	16 (66%)
Lipid intake		
Fats	15.4 (3.4)	46.1 (17.0)
Oils	18.2 (3.5)	10.2 (4.1)
<i>Severe disability (grades³⁻⁵, mean 3.21 [0.4])</i>		
Number (M:F)	24 (7:17)	33 (17:16)
Mean (SD) age (yr)	34.2 (10.2)	37.1 (7.5)
Mean (SD) duration of MS (yr)	33.8 (9.5)	29.9 (10.7)
Before trial	6.2 (7.10)	10.4 (7.8)
Diet period	27.6 (8.5)	19.5 (9.6)
Mean (SD) final neurological grade [change]	4.0 (1.8) [0.8]	5.6 (1.0) [2.4]
Deaths		
All causes	8 (33%)	28 (85%)
MS only	5 (21%)	25 (83%)
Lipid intake		
Fats	15.8 (2.6)	36.5 (10.5)
Oils	18.1 (7.9)	10.5 (6.9)

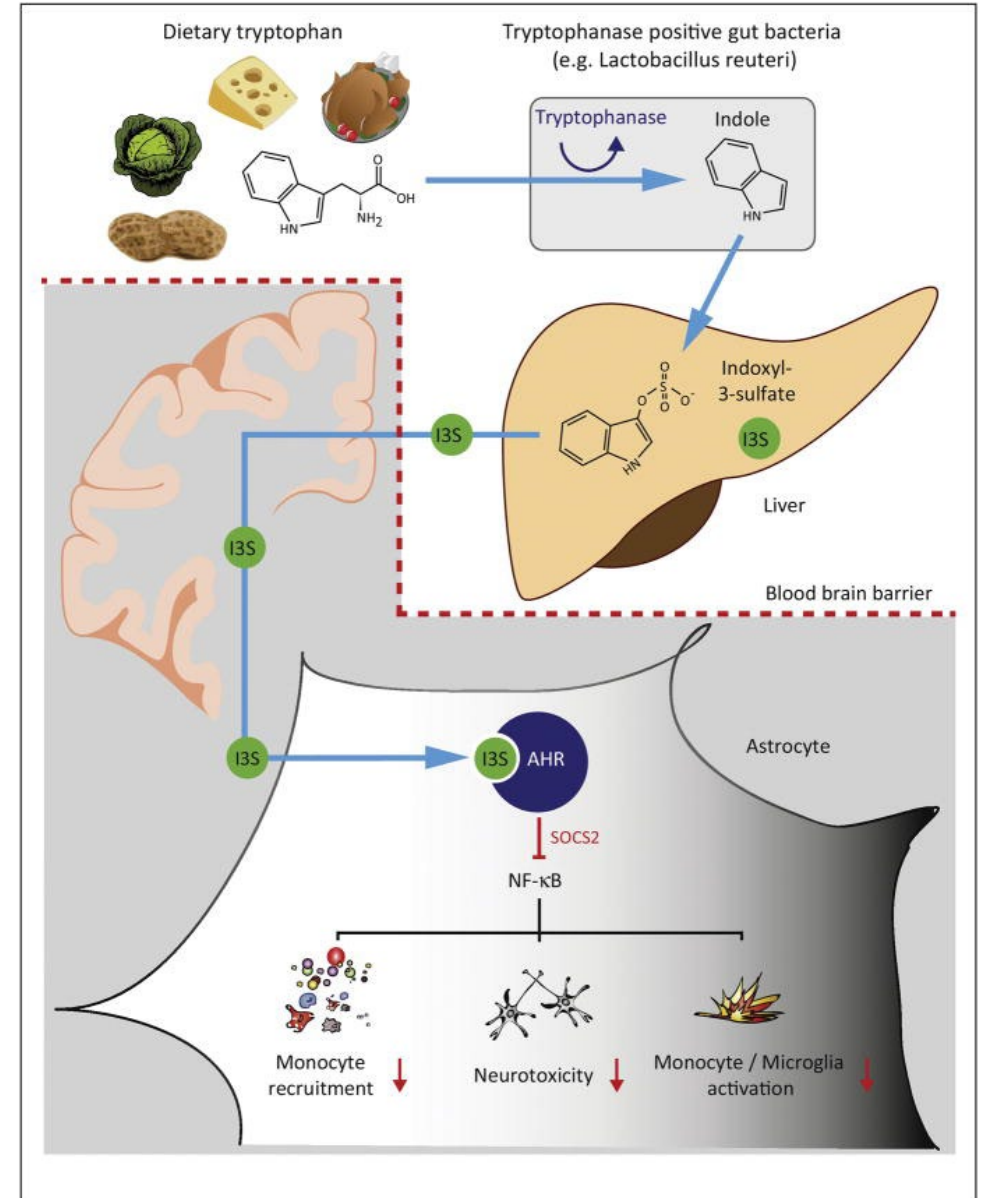
Polyunsaturated Fats



- Found in fish, walnuts, flax seeds
- Animal model effects on:
 - Immunomodulation
 - Neuroprotection
 - Remyelination and repair
- Epidemiologic studies in MS with conflicting results
 - Nurses Health studies suggest link between MS incidence and intake of alpha linolenic acid (ALA)
 - Several other studies demonstrate link between intake of fish and omega-3 fatty acids, but not clearly ALA
- Clinical trials of PUFA supplements with mixed results

Fruits and Vegetables

- Fiber intake: induction of production of short chain fatty acids by gut microbiota
- Flavonoids (brightly colored) effects on:
 - Immunomodulation
 - Neuroprotection/Repair
- Example: **tryptophan derived from the diet can cross the blood brain barrier** and have important effects inside the brain



Fruits and Vegetables (Continued...)

- Pediatric MS study: a one-cup equivalent increase in vegetable intake decreased the risk of relapse by 50% (HR 0.50, $p=0.024$)¹
- Registry-based study found link between higher intake of fruits and vegetables and patient-reported disability and disease activity²



Grains and Gluten



- Studies specifically evaluating the role of gluten, including both animal model studies and those in *MS* patients, have had mixed results¹
- NARCOMS study found an association between higher intake of whole grains and lower level of *MS*-related disability²
- Theoretically, high fiber content may be of benefit due to induction of SCFA production

Salt

- High salt intake induces the development of proinflammatory immune cells (T_H17)¹
- T_H17 cells that develop in a high salt environment demonstrate a more pathogenic phenotype and mice fed a high salt diet exhibit worse disease²
- **70 RRMS patients stratified by sodium intake**
 - Medium and high intake with higher relapse rates over 2 years
 - Also, with increased number of T2 lesions

Multiple sclerosis

RESEARCH PAPER

Sodium intake is associated with increased disease activity in multiple sclerosis

Mauricio F Farez,¹ Marcela P Fiol,¹ María I Gaitán,¹ Francisco J Quintana,² Jorge Correale¹

Table 2 Association between sodium intake and exacerbation rate in a regression analysis

	IRR	95% CI	p Value
<i>IRR of exacerbation (univariate model)</i>			
Sodium intake (g/day)			
<2	1 (baseline)	–	–
2–4.8	2.56	1.3 to 4.9	0.005
>4.8	3.37	1.5 to 9.55	0.001
<i>IRR of exacerbation (adjusted model)</i>			
Sodium intake (g/day)			
<2	1 (baseline)	–	–
2–4.8	2.75	1.3 to 5.8	0.008
>4.8	3.95	1.4 to 11.2	0.01
Age (1-year increment)	0.992	0.96 to 1.02	0.59
Gender (male)	1.09	0.49 to 2.42	0.82
Disease duration (1-year increment)	0.99	0.98 to 1.01	0.08
Vitamin D (1 ng increase)	1	0.96 to 1.04	0.85
Smoking (smoker)	1.13	0.56 to 2.28	0.73
BMI (1 unit increase)	0.97	0.87 to 1.07	0.58
Treatment (immunosuppressant vs immunomodulators/untreated)	1.46	0.79 to 2.73	0.22

BMI, body mass index; IRR, incidence rate ratio.

