Nutritional Epidemiology

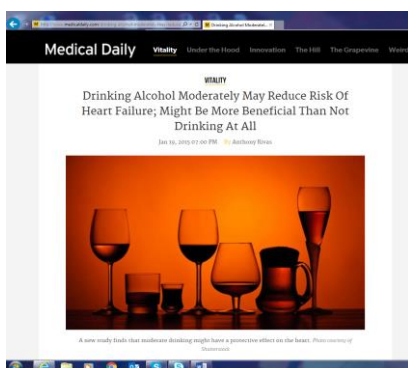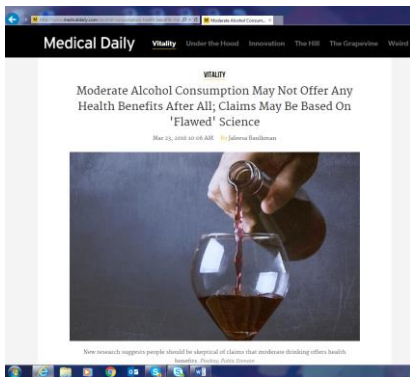**Brenda Leung, ND, PhD**

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Learning Objectives

- Introduction to Nutritional Epi
- Issues with studying contemporary nutrition-related disease
- Methods of data collection
- Merits and limitations of Nutritional Epi

Medical Daily   **Vitality**   Under the Hood   Innovation   The Hill   The Grapevine   Weird

VITALITY

Drinking Alcohol Moderately May Reduce Risk Of Heart Failure; Might Be More Beneficial Than Not Drinking At All

A new study finds that moderate drinking might have a protective effect on the heart.

Why study nutrition?

"Let medicine be thy **food** and **food** be thy medicine."

Hippocrates, a long long time ago

"…It is our continuous exposure to foods throughout our lifetime that renders diet the most important environmental factor challenging our biological system"

Mutch et al., 2005

Past diet-disease relationships

- Overt nutrient deficiencies and disease outcome

- Typical deficiency syndromes
  - Protein energy malnutrition
  - Iron deficiency anemia
  - Goiter

- Characteristically,
  - High frequency among those with very low intake
  - Short latent periods
  - Can be reversed within days or weeks

Contemporary diet-disease relationship

Major diseases throughout the world
- Heart disease
- Cancer
- Osteoporosis
- Stroke
- Diabetes
- Congenital malformations

What is Nutritional Epi?

- To study how diet influences occurrence of diseases

- Relatively new discipline which *combines* the knowledge of nutrition with the methodology epidemiology to study the determinants of diseases with *multiple etiologies* and *long latent periods*.

How is it important?

- Enable us to understand the relationship between **diet** and long term **health** and **disease**

- To determine the intake of dietary components and the risk of death or disease among groups of people

Goals of nutritional epi

- The most basic is to *monitor* the food consumption, nutrient intake and nutritional status of a population.

- To generate new *hypotheses* about diet and disease.

- The overall goal is to contribute to the prevention of disease and the improvement of *public health*.
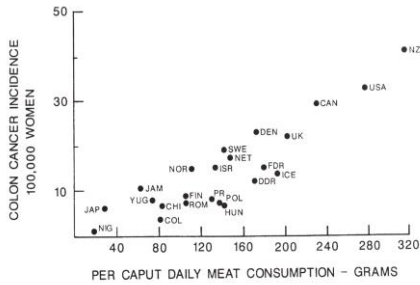
Association is not causation

Figure 1–1. Correlation between per capita meat intake and incidence of colon cancer in women in 23 countries. (From Armstrong Doll, 1975; reproduced with permission.)

Complex nature of diet/food/nutrition

- Do you eat?
- Do you eat the same foods every day?
- Do you all eat the same foods?
- What's in the foods you eat?
- Are you eating vitamin d? Calcium?

Exposure → Outcome

What's in a food?

Diet → food → nutrients

The tomato

- Food composition influenced by varieties and genetic, variation, growing conditions

- Myriad chemicals:
  - essential nutrients (vitamins, minerals, lipids, amino acids),
  - major energy sources (fat, protein, carbohydrate, alcohol),
  - additives (preservatives, flavorings),
  - agricultural contaminants (pesticides, growth hormones),
  - microbial toