

# MCNER Webinar Series



## Are All Plant-Based Diets (PBD) Created Equal? Comparing Impact on Health and Metabolic Syndrome

Wednesday, 9/25/24

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Moderator:

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Associate Director

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Villanova University M. Louise Fitzpatrick College of Nursing

# Finding Slides for Today's Webinar

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- Slides are posted at [villanova.edu/cope](http://villanova.edu/cope)
- From right menu → Webinars
- Go to 9/25/24 webinar presented by Maria Luz Fernandez, PhD

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  - Level 2 activity
  - Suggested CDR Performance Indicators: 7.2.3, 9.1.1, 9.1.5, 9.2.1
  - To receive CE credit, you must attend the entire program.

# Today's webinar objectives:

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- Understand the definitions of plant-based diets based on both food composition and availability of nutrients, and why they can be healthy or unhealthy.
- Explore a variety of plant-based diets using the latest clinical trials, with emphasis on impact on chronic disease and metabolic syndrome, and the role of eggs as part of healthy plant-based diet in metabolic syndrome.
- Discuss health implications of plant-based diet selection on guidance for patients.

# Disclosures



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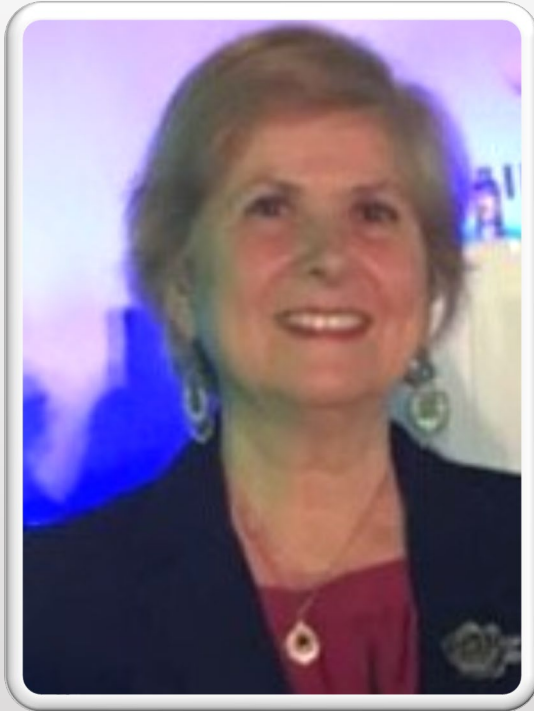
# Are All Plant-Based Diets (PBD) Created Equal? Comparing Impact on Health and Metabolic Syndrome

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Maria Luz Fernandez, PhD  
Professor Emerita  
University of Connecticut



# Are all Plant-based Diets Created Equal? Comparing Impact on Health and Metabolic syndrome



Maria Luz Fernandez, PhD

Professor Emerita, University of Connecticut

Instructional Designer/Precision Nutrition, University of Arizona

September 25, 2024



# Outline of the Presentation

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Definition of Plant-Based Diets and benefits against chronic disease

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Healthy vs unhealthy Plant-Based Diets

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Classification of Plant-Based diets according to food components

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Plant-Based diets and metabolic syndrome

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Eggs as a component of a Plant-Based Diet

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Summary and Discussion on which is the best diet to recommend

# Plant- Based Diet: Definition

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An eating pattern that focuses on plant food and includes minimal or no animal foods

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They have become very popular

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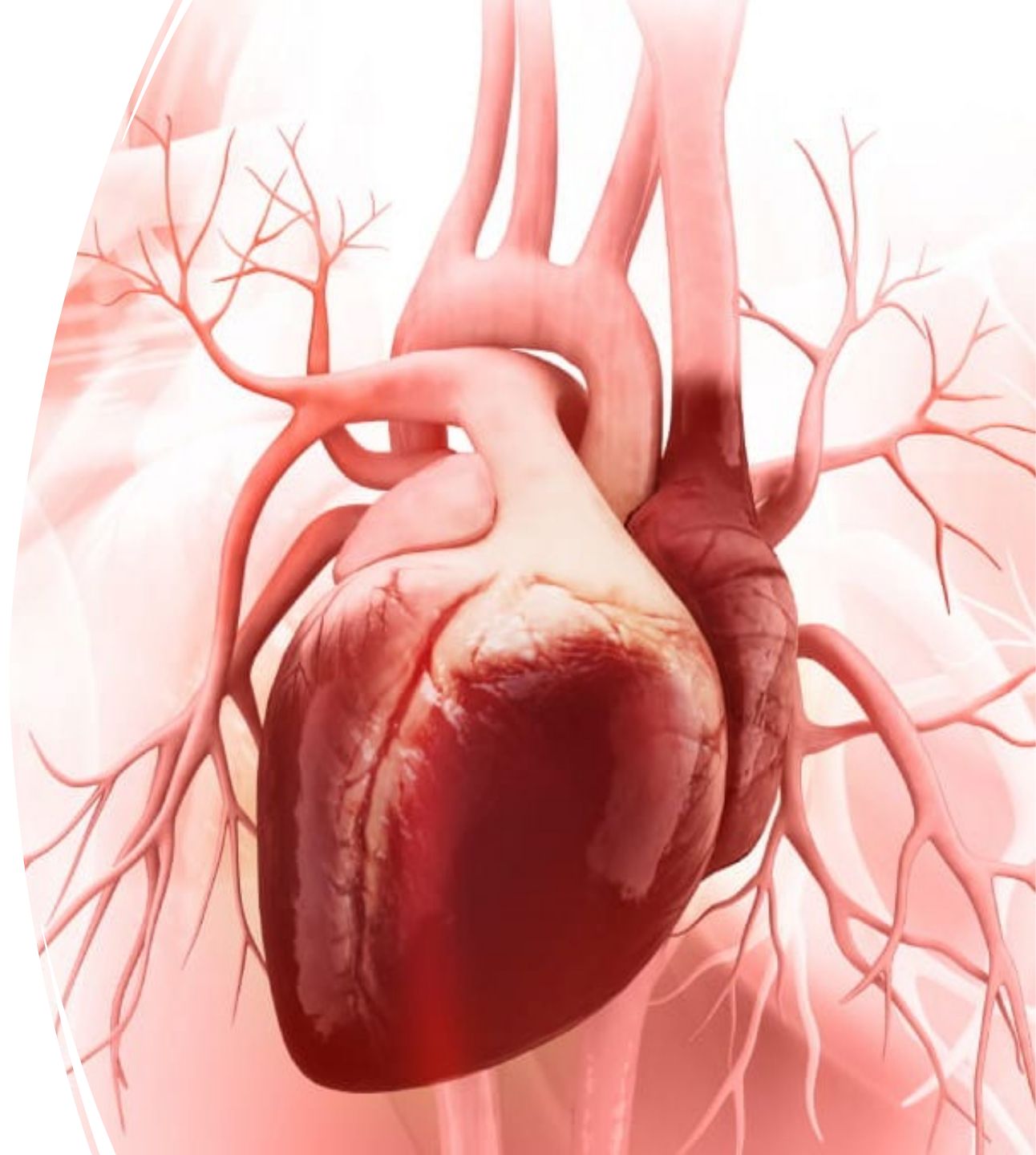
They are environmental healthy and cause less pollution

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They provide multiple health benefits in the whole body and in the brain<sup>1</sup>

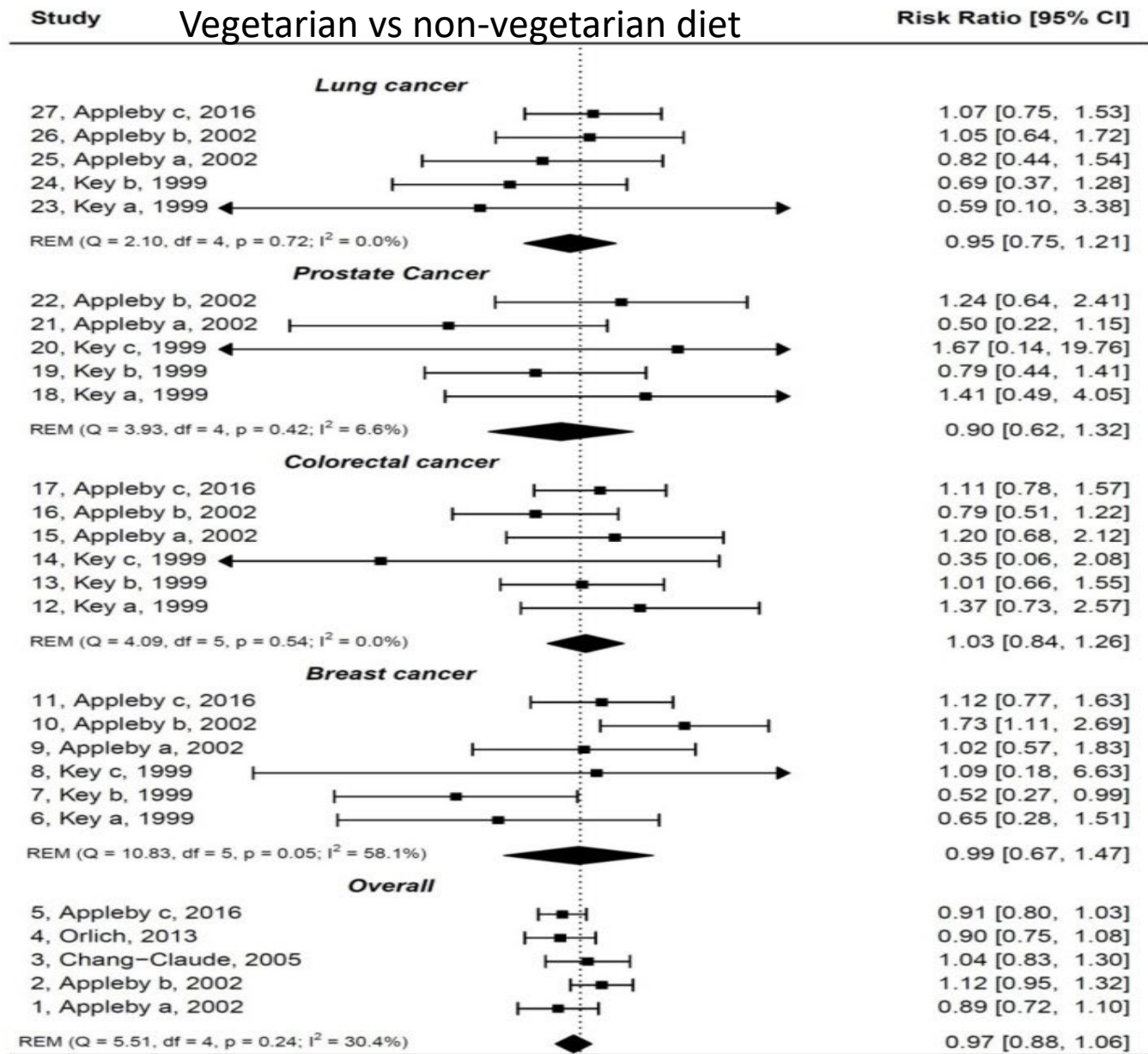
# Plant-based diets and Cardiovascular Disease

- Low-fat vegetarian diets show cessation and **reversal of atherosclerotic plaques**
- Risk factors for heart disease are less frequent in those who follow plant-based diets
- Meta analysis of 7 randomized trials concluded that compared to omnivorous diets, vegetarian diets result in **lower blood pressure**



# Plant-Based Diets and Cancer

- There is no sufficient evidence of plant-based dietary patterns and cancer prevention
- The American Association for Cancer Research shows that for every 10 g increase in fiber, survival after diagnoses increases by 13%
- High protein plant-based diets are recommended (beans, lentils, soybean)



# Plant-based diets and Diabetes

Consensus that plant-based diets are beneficial to protect vs diabetes

They promote weight loss and lower adiposity

Plant-based diets may reverse insulin resistance

Helpful for glucose control

# Plant-based diets and Diet Quality

Diet quality of plant-based diets varies extensively

It is directly associated to the dietary components that may protect against chronic disease

Plant-based diets have been classified into healthy and non-healthy

# Healthy Plant- based diets

They are rich in antioxidants  
(polyphenols, anthocyanins  
carotenoids)

Have sufficient concentrations of all  
vitamins and minerals

Are a good source of dietary fiber



# Is a plant-based diet healthful?



There is a way to calculate Plant –Based Diet indexes



Healthful plant-based diet index (hPBi) or unhealthy plant-based diet index (uPBi).



Foods are classified into healthful and unhealthy, and the index is related to the number of servings of these foods that are taken



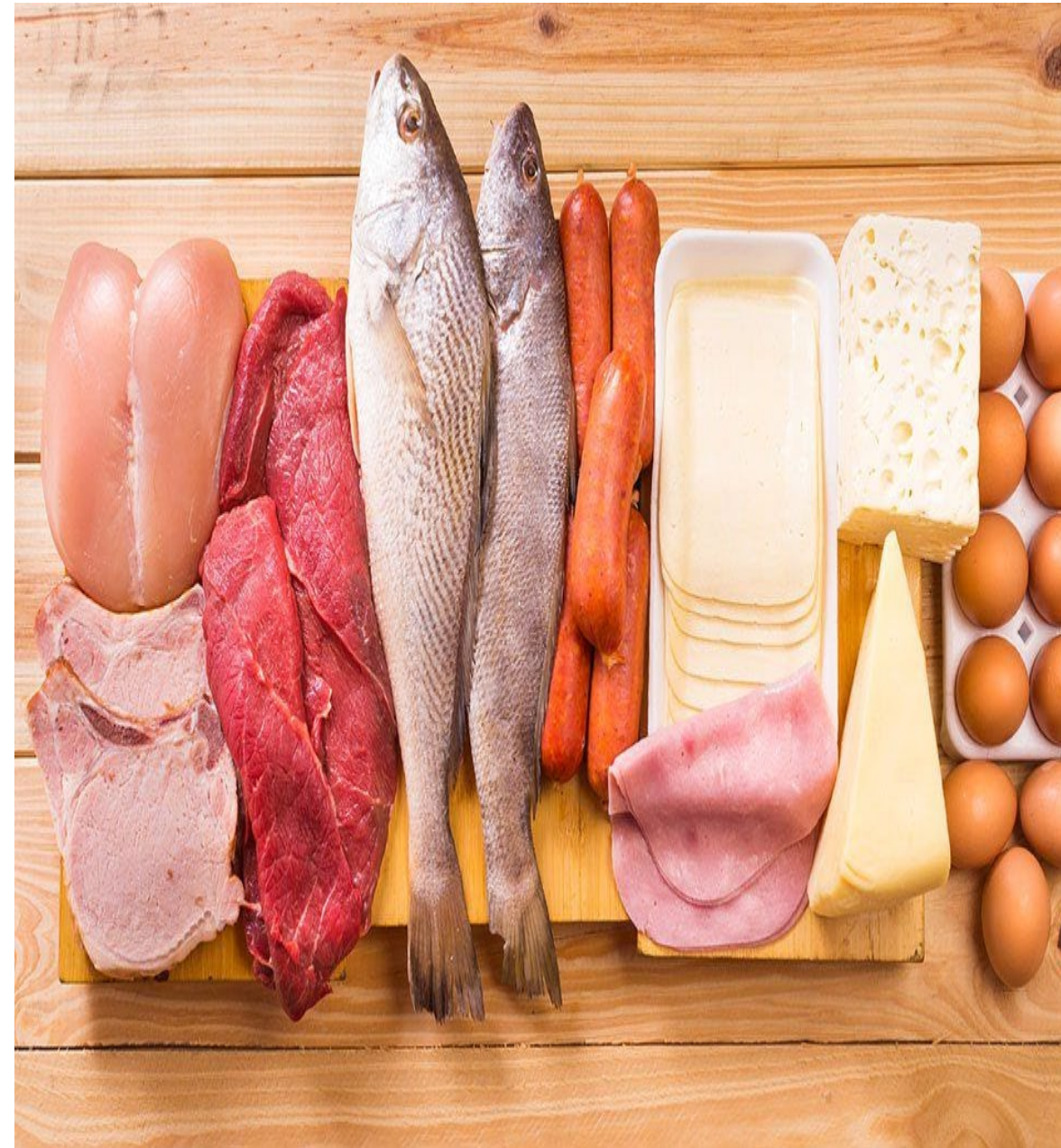
## Less Healthy

- Refined grains
- Potatoes
- Sweetened beverages
- Sweets and Desserts
- High-fat dairy



# Animal Foods

- Animal fat
- Dairy
- Egg
- Fish or Seafood
- Meat
- Miscellaneous animal-based products



## Classification of Plant- based diets<sup>1</sup>

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For example, the hPDi was found to be 30-48 for those classified into the first tertile, 53-55 for second tertile and 63-84 for highest tertile

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The higher the number the healthier the plant-based diet

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Higher hPDi associated with lower saturated fat, lower trans fat, more protein, more fiber, more folate and less energy<sup>1</sup>

<sup>1</sup>Satija et al. Plos One 2016, 13 (6) e1002039

# Nutrients associated with beneficial effects of plant-based diets

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**Dietary fiber:** Lowers plasma cholesterol and reduces the postprandial response to glucose

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**N-3 fatty acids:** reduce plasma triglycerides and inflammation

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**Polyphenols:** Have antioxidant properties, lower blood pressure, plasma glucose and improve abnormal lipid metabolism

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**Flavonoids:** Have anti-inflammatory properties and protect against hypertension and hyperglycemia

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**Carotenoids:** Protect against age-related macular degeneration and oxidative stress in liver and blood

# Classification of plant-based diet based on foods

- *Vegan:*
  - ✓ Exclusively Plant foods
- Vegetarian*
  - ✓ May include dairy, eggs or both
- Pescatarian*
  - ✓ Includes fish and seafood



# Vegan Diets

- Based on plants only and on foods made from plants
- It is a healthy diet high in fiber and lower in saturated fat
- Some deficiencies *do exist* B-12, N-3 fatty acids, Vitamin D and iron





# Documented risks of vegan diets

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High risk of stroke (*could be associated to the quality of the diet*)

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High risk of total and site-specific fractures (*Low Calcium*)

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Pregnant women should pay attention to:  
Vitamin D, Vitamin B-12, Calcium, DHA and iron

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Lack of those nutrients during pregnancy can lead to low birth weight or birth defects

# Lacto-ovo-vegetarian diets

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- Have been shown to increase HDL cholesterol
- Decrease fasting glucose
- Reduce inflammation
- Reduce Oxidative Stress

## Lacto-Ovo Vegetarian

diets exclude meat, fish, and poultry, but allow dairy products and eggs.

A single 1-oz serving of **cheese** contains 7-9 g of protein

A half cup of **cottage cheese** contains a whopping 15 g of protein

Just 8 oz of **yogurt** boasts up to 12 g of protein

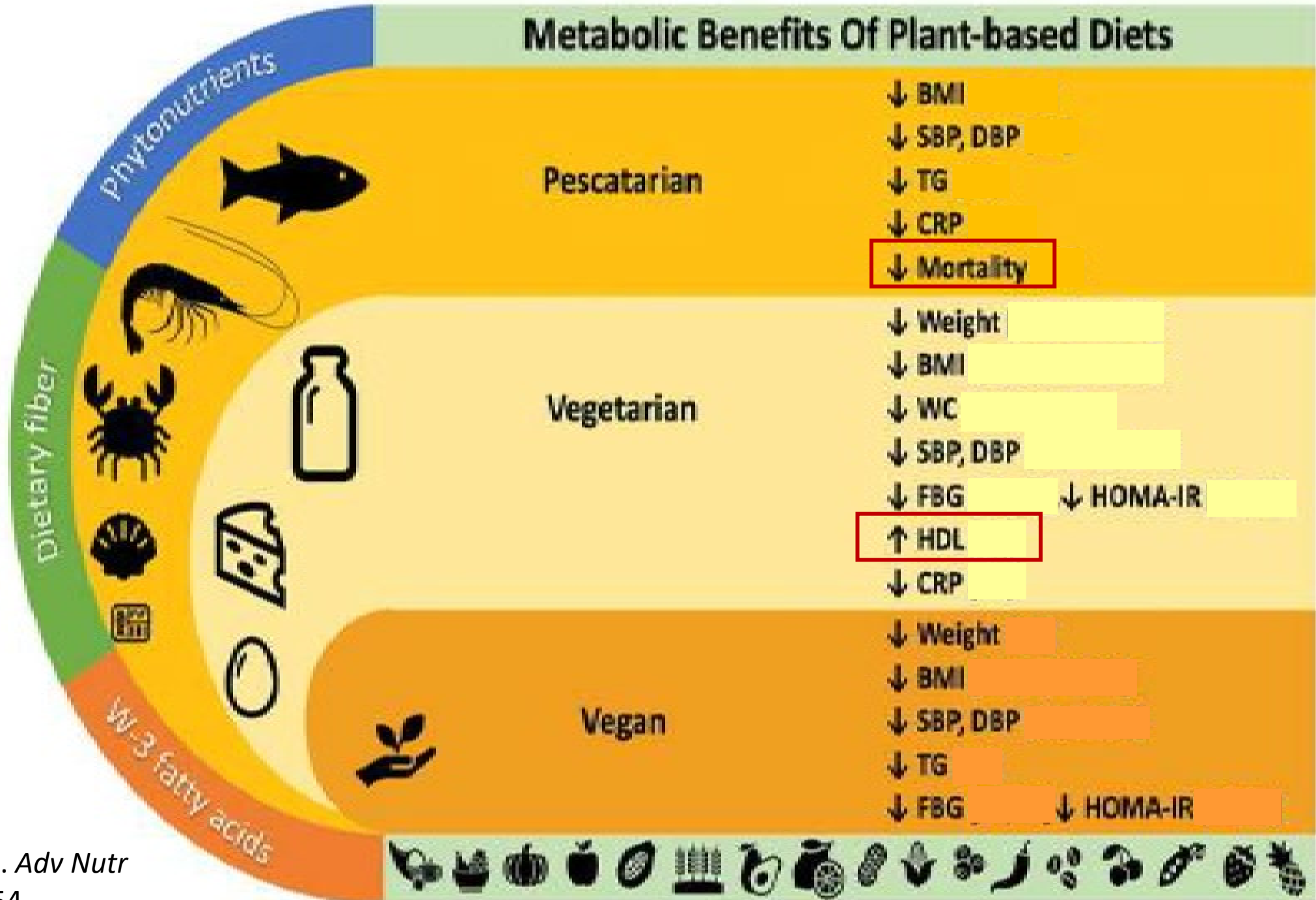
An **egg** contains approximately 6 g of protein

**Tofu** includes more than 2 g of protein per ounce

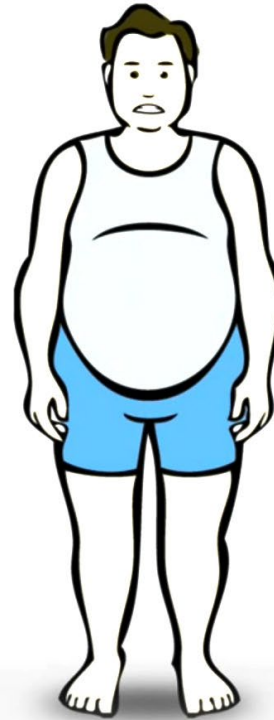
Data courtesy of the USDA



# Metabolic Benefits Of Plant-based Diets



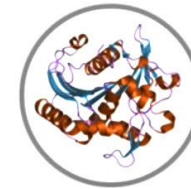
# Plant-Based Diets and Metabolic Syndrome



## THE METABOLIC SYNDROME



HEART DISEASE



LIPID PROBLEMS



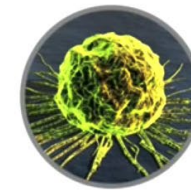
HYPERTENSION



TYPE 2 DIABETES



DEMENTIA



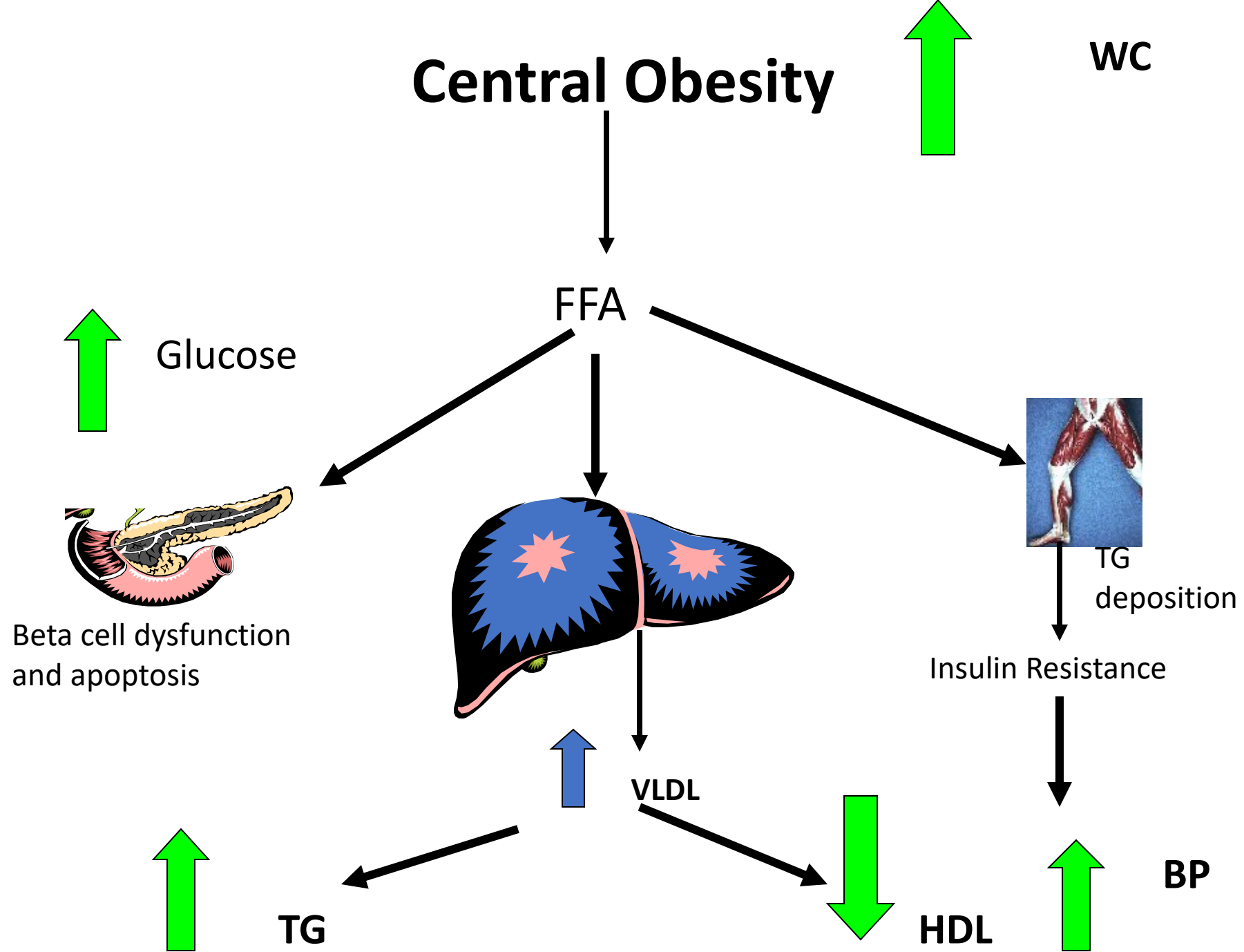
CANCER



POLYCYSTIC  
OVARIAN  
SYNDROME

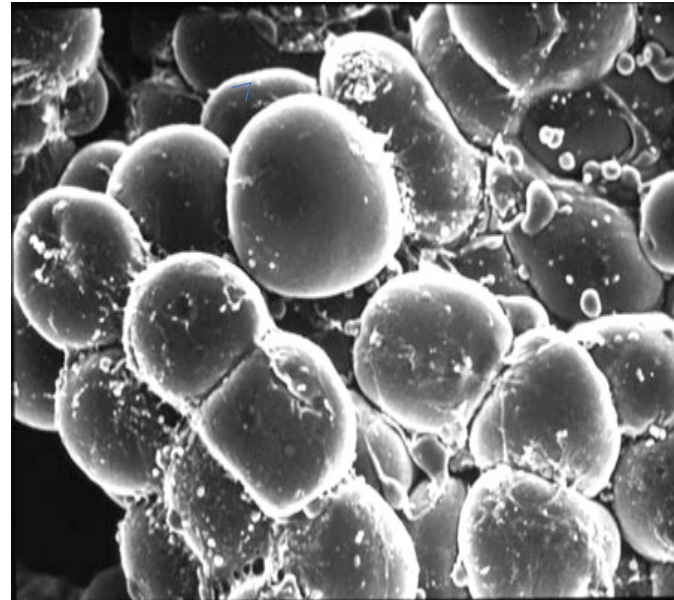


NON-ALCOHOLIC  
FATTY LIVER  
DISEASE



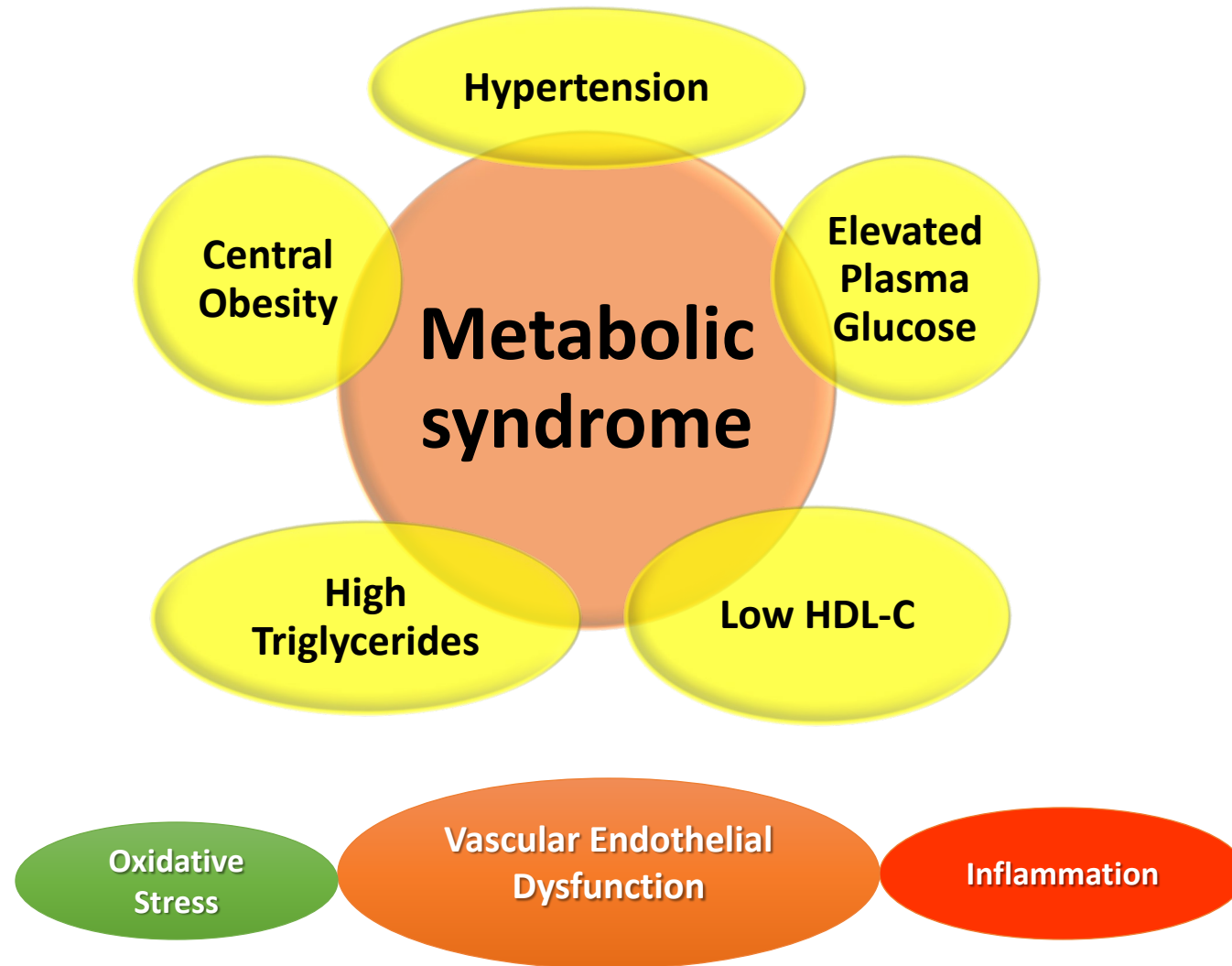


**Excessive adipose Tissue in the trunk area results in Metabolic Syndrome**



**Increased risk for heart disease (2X) and type 2 diabetes (5X)**

# MetS according to AHA/NCEP/ATP-III





# Plant-Based Diets and Metabolic syndrome

Plant –based diets have been shown to provide health benefits for cardiovascular disease and diabetes

**Metabolic syndrome** increases the risk for diabetes 5 times and 2 times the risk for heart disease

Therefore Plant-based diet should be helpful to reduce metabolic syndrome

# Plant-Based Diets and Metabolic syndrome (MetS)

Have been shown to be beneficial for Metabolic Syndrome


Case-control study in female vegetarians (80% lacto-ovo vegetarians) was associated with reduced risk for MetS and insulin resistance

Vegetarians vs non-vegetarians presented lower values of BP, glucose and LDL and **HDL**

Eggs have been shown to increase HDL cholesterol as well as large HDL and increase plasma antioxidants

Eggs as Part of  
healthy Plant-  
Based diet





# Hypothesis and Objectives for Clinical Trial

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- We hypothesized that the inclusion of eggs with a Plant-based diet would result in additional benefits in lipoprotein metabolism, circulating antioxidants and choline
- Our main objective was to compare the consumption of 2 eggs daily for 4 weeks with zero eggs or egg substitutes on parameters of metabolic syndrome



# History about Eggs

# Historical Recommendations

- AHA recommended no more than 300 mg of dietary cholesterol per day
- Where did these recommendations come from?



## How did we get to 300 mg per day ?

- A group of scientists got together in the 1960's and could not come up with a number for dietary cholesterol
- The arguments went between 0 to 600 mg/day.
- Scientists settled right at the middle 300 mg/d



# DIETARY RECOMMENDATIONS

**"One of the problems is that strong recommendations have often been made on very weak data. It may have been the best guess at the moment, but often the recommendations are repeated so many times that people forget they were rough guesses in the first place and come to think they are hard facts."**

Dr. Walter Willett, 2000

Harvard School of Public Health



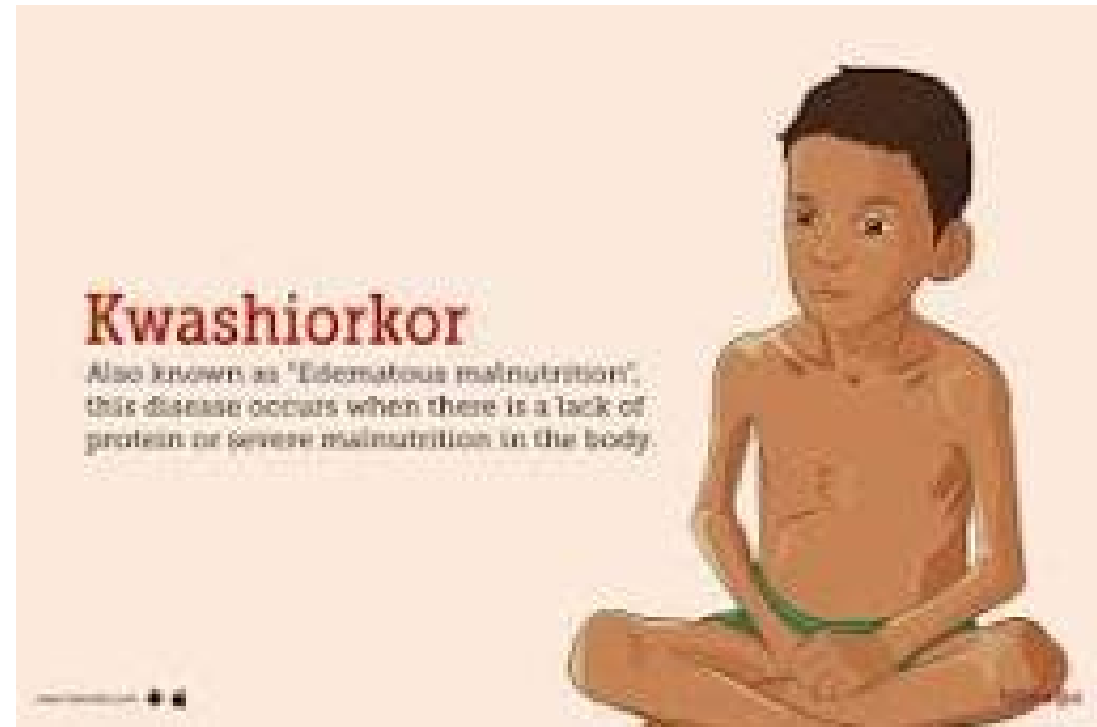
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I have bad news: you have high cholesterol!!

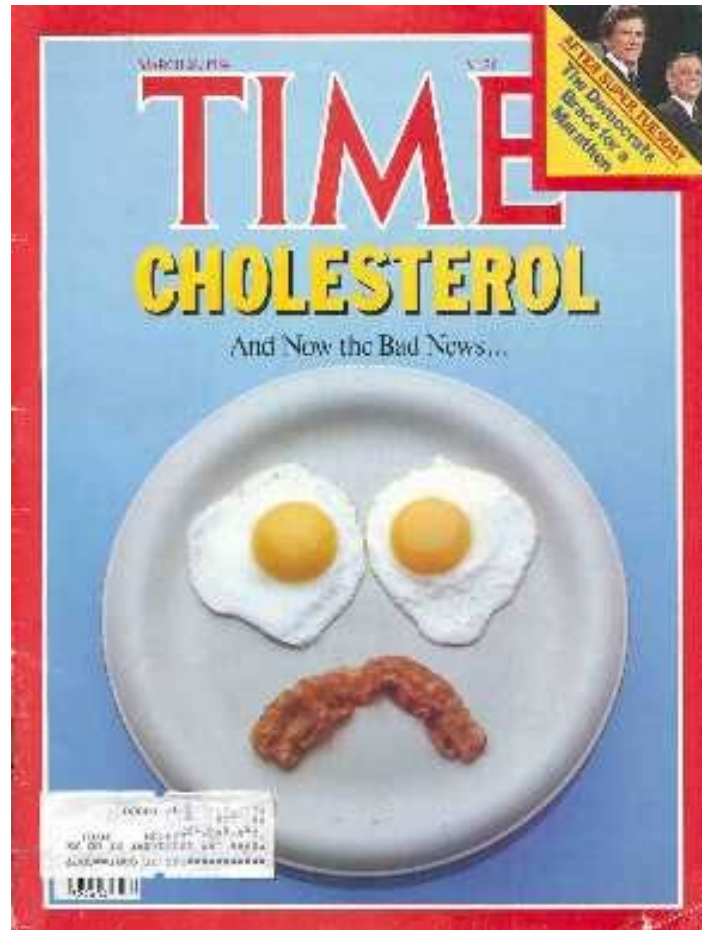
# Problems with blanket recommendations

- *In the 1980's No more than 2 eggs per week across populations*
- Children from a small town in Peru developed kwashiorkor
- Eggs were being sold to buy potatoes
- Carbohydrate-loaded potatoes became a staple food for children instead of protein-rich eggs

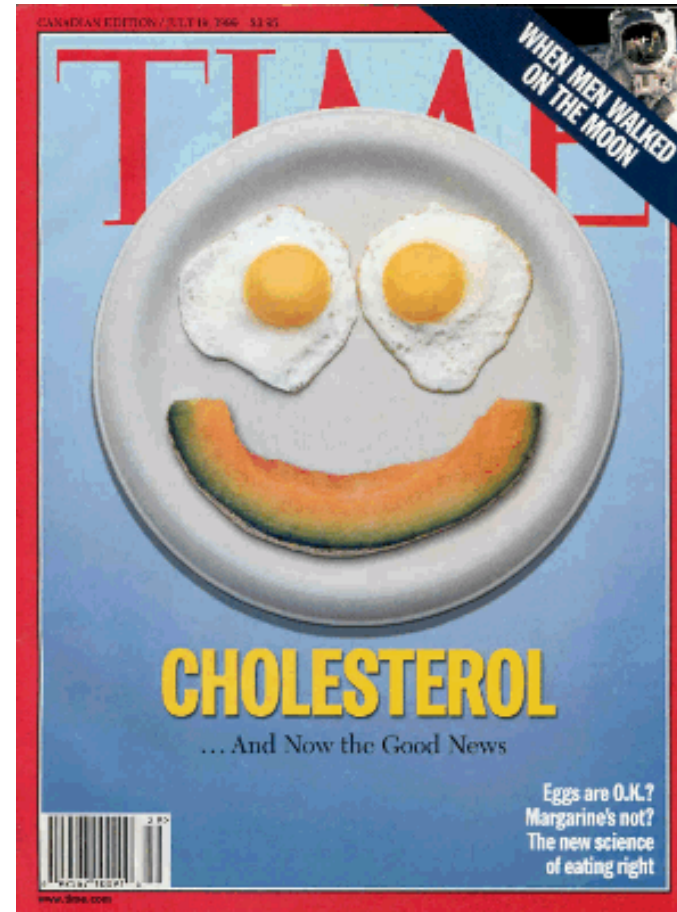


# CONCEPTS DO CHANGE

1984



1999



# Dietary Guidelines 2010: Evidence Summaries

Worksheets: What is the effect of dietary cholesterol intake on risk of CVD?

- Reaven GM, Abbasi F et al. 2001
- Weggemans RM, Zock PL et al. 2001
- **Mutungu et al. 2008**
- Harman et al. 2008
- **Greene CM et al 2005**
- **Ballesteros et al 2004**
- **\* The conclusion was that one egg per day was OK**

2015 Dietary Guidelines-released 1/7/16

Dietary cholesterol upper limits no longer apply

2020 Dietary Guidelines-released 1/21

Dietary cholesterol upper limits no longer apply



PLANT-Based  
diets with Eggs  
and metabolic  
syndrome

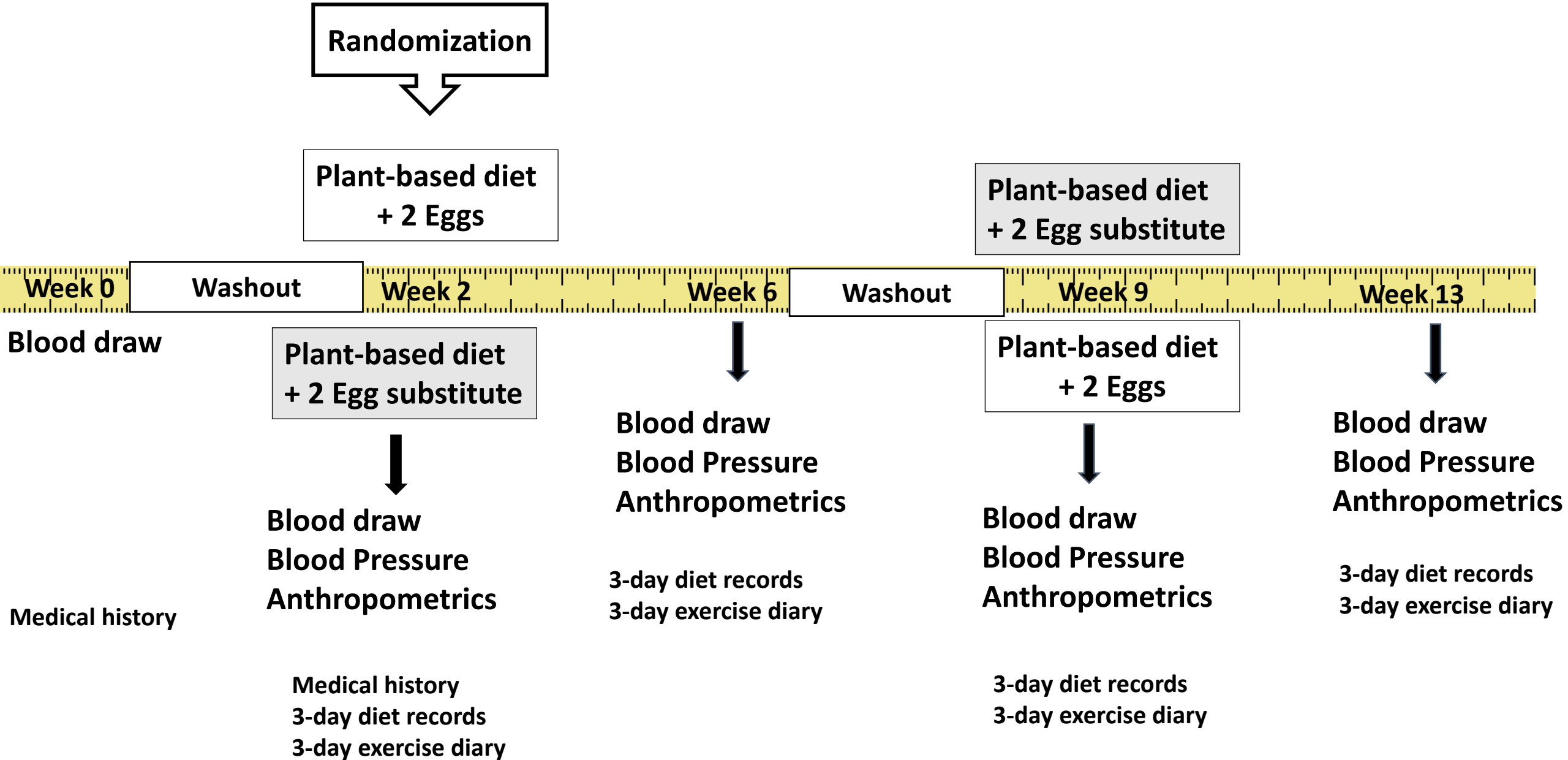
# Clinical Trial

Population:  
Metabolic  
Syndrome

Intervention:  
Lacto-ovo-  
vegetarian diet

Design:  
Crossover

# Experimental Design



Two eggs or the equivalent of egg substitute were taken daily for breakfast with spinach

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# Intervention


- Eggs and Egg substitute were consumed daily at Breakfast with 70 g of spinach

Nutrient	Eggs (2 large)	Egg Substitute	Spinach
Cholesterol (mg)	370	0	0
Choline (mg)	~294	0	13.5
Lutein (mg)	0.4	0	20.3
Zeaxanthin	0.1	0	0

# Metabolic Syndrome Participants (3/5 of NCEP-ATP III criteria)

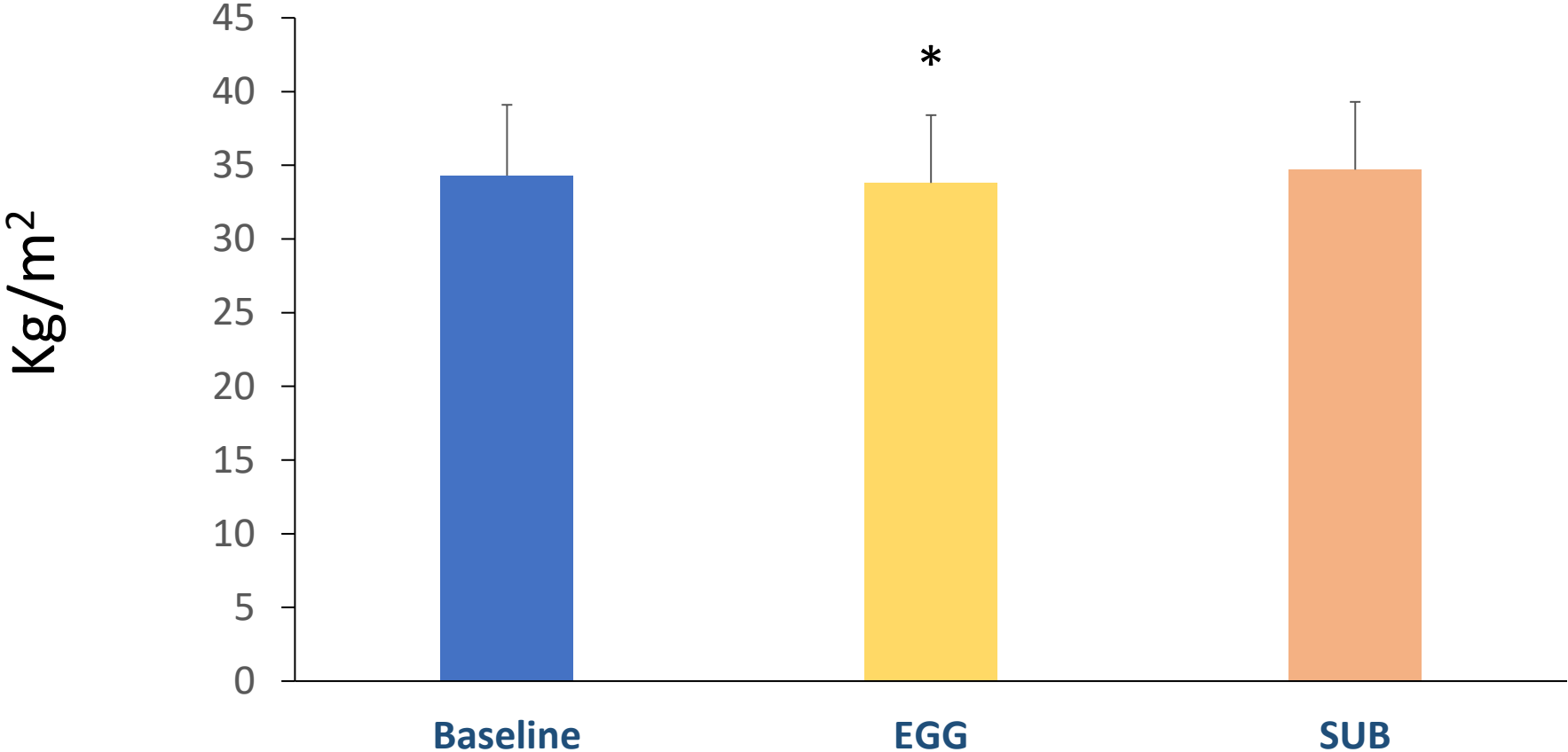
<p>N = 30</p> 	Waist circumference	Blood pressure	HDL-C	Triglycerides	Fasting blood glucose
	<p>≥ 102 cm for men or ≥ 88 cm for women</p>	<p>≥ 130/85 or Sys ≥ 130 or Dia ≥ 85</p>	<p>&lt; 40 mg/dL for men or &lt; 50 mg/dl for women</p>	<p>≥ 150 mg/dL</p>	<p>≥ 100 mg/dL</p>

Diet Assessment	Fasting blood samples
<p>3 day-diet records at baseline and after whole egg or egg substitute</p>	<p>Fasting blood collected from antecubital vein at baseline and at the end of each intervention, centrifuges at 2000 x g for 20 minutes, and plasma collected and stored at -80°C for analyses</p>

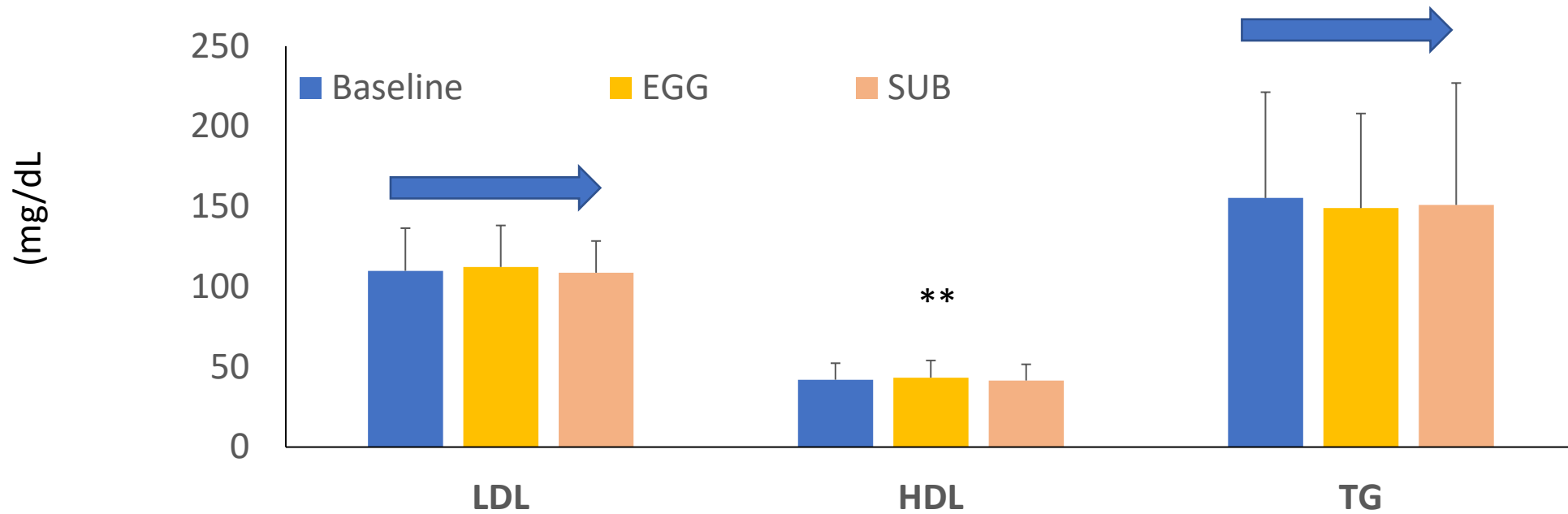
Dietary analysis	Plasma biomarkers
<p>Evaluated using NDSR software</p> 	<ul style="list-style-type: none"> <li>• Plasma lipids (total cholesterol, triglycerides, HDL-c), glucose, CRP and liver enzymes (ALT &amp; AST) were measured using a <b>Cobas c-111</b> analyzer</li> <li>• Plasma Insulin was measured using ELISA immunoassay (<b>R&amp;D systems</b>).</li> <li>• Plasma choline and TMAO evaluated using LC-MS/MS</li> <li>• Lipoprotein particle size was measured by NMR</li> <li>• Plasma Lutein and Zeaxanthin measured using Reverse phase High-Performance liquid Chromatography</li> </ul>

Statistics were performed in SPSS version 20. Data are represented as mean ± SD in all figures; p< 0.05 was considered significant

# Effects of the intervention in BMI

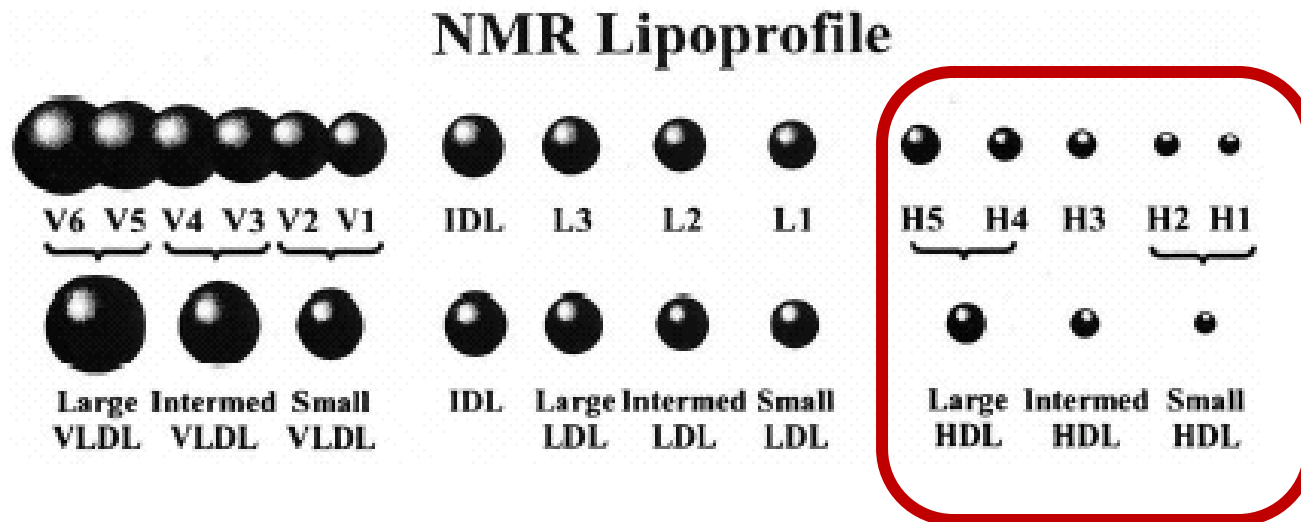


## Plasma Lipids during the intervention

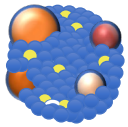


# Concentration and Size of Lipoproteins

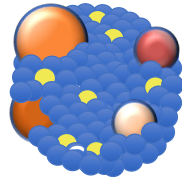
## Nuclear Magnetic Resonance



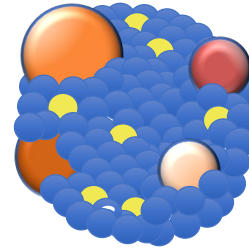
# HDL Particle Size



Small



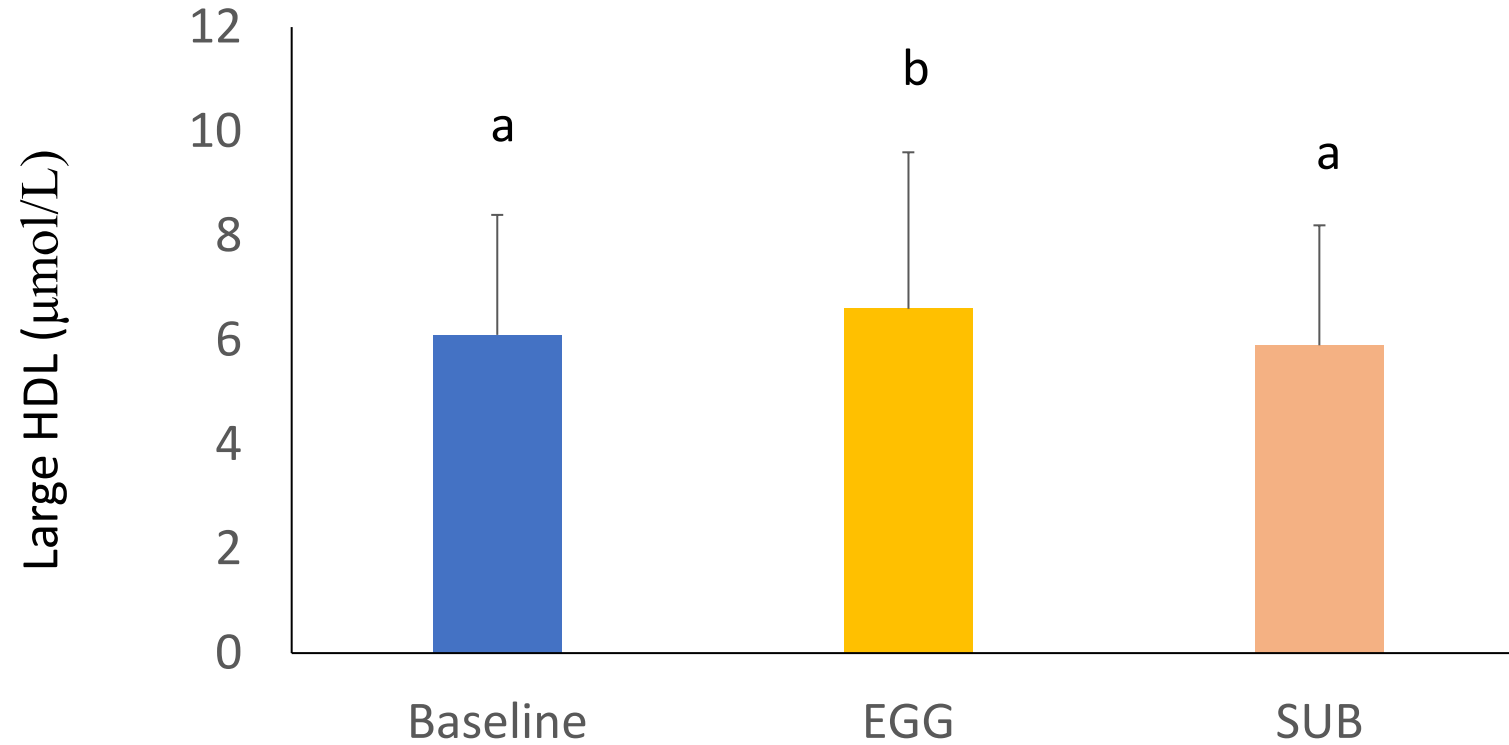
Median



Large

Large HDL has been associated with a more efficient reverse cholesterol transport

# Effects of the Intervention on Large HDL



HDL from  
subjects  
consuming  
eggs

Has been shown to increase  
cholesterol efflux from  
macrophages in patients with  
metabolic syndrome<sup>1</sup>

Similar findings for  
postmenopausal women<sup>2</sup>

<sup>1</sup> Andersen et al. Lipids 2013;48:557-567

<sup>2</sup> Sawrey-Kubicek L et al, AJCN 2019; 110:617-627



# Lutein and Zeaxanthin

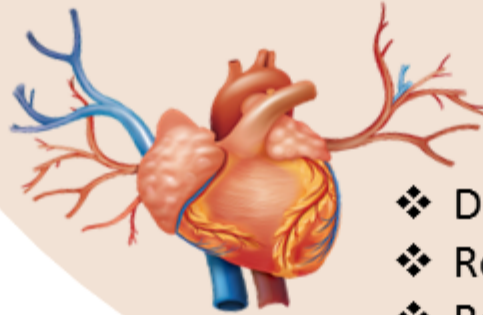
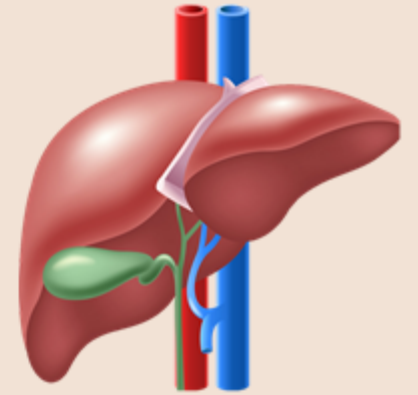


## Eyes

- ❖ Reduce photo-oxidative damage
- ❖ Impair the formation of ROS
- ❖ Protect against AMD
- ❖ Protect against cataracts

## Liver

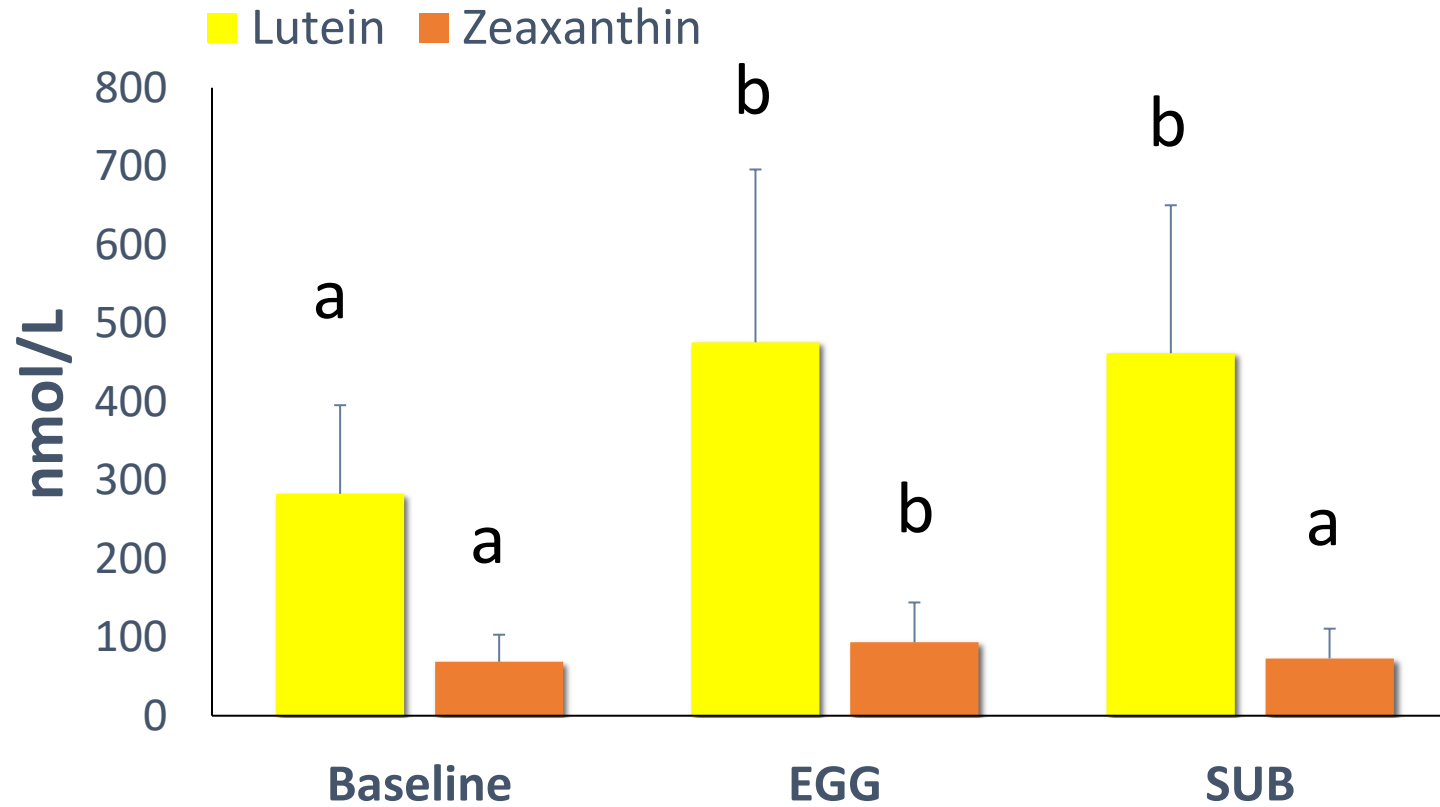
- ❖ Reduce Inflammation
- ❖ Protect against hepatic steatosis
- ❖ Decrease DNA damage/oxidative stress
- ❖ Reduce inflammatory gene expression

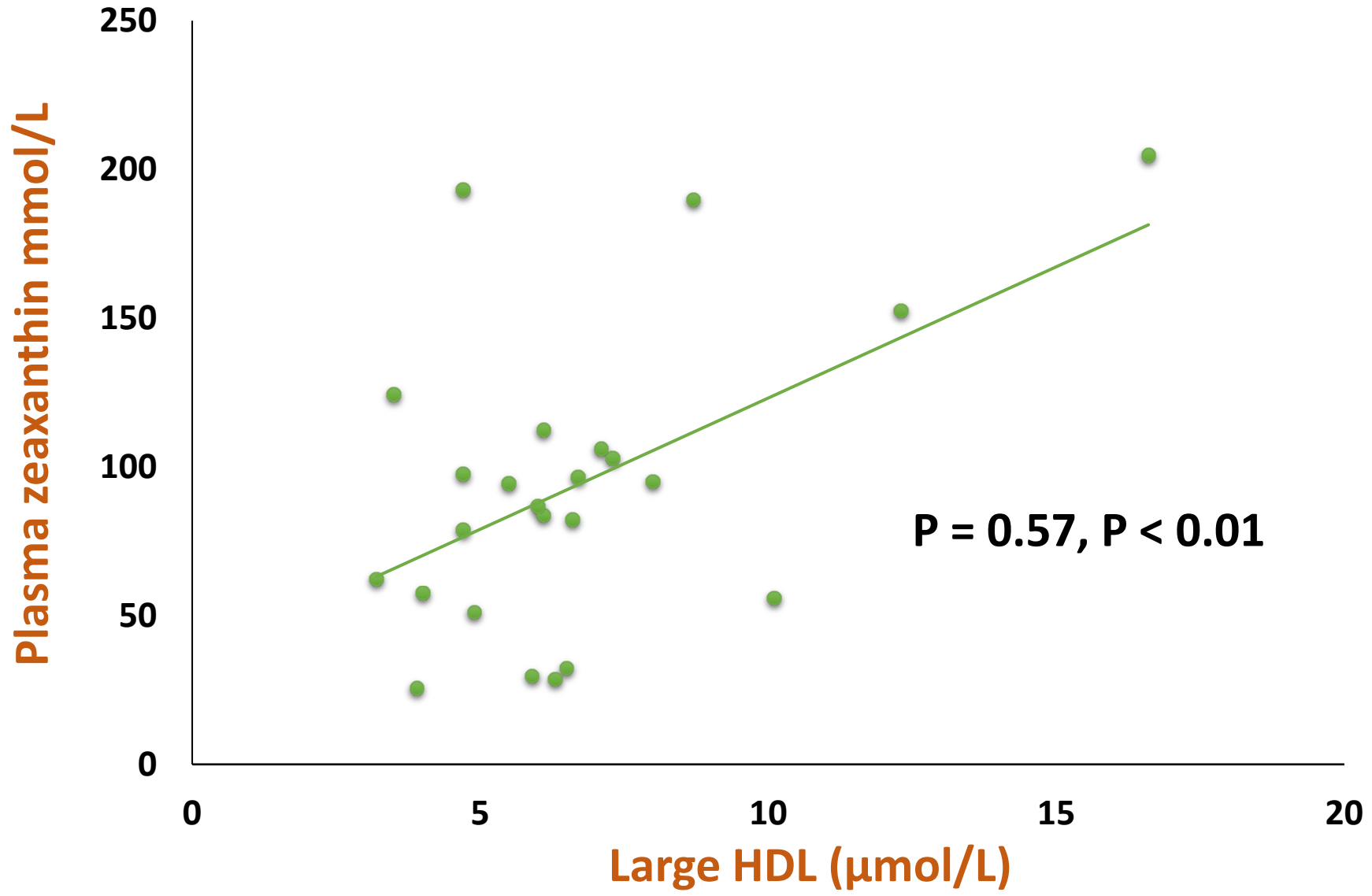


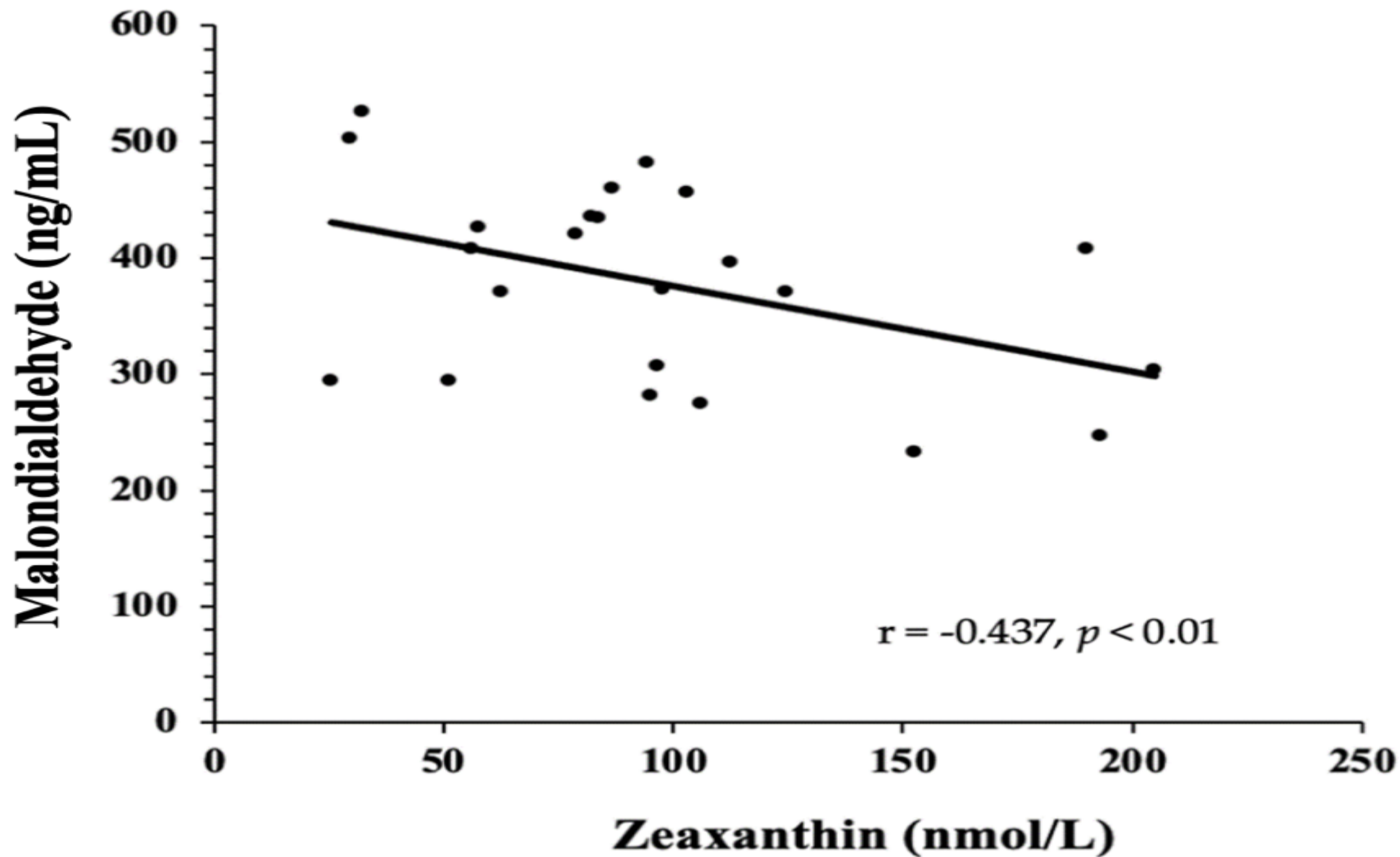
## Heart and Blood

- ❖ Decrease lipid peroxidation
- ❖ Reduce ox-LDL in blood and heart
- ❖ Reduce inflammatory markers in heart
- ❖ Reduce atherosclerosis

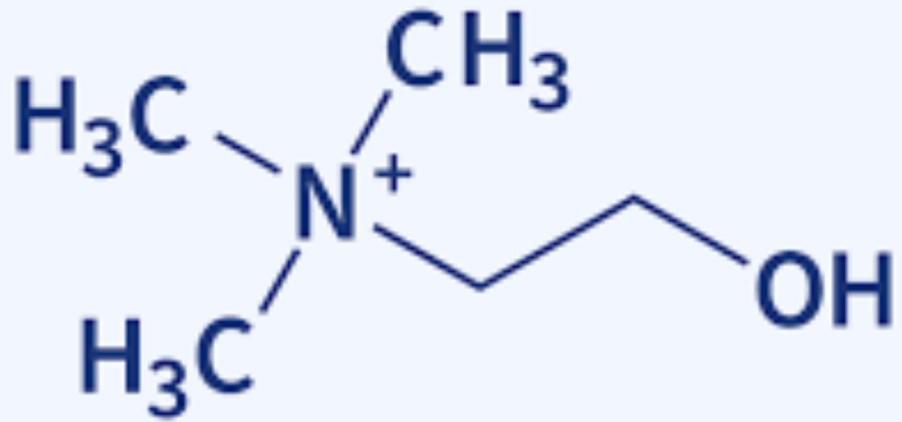
## Concentration Lutein and Zeaxanthin during the 3 Periods





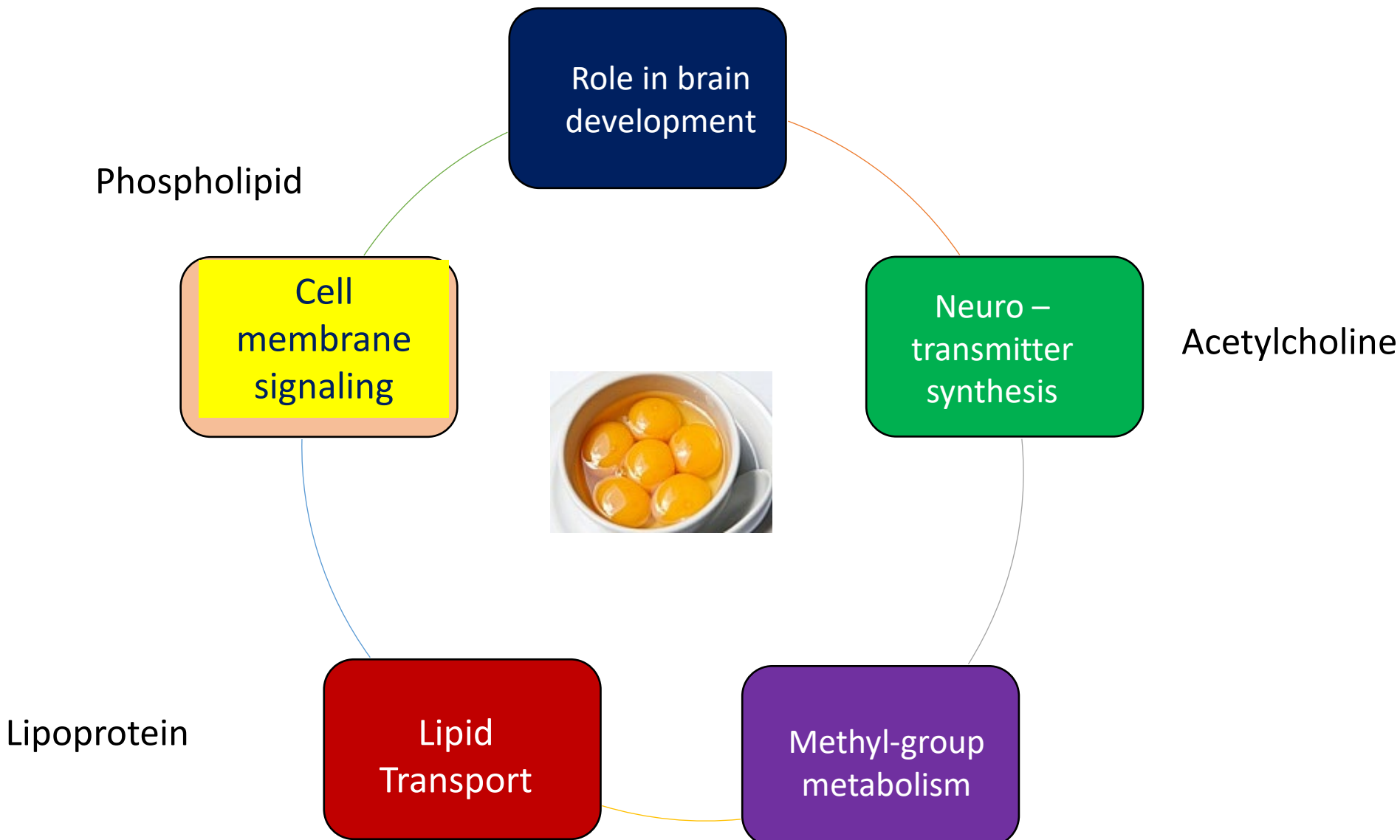


Choline Molecular Structure



Choline and  
TMAO

# Choline BENEFITS



# Choline

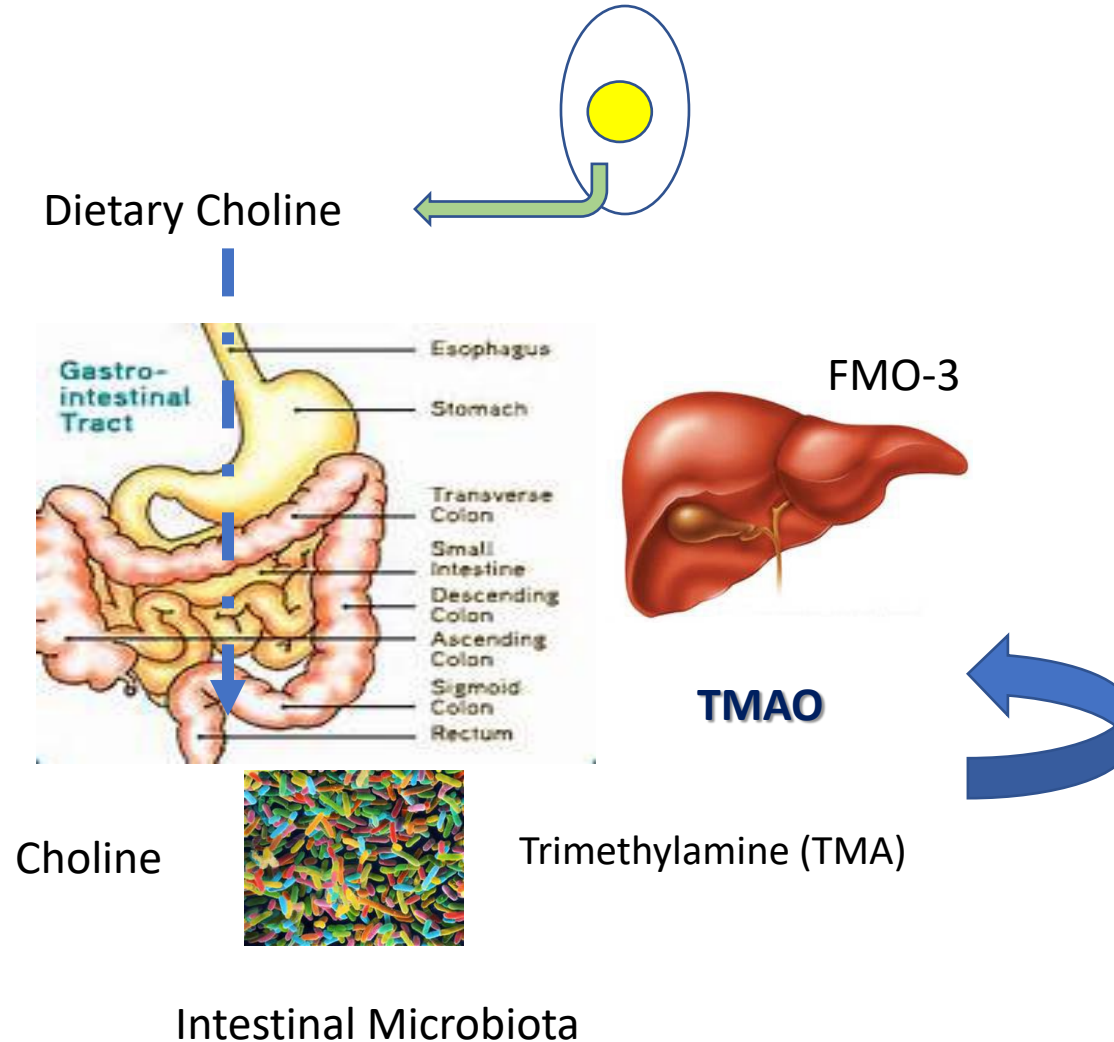
Recommendations for choline: 425 mg/d for women and 550 mg/d for men

Average American consumer ~350 mg/day

Choline deficiency has been associated with:

Fatty liver and muscle damage

# Trimethylamine N-oxide (TMAO)

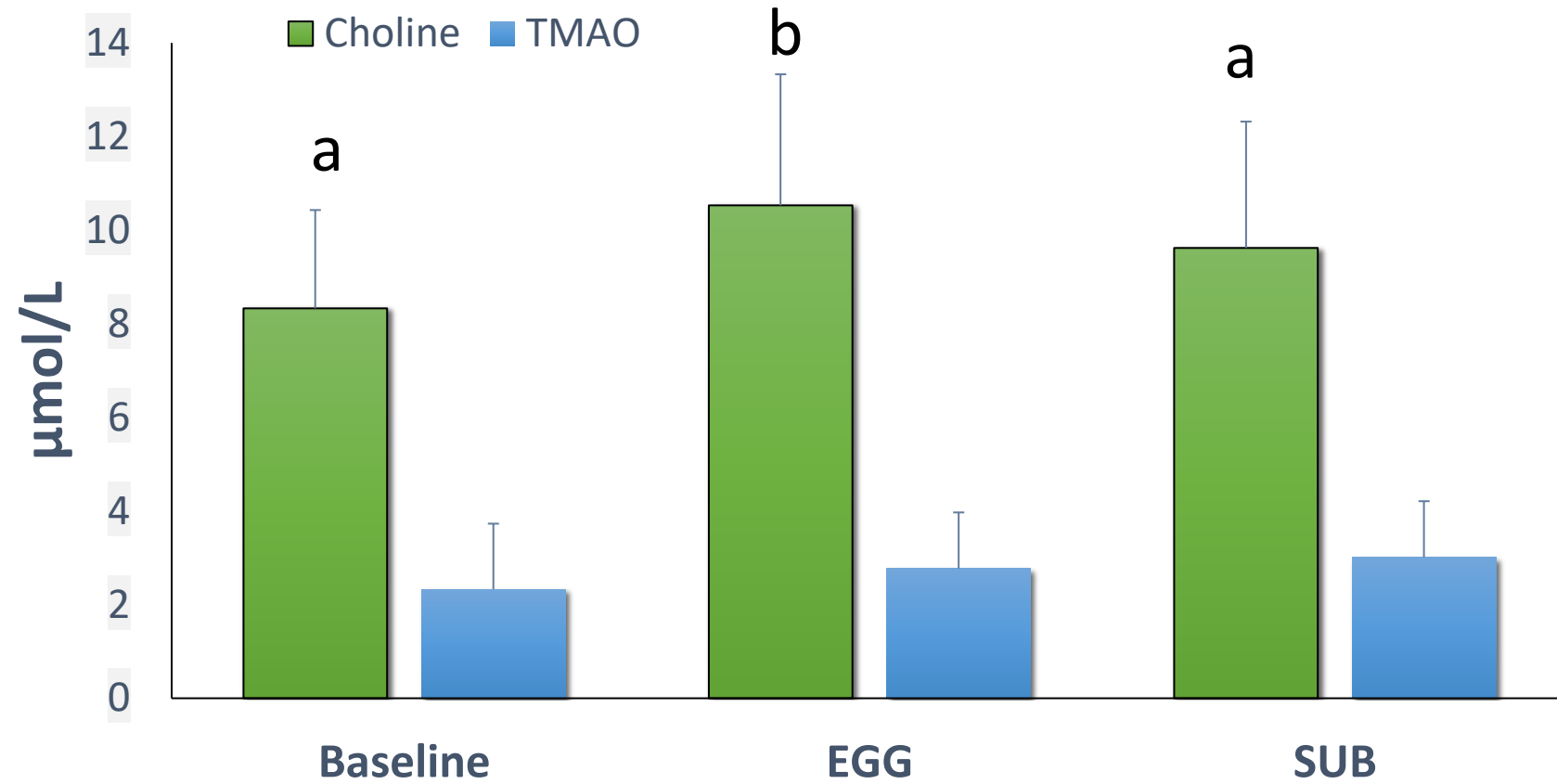


TMAO concentrations have been related to cardiovascular Disease risk<sup>1</sup>

<sup>1</sup> Wang et al. Nature 2011: 472:57-63



## Concentrations of choline and TMAO after the intervention



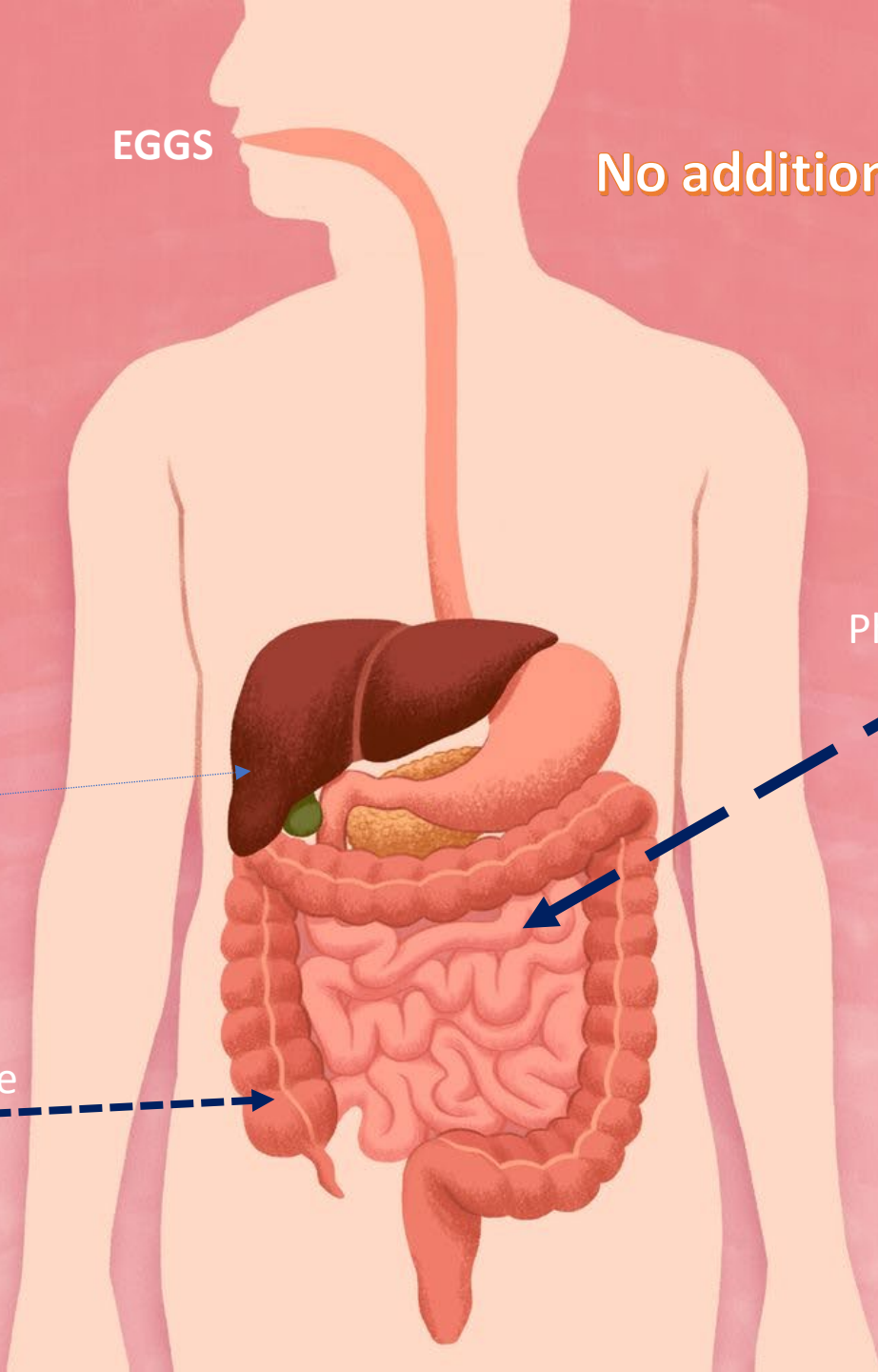
EGGS

No additional formation of TMAO

Phosphatidyl choline in eggs

TMA

Negligible amounts of choline



# Summary

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Inclusion of eggs in a plant-based diet resulted in higher concentrations of plasma **zeaxanthin** and **choline**, a key nutrient that is not taken in sufficient amounts in US, **without increasing plasma TMAO**

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Eggs also modified lipoprotein metabolism favorably by increasing **HDL-cholesterol** and **large HDL**, that has been associated with a more efficient reverse cholesterol transport. **Eggs also did not increase LDL-cholesterol in this population**



## Conclusion

- Inclusion of eggs in plant-based diets results in additional health benefits for individuals with metabolic syndrome

## Akcknowledgments

Minu Thomas, PhD

Marissa Dibella, MS

Michael Puglisi, PhD, RD

Recommendations  
for the best option  
of a plant-based  
diet

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Precision Nutrition addresses  
personalized nutrition vs blanket  
recommendations

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It is important to have as much  
information as possible about a person  
before specific diets are recommended

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The most important is to focus on the  
nutrient content of the plant-based  
diets (anecdote from my study)

## Other things to consider

Preference of individuals for specific diets (vegan, want to include egg, dairy or fish, might like to have meat now and then)

Make them aware of the benefits and drawbacks of these diets

**Vegan diets**: Healthy, but awareness of missing nutrients that need to be supplemented is necessary (more important during pregnancy)

**Vegetarian diets**: Healthy but focus on those foods that provide the needed nutrients (avoid desserts and sugar drinks)

**Pescatarian diets**: Might be beneficial for those individuals that have a problem with elevated triglycerides or risk for heart disease

# References

Thomas MS, Calle M, Fernandez ML. Healthy Plant-Based Diets Improve Dyslipidemias, Insulin Resistance and Inflammation in Metabolic Syndrome. A Narrative Review. *Adv Nutr* 2023; 14:44-54.

McGrath L, Fernandez ML. Plant-based diets and metabolic syndrome: evaluating the influence of diet quality. *J Agric Food Res.* 2022;9:100322.

Bradbury KE, Crowe FL, Appleby PN, Schmidt JA, Travis RC, Key TJ. Serum concentrations of cholesterol, apolipoprotein A-I and apolipoprotein B in a total of 1694 meat-eaters, fish-eaters, vegetarians and vegans. *Eur J Clin Nutr.* 2014;68(2):178–83.

Dinu M, Abbate R, Gensini GF, Casini A, Sofi F. Vegetarian, vegan diets and multiple health outcomes: A systematic review with meta-analysis of observational studies. *Crit Rev Food Sci Nutr.* 2017;57(17):3640–9.

Andersen CJ, Fernandez ML. Dietary strategies to reduce metabolic syndrome. *Rev Endocr Metab Disord.* 2013;14(3):241–54.

Medawar E, Huhn S, Villinger A, Witte AV, The effects of plant-based diets on the body and the brain. A systematic review *Transl. Psychiatry* 2019; 9;226

Melina V. Craig W, Levin S. Position of the academy of nutrition and dietetics; vegetarian diets. *J. Acad Nutr Diet* 2016: 116 (12).

USDA Dietary guidelines 2020. <https://www.fns.usda.gov/cnpp/dietary-guidelines-americans>

Bali A, Naik R. The impact of a vegan diet on many aspects of health. *Cureus* 2023 15(2) 325148



# References

Satija A, Bhupanthiraju SN, Rimm EB, Spiegelman D, Chiuve SE, Borgi L et al. Plant-based dietary patterns and incidence of type-2 diabetes in US men and women; results from three prospective cohort studies. *PLoS Med* 2016;13 (6) e1002039.

Ford ES. The metabolic syndrome and mortality from cardiovascular disease and all causes: Findings from the National Health and Nutrition Examination Survey II Mortality Study. *Atherosclerosis* 2004;173:309-314.

Yokoyama Y, Nishimura K, Barnard ND, Takegami M, Watanabe A et al. Vegetarian diets and blood pressure, a meta analysis: *JAMA Intern Med* 2014 174(4):577-587.

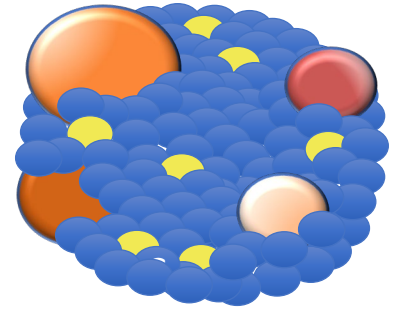
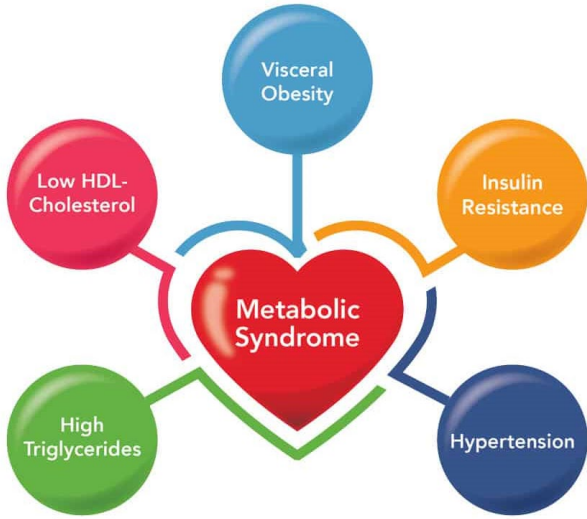
Molina-Montes E, Salamanca-Fernandez E, Garcia-Villnov B, Sanchez MJ. The impact of plant-based dietary patterns on cancer-related outcomes: A rapid review and meta-analysis. *Nutrients* 2020: 12(7):2010

Thomas MS, Puglisi M, Cooperstone J, Malysheva O, Caudill M, Sholola M, Cooperstone JL, Fernandez ML. Eggs improve plasma biomarkers in patients with metabolic syndrome following a plant-based diet. *Nutrients* 2022; 14, 2138.

Chiang, JK, Lin YL, , Chen CI, Ouyang CM, Wu YT, Y Chi C, et al., Reduced risk for metabolic syndrome and insulin resistance associated with ovo-lacto-vegetarian behavior in female Buddhists: a case-control study, *PLoS One* 2013; 8 (8): e71799.

Albracht-Schulte JK, Kalupahana NS, Ramalinga L, Wang S, Rahman RM, Robert-McComb J, et al., Omega-3 fatty acids in obesity and metabolic syndrome: a mechanistic update, *J. Nutr. Biochem.* 2018: 58:1–16.

Kahleova H, Levin S, Barnard N. Cardio-metabolic benefits of plant-based diets, *Nutrients* 2017; 9: 848.



Functional HDL

# Thank You



# To Receive Your CE Certificate

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- A link to an evaluation will be sent within a day or two.
- RNs must complete the evaluation in order to receive CE certificate.
- RD/RDNs: Although completing an evaluation is not required, we truly appreciate your feedback.

**If you do not see the evaluation, look in your spam folder.**

- CE certificates for RDs/RDNs/DTRs will be emailed to you within 1-2 days after the program.

# Next Up in Plant-Based Eating Series

## To Plant or Not to Plant: Overview of Cancer Epidemiology and Analyzing the Food Environment and its Role in Obesity-Related Cancer

Malcolm Bevel, PhD, MSPH  
August University Georgia Cancer Center

**Wednesday, 10/16/24 12-1 PM ET**

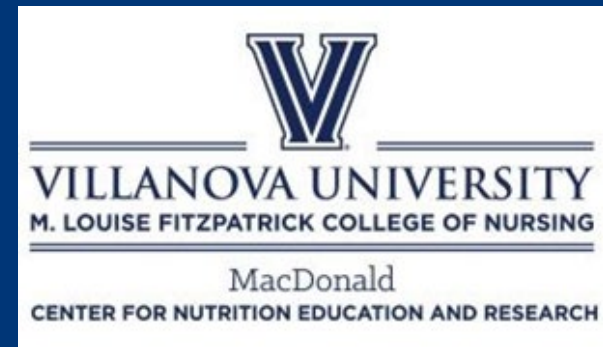
## Plant-Based Eating: A 2024 Deep Dive Literature Review

Andrew Freeman, MD, FACC, FACP  
National Jewish Health, Denver CO

**Wednesday, 11/13/24 1:30-2:30 PM ET**



# Q&A



Moderator:  
Lisa Diewald, MS, RDN, LDN  
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*If you are an RD or RDN and have any questions or concerns about this continuing education activity, you may contact CDR directly at [QualityCPE@eatright.org](mailto:QualityCPE@eatright.org).*