Additional Studies Have Not Confirmed These Effects



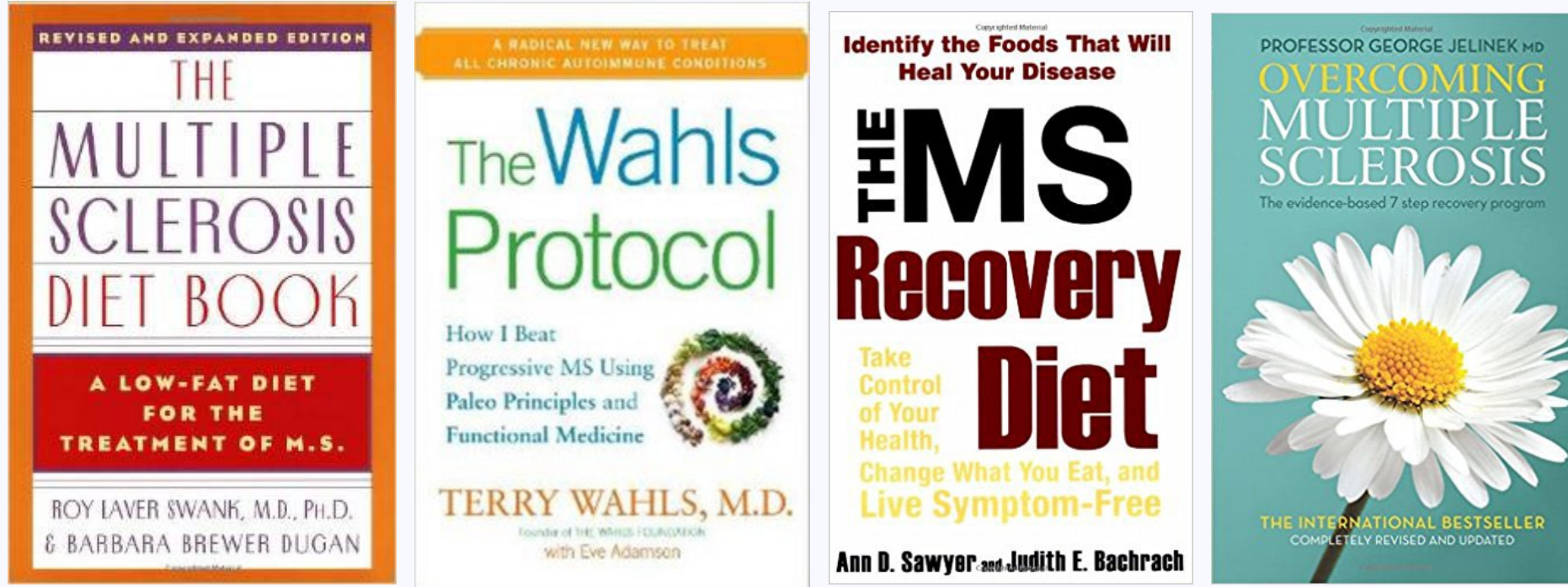
- Pediatric case control study of 170 MS patients and 331 controls using food frequency questionnaire (FFQ) to estimate dietary sodium found no link¹
- Pediatric study of 174 RRMS participants followed for 1.8 years found no link between relapse rates and sodium intake by FFQ²
- BENEFIT trial data³
 - Median of 14 urine samples per participant³ estimate dietary sodium
 - Over 400 patients in the trial, followed for 2 years then additional 3 year extension
 - No link between dietary sodium and clinical relapses or MRI lesions



Evidence For Dietary Patterns in MS



Many Popular MS Diets To Choose From, BUT...



- Each recommends something different: is one of them “**RIGHT?**”
- What is the **evidence?**

Overall Dietary Quality



- Within the HOLISM (Health Outcomes in a Sample of people with MS) study, 2047 participants completed the Diet Habits Questionnaire (DHQ)
 - **10-point increase on the DHQ** (higher scores indicating higher quality diet) was associated with a **30% less likelihood of higher disability level**.
 - Higher DHQ scores were also significantly associated with **better physical and mental health-related quality of life**
- North American Research Committee on MS (NARCOMS) Registry, 6989 participants completed a dietary screener questionnaire (DSQ)
 - Participants with **top diet quality scores were at 20% lower odds of higher disability scores** compared to those in the bottom range.

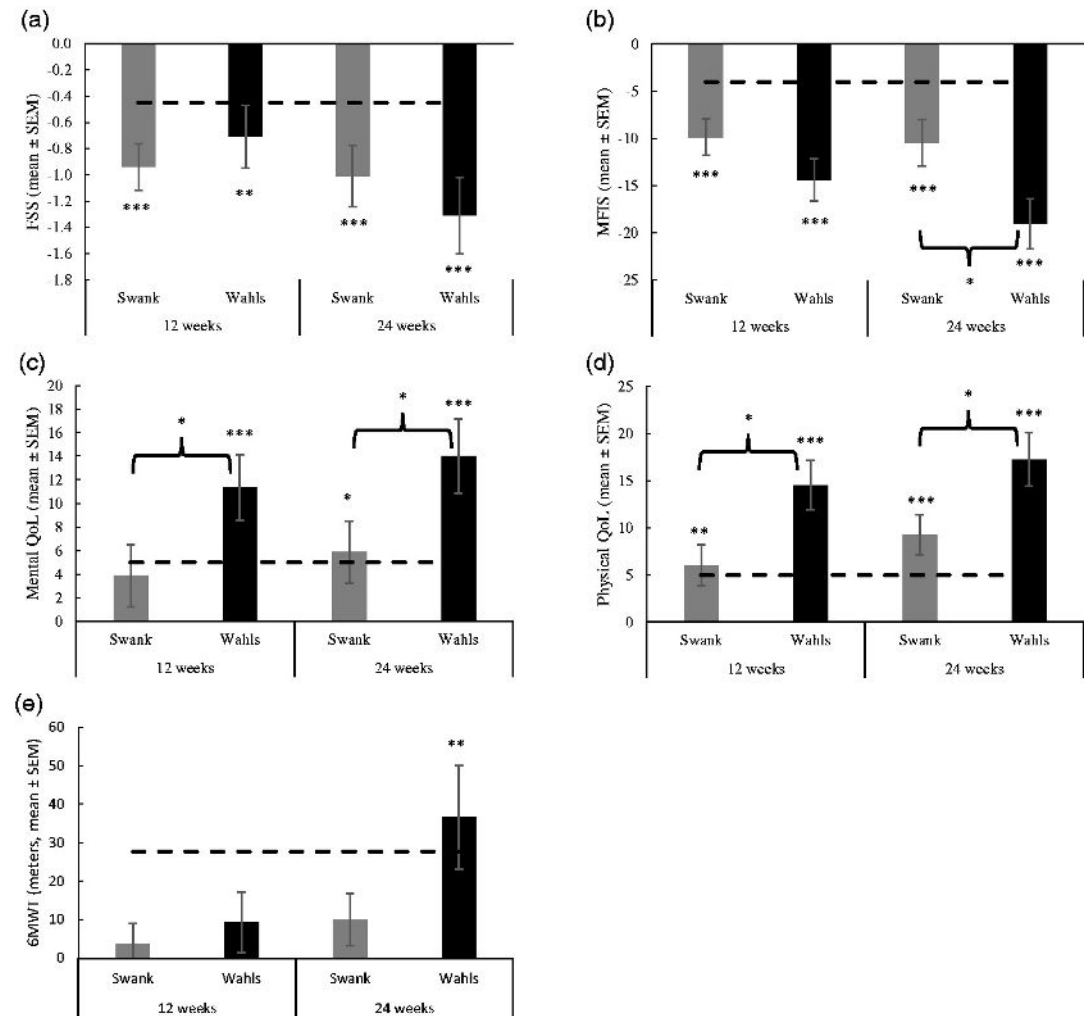
Dietary Patterns Under Investigation In MS



- Swank diet (low saturated fat)
- Modified paleolithic (Wahls protocol)
- McDougall diet (plant-based, very low fat)
- Caloric restriction/intermittent fasting
- Ketogenic diet
- Mediterranean/MIND diet

Modified Paleolithic (Wahls) Diet: WAVES Diet

- Swank diet vs. Paleolithic elimination (Wahls) diet
- **Paleolithic elimination diet:** include meat, fish, certain vegetables and fruits, eliminate gluten, casein, and lectins
- 87 participants with significant fatigue randomized 1:1, followed 24 weeks



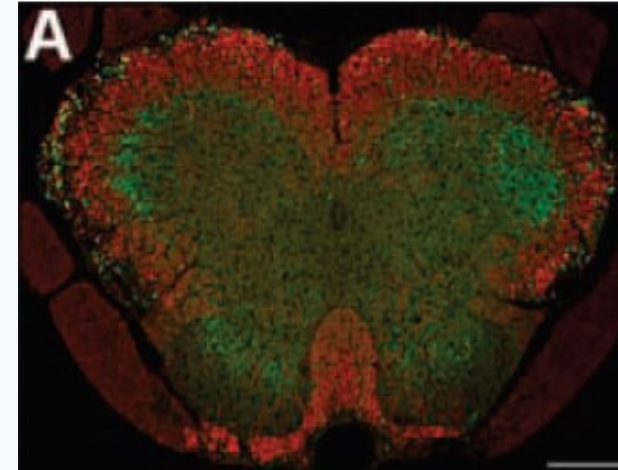
McDougall Diet



- Based on intake of **starchy plant-based foods**, with addition of non-starchy vegetables and fruits
 - 10% of energy intake from fats
 - No animal products or oils (including olive oil)
- One study randomized 61 MS patients to either follow the diet or participate as wait-list control x 1 year
 - Primary endpoint (new T2 lesions on MRI) not satisfied
 - No difference in clinical relapse rate
 - **Significant reduction in fatigue**, moderated by weight loss
- Current study aims to enroll just over 100 participants, focused on fatigue

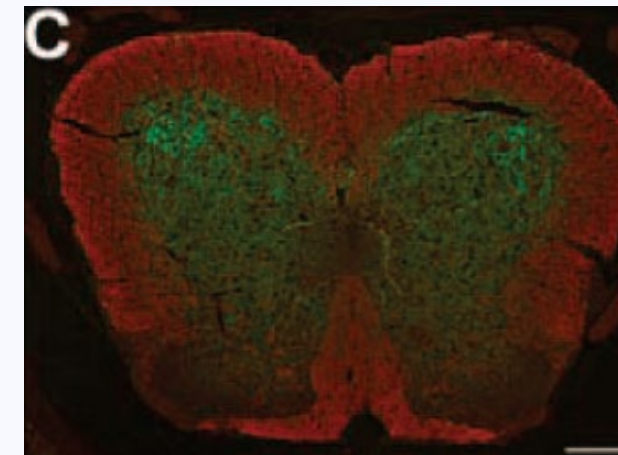
Caloric Restriction and Intermittent Fasting

