



EATUNIQUELY

#### Developing Your Next Essential Health Test

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### **MY JOURNEY**







Images from Wikipedia.com & UNESCO.com



# **MY JOURNEY**



Image from www.dol<u>e.com</u>

# WHAT IS CHOLINE?



Daily adult choline requirement estimated at 400-500 mg (Adequate Intake)

Images from Pinterest



# THE HUMAN BODY PRODUCES CHOLINE

Phosphatidylethanolamine-N-transferase





# WHY IS CHOLINE IMPORTANT?

- Liver (Low choline causes fatty liver)
- Muscle (low choline and its relation with muscle injury)
- Essential for proper brain development
- Important for memory center in brain



# WE NEED CHOLINE FROM FOODS AND FROM *DE NOVO*





Images from FoodInsight and Wikipedia



#### **MOST AMERICANS DO NOT ACHIEVE AI FOR CHOLINE**



### Adequate Intake Actual Intake

From: http://choilnecouncil.com/health\_professional/

Slide courtesy of SHZ

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### GENETIC VARIATION CAN ALTER NUTRITENT REQUIREMENTS



PEMT

- Many of us have "spelling differences" in our DNA
- Common SNPs influence choline demand



Image from neuroendoimmune.wordpress.com



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Images from FoodInsight and Wikipedia



# WHY IS CHOLINE IMPORTANT?

Choline and its metabolites are important for:

- Liver (Low choline causes fatty liver)
- Muscle (low choline and its relation with muscle injury HOW DO WE KNOW CHOLINE IS IMPORTANT?
- Essential for proper brain development
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### **SCIENTIFIC MODELS FOR RESEARCH**



Adequate choline



Low choline







### **DIETARY CHOLINE REGULATES BRAIN DEVELOPMENT IN MICE**



#### **Cerebral cortex**



Wang Y, et al. (2015). Maternal dietary intake of choline in mice regulates development of the cortex in the offspring

FASEB J.



#### **DIETARY CHOLINE REGULATES BRAIN DEVELOPMENT IN MICE**



Wang Y, et al. (2015). Maternal dietary intake of choline in mice regulates development of the cortex in the offspring

FASEB J.



#### **DIETARY CHOLINE REGULATES EYE DEVELOPMENT IN MICE**



Adequate Choline



All cells

Trujillo-Gonzalez, *et al.* (2019). Low availability of choline in utero Disrupts development and function of the retina. FASEBJ



#### **DIETARY CHOLINE REGULATES BRAIN DEVELOPMENT IN MICE**

NBL GCL

Adequate Choline

Magenta: Dividing Cells

Green: Neurons

Trujillo-Gonzalez, *et al.* (2019). Low availability of choline in utero Disrupts development and function of the retina. FASEBJ







### **CHOLINE FROM MOTHER ESSENTIAL FOR BRAIN** DEVELOPMENT



**Image from Pinterest** 

Meck and Williams. 2003. Neurosci Biobehav

26.5





• Adequate choline during pregnancy reduces neural tube defects in developing fetuses.

Shaw et al, 2009, American Journal Of Epidemiology

• Higher gestational choline intake was associated with better child visual memory at 7 y o Boeke et al, 2012, American Journal Of Epidemiology





# CHOLINE IN ADULTHOOD

• Higher choline intake was associated with better cognitive performance in 744 women and 647 men. (Age range 36-83 y)

Poly et al, 2011, American Journal of Clinical Nutrition

• Choline intake prevents age-related memory decline and protects from changes associated with Alzheimer's Disease.

Blusztajn et al, 2017, Nutrients



#### LOSS OF A GENE IMPORTANT FOR CHOLINE METABOLISM CAUSES FATTY LIVER

#### FATTY LIVER IN MICE



Teng et al. 2011. J Biol Chem



• Hospitalized patients in total parenteral nutrition developed fatty liver. Hepatic symptoms were reversed after choline supplementation.

Buchman. 2009. Gatroenterology



# CHOLINE AND MUSCLE DAMAGE



Males susceptible to exercise-induced muscle damage reported low choline intake.

Image from www.interactivebiology.com

Kohlmeier and Olivia Dong. 2016. FasebJ Supplement.

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# WHY IS CHOLINE IMPORTANT?

- Liver (Low choline causes fatty liver)
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# HOW DO YOU KNOW IF YOU ARE EATING ENOUGH CHOLINE?



# **DEVELOPING A CHOLINE BIOMARKER**



Steven H. Zeisel, MD, PhD

Funding NIH, DK056350, DK115380 Balchem



# **SEEKING HEALTHY PARTICIPANTS**

- Males and Females 17-70 years old
- Participate for up to 6 weeks
- Participants will be paid.
- No smoking
- No substance abuse
- No overweight, unusual diets, allergy to soy
- History of liver or kidney disease

# **CHOLINE STUDY DESIGN**







#### PARTICIPANT'S MEALS





#### Images from www.jimmydean.com

### PARTICIPANT'S MEALS



#### **BUTTERNUT SQUASH LASAGNA**

VEGETARIAN 200 Protein 30 Photo

NET WT. 10.8 07 (3076)





#### Images from www.Walmart.com

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# **CHOLINE STUDY DESIGN**

• Heart Rate



Saliva sample



• Blood sample



#### Images from amazon.com, bbc.com and IT



#### **PREGNANCY TEST**



#### FOOD FREQUENCY QUESTIONNAIRE

NIH

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2	Roadmap	Citation	Contact Us	Print 🖶											
strum	nent Profiles + In	troduction » Fe	od Frequency Questi	maire											
ent i	Profiles	1.00													
ducti	00	Food	Frequency Q	iestionnaire at a Glance											
hour	Dietary	Purpos													
all		To obta	To obtain frequency and, in some cases, portion size information about food and beverage consumption over a specified period of time, typically the past												
d Re	cord	month o	x year.												
estionnaire		Description													
Alidation		A food frequency questionnaire (FPQ) consists of a finite list of foods and beverages with response categories to indicate usual frequency of consumption over the time period gueried. To assess the total diet, the number of foods and beverages gueried typically ranges from 80 to 120.													
ata C	Capture	lisual pe	ortion size can be	sked separately for each food and beverage. Al	ternatively, portion size can be combined	with frequency informa	tion by asking								
ata Processing and Data Analysis		respondents to translate usual consumption amount to number of specified units (e.g., How often do you eat a 's cup of rice'). Some questionnaires include portion size images in an attempt to enhance reporting accuracy.													
leferences and		in addition to foods and beverages, FFQs often ask about the frequency of intake and dosages of commonly consumed dietary supplements.													
tesources eeners mparing Dietary sessment		FFQs are usually self-administered, interviewer-administration is done occasionally, for example, when literacy is low. Completing a questionnaire aimed at capturing the total dietary intake usually requires 30 to 60 minutes. An FFQ is sometimes loosely referred to as a diet history. However, the term diet history can refer generally to any instrument that asks about dies in the													
								truments.		past (Learn More about Diet History). It also is used to refer specifically to a meal-based FFQ or the Burke diet history, which includes a food frequency					
								псер	ts.	cross-c	neck component, 4	io its various adaptacions.			
ng An Approach		To learn more about brief requency questionnaires aimed at capturing particular aspects of the diet, see <u>Screener Profile</u> .													
mena	lations	The Nat	ional Cancer Institu	te's <u>Diet History Questionnaire</u> is a freely availa	ible FFQ,										
lore		Utility of Data													
Y		• FI	<ul> <li>FFQs provide information on consumption of queried foods and beverages over the specified period.</li> </ul>												
ices i	& Resources		<ul> <li>Depending or</li> </ul>	the breadth of items gueried, data can be used	to assess total dietary intake and/or part	icular aspects of diet.									

#### Images from eBay and www.cancer.gov



#### ABDOMINAL ULTRASOUND EXAM



#### FIBROSCAN MEASURES FAT CHANGES IN YOUR LIVER



#### Images from NRI and IT



### BODY COMPOSITION AND MUSCLE STRENGTH



#### MRI IMAGING TO CALCULATE CHOLINE IN YOUR LIVER



Images from biodex.com and Wake Forest Baptist Health

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# JOIN OUR STUDY

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# **CHOLINE GROUP**



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**MUN** 

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