- **Chronic caloric restriction** of benefit in animal models of MS
- **“Fasting mimicking diet”** with multiple benefits in animal models of MS
 - Immunomodulation
 - Oligodendrocyte protection
 - Promotion of oligodendrocyte differentiation and repair
- A initial study in MS patients shows that mild chronic caloric restriction and intermittent fasting
 - Are **relatively well-tolerated** without evidence of harm
 - Result in **weight loss**, improved **emotional** well-being



Control

Myelin integrity
in spinal cord in
mouse MS model



Caloric restriction

Ketogenic Diet



- **Shift metabolism** by using fatty acids as the primary energy source → increase in oxidative phosphorylation and production of **ketone bodies**
- Decrease in pro-inflammatory cytokines
- Ketogenic diet of benefit in animal models of MS
 - Suppressed expression of inflammatory cytokines and reactive oxygen species
 - Associated with improvements in memory and motor disability
- **Open-label** single arm studies of KD in MS showed that it was:
 - **Relatively well-tolerated**
 - Associated with **weight loss** and **improved body composition**
 - Resulted in reductions in **fatigue, depression, and disability**

Rationale For Pursuing Mediterranean-Style Diet Investigation



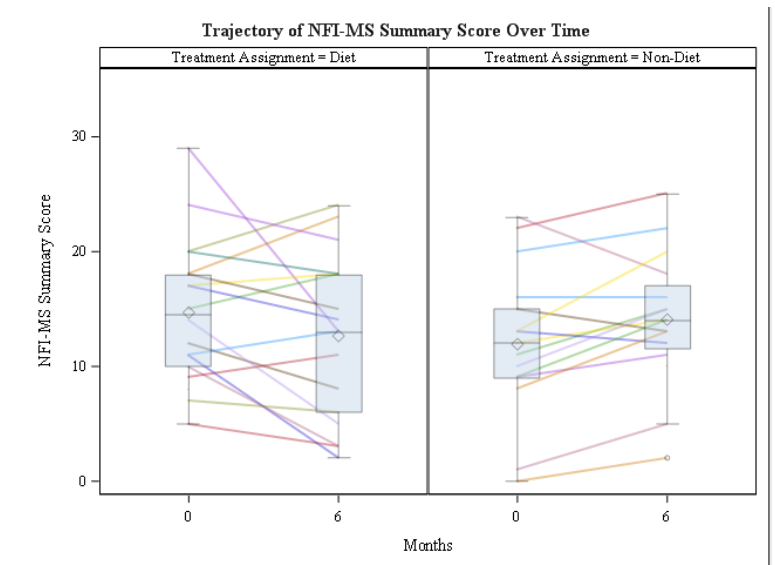
- General health benefits are well-established
- Data in cognitive aging
- Combines limited available information about dietary components that might be important
- Reasonable to aim for long-term adherence
 - Lifestyle change rather than a “diet”
 - Budget friendly
 - Household involvement

Randomized-controlled trial of a modified Mediterranean dietary program for multiple sclerosis: A pilot study



Ilana Katz Sand^{a,*}, Emma K. T. Benn^b, Michelle Fabian^a, Kathryn C. Fitzgerald^c, Elise Digga^a, Richa Deshpande^b, Aaron Miller^a, Samantha Gallo^d, Lenore Arab^e

- Recruitment and adherence went great!
- Dietary intervention participants lost a small amount of weight (approximately one pound per month)
- There was a benefit seen in the intervention group compared to the non-intervention group with respect to:
 - Fatigue
 - Impact of MS symptoms on daily life (MSIS-29)
 - Disability score



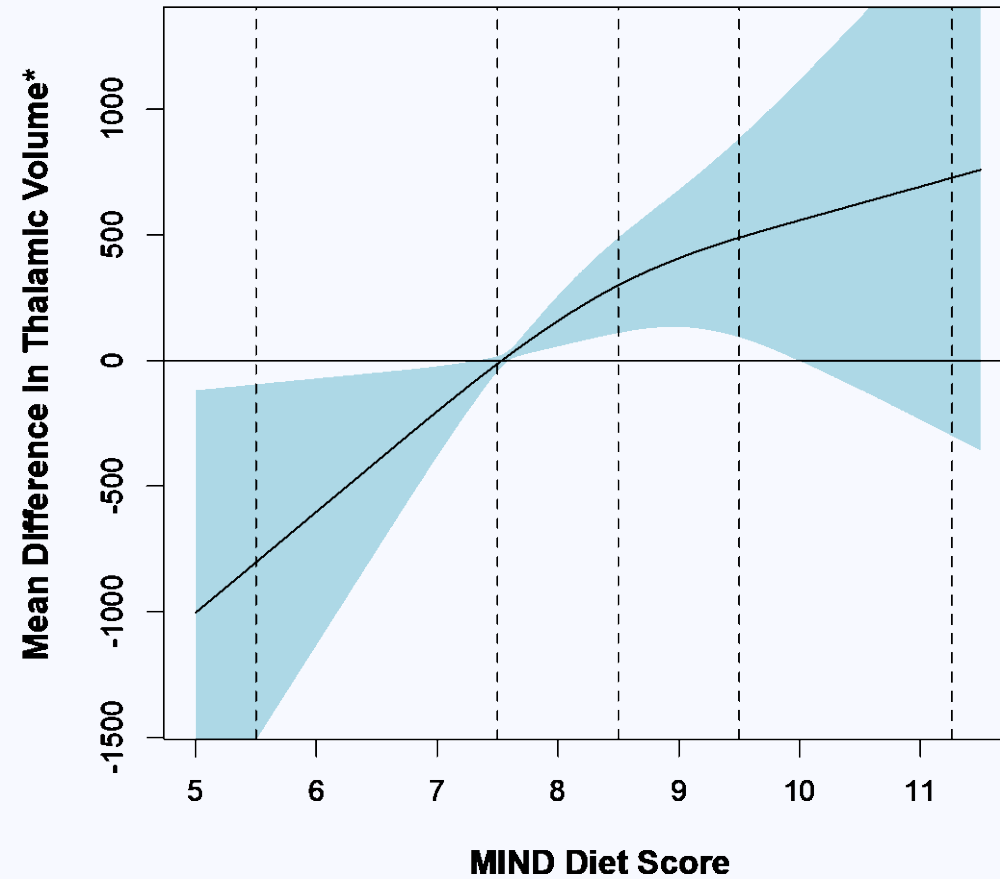
Mind Diet: Mediterranean-Dash Intervention for Neurodegenerative Delay

MIND diet component servings and scoring

	0	0.5	1
Green Leafy Vegetables ^a	≤2 servings/wk	> 2 to <6/wk	≥6 servings/wk
Other Vegetables ^b	<5 serving/wk	5 – <7 wk	≥1 serving/day
Berries ^c	<1 serving/wk	1 /wk	≥2 servings/wk
Nuts	<1/mo	1/mo – <5/wk	≥5 servings/wk
Olive Oil	Not primary oil		Primary oil used
Butter, Margarine	>2 T/d	1–2 /d	<1 T/d
Cheese	7+ servings/wk	1–6 /wk	< 1 serving/wk
Whole Grains	<1 serving/d	1–2 /d	≥3 servings/d
Fish (not fried) ^d	Rarely	1–3 /mo	≥1 meals/wk
Beans ^e	<1 meal/wk	1–3/wk	>3 meals/wk
Poultry (not fried) ^f	<1 meal/wk	1 /wk	≥2 meals/wk
Red Meat and products ^g	7+ meals/wk	4–6 /wk	< 4 meals/wk
Fast Fried Foods ^h	4+ times/wk	1–3 /wk	<1 time/wk
Pastries & Sweets ⁱ	7+ servings/wk	5 –6 /wk	<5 servings/wk
Wine	>1 glass/d or never	1/mo – 6/wk	1 glass/d
TOTAL SCORE			15

- Scored based on brain “healthy” and “unhealthy” foods
- Literature demonstrating slowing in cognitive decline with aging and in progression of Parkinson’s disease
- We hypothesized a potential benefit on neurodegeneration in MS, in addition to potential immunomodulatory benefits

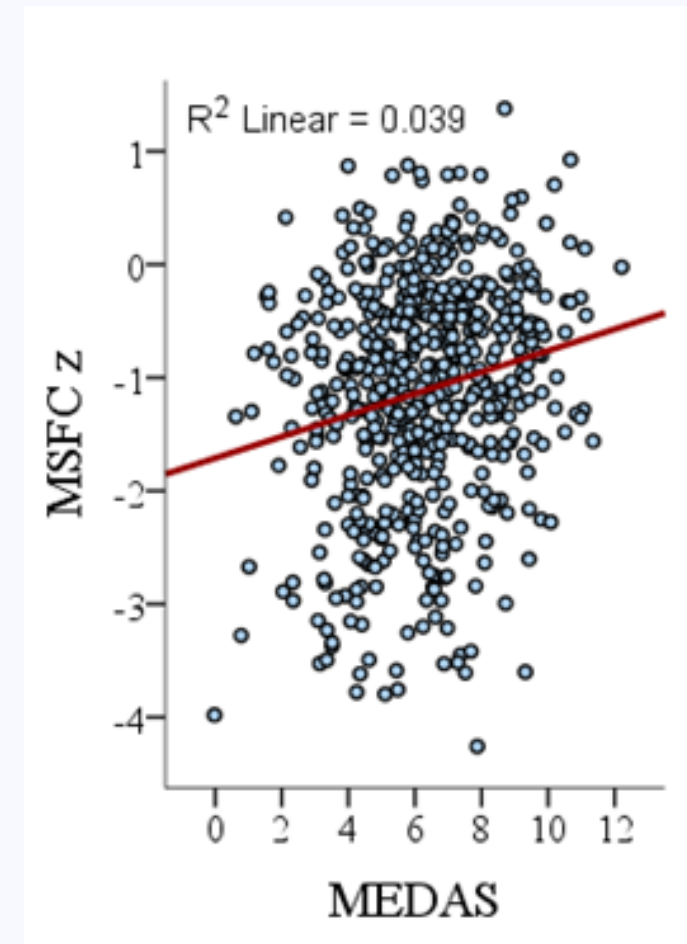
Association Between MIND Diet Score and Thalamic Volume in MS



Primary Analysis: MEDAS Score Predicts MSFC

Multiple Regression Adjusting for All Demographic and Health-Related Covariates

Predictor	B	95% CI		β	p
Constant	-1.655	-2.368	-0.941		<0.001
AGE	-0.046	-0.054	-0.038	-0.43	<0.001
SEX	0.381	0.194	0.569	0.14	<0.001
RACE	0.422	0.209	0.634	0.16	<0.001
ETHN	0.151	-0.095	0.396	0.05	0.228
SES	0.017	0.012	0.022	0.26	<0.001
BMI	0.004	-0.011	0.020	0.02	0.570
MVPA	0.002	-0.002	0.006	0.04	0.235
SLEEP	-0.187	-0.358	-0.017	-0.08	0.032
HTN	0.212	-0.034	0.458	0.07	0.091
DM	-0.090	-0.531	0.350	-0.02	0.687
HLD	0.135	-0.099	0.368	0.04	0.258
SMOKE	-0.142	-0.327	0.043	-0.05	0.131
MEDAS	0.095	0.055	0.134	0.18	<0.001



Secondary Analysis: MSFC Components & PROs

Outcome	B	95% CI		β	p
MSFC	0.095	0.055	0.134	0.18	<0.001
SDMT	0.869	0.458	1.279	0.17	<0.001
NHPT	-0.392	-0.584	-0.199	-0.17	<0.001
T25FW	-0.077	-0.121	-0.033	-0.14	0.001
MSIS-20	-0.993	-1.609	-0.377	-0.13	0.002
FSS	-0.102	-0.170	-0.034	-0.13	0.003
MSWS	-1.312	-2.108	-0.516	-0.13	0.001
PDQ	-0.056	-0.091	-0.022	-0.13	0.001
HADS-D	-0.234	-0.362	-0.105	-0.15	<0.001
HADS-A	-0.190	-0.338	-0.042	-0.11	0.012

Primary Analysis: MEDAS Score Predicts Cognition

Multiple Regression Adjusting for All Demographic and Health-Related Covariates

Predictor	B	[95% CI]	β	P
(Constant)	-1.81	[-2.40, -1.22]		<0.001
AGE	-0.03	[-0.04, -0.02]	-0.37	<0.001
SEX (F)	0.37	[0.21, 0.52]	0.18	<0.001
RACE (W)	0.32	[0.13, 0.51]	0.16	0.001
ETHN (H/L)	0.35	[0.12, 0.58]	0.13	0.003
SES	0.02	[0.01, 0.02]	0.29	<0.001
BMI	0.01	[0.00, 0.02]	0.07	0.077
MVPA	0.00	[0.00, 0.00]	-0.03	0.477
SLEEP	0.04	[-0.10, 0.17]	0.02	0.622
HTN	0.15	[-0.06, 0.35]	0.06	0.157
DM	0.20	[-0.16, 0.55]	0.04	0.284
HLD	-0.08	[-0.27, 0.11]	-0.03	0.416
SMOKE	-0.03	[-0.18, 0.12]	-0.01	0.708
MEDAS	0.08	[0.05, 0.11]	0.20	<0.001

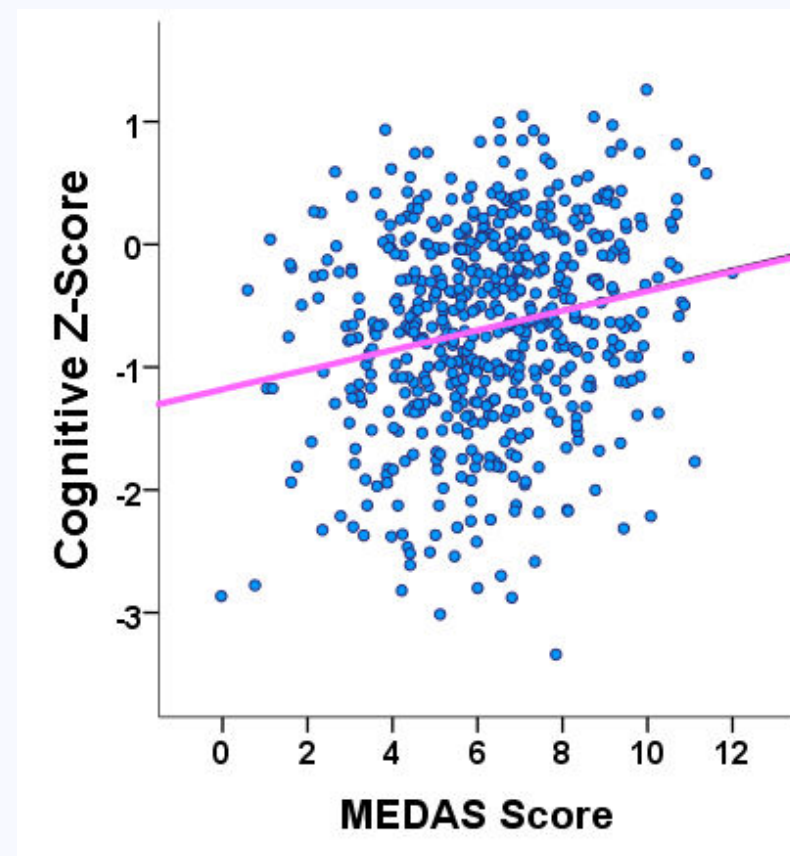


Figure by Dr. Sumowski

Current Recommendations: NMSS Wellness Research Working Group



- <https://www.nationalmssociety.org/Living-Well-With-MS/Diet-Exercise-Healthy-Behaviors/Diet-Nutrition>
- Prepare meals at home as much as possible
- Incorporate colorful fresh fruits and vegetables daily
- If you choose to eat grains, choose whole grains over refined grains
- Avoid/limit processed foods and added sugars as much as possible

Getting Started...



Aim to make positive changes that will become your lifestyle, rather than looking for a “diet”

Think about your goals

- Short-term
- Long-term

Consider how your symptoms impact implementation of ideas

- Fatigue: meal planning, energy conservation techniques
- Adaptive cooking tools

Include your household in your plans

- Children and partners need healthy habits too!

Getting Started...



Practice makes progress

- Strive for progress, not perfection

Ask for help:

- Talk to your primary care doctor
- Arrange a visit with a dietitian
- Ask if your MS Center has a staff member who is able to counsel about diet

Be kind to yourself! 

Tips for Energy Conservation



Plan, plan, plan!

- Set out meal plans at a time interval that is convenient for you in terms of groceries, for example many people use one week at a time
- Plan to do the bulk of preparation at times when you usually have more energy. This may be different for you on different days depending on the other activities you need to do that day.
- Consider dividing up the tasks required to prepare meals so that you don't have to do it all at once
- Include plans for everything you are going to eat, including snacks, so that you won't find yourself hungry and out somewhere where access to healthy food isn't easy or affordable

Consider a grocery delivery service so you don't use time and energy in the store

Utilize recipes that prioritize efficiency: "one pot" or "sheet pan" dinners minimize clean up

Tips for Energy Conservation



Prepare enough to allow for leftovers: tonight's dinner often makes a great lunch for tomorrow and preparing more of the same is less work than preparing another meal

Use the freezer and stock your pantry

- Prepare extra/leftovers that can be frozen and used on a day when you don't have the energy to prepare
- Frozen vegetables are often as high quality as fresh (or even higher)
- Cans of beans, nut butters, whole grain pastas are shelf-stable items that can be made into meals

Take family and friends up on offers to help

C. Olsten MS Patient Wellness Program



Key Take-Aways



1. There is strong scientific rationale for interest in the role of diet in *MS*
2. There is currently limited evidence for a role for particular dietary factors and patterns on *MS* outcomes
3. General principles of healthy eating are reasonable to recommend now; ask for help to get started!

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Our patients and their families!

THANK YOU!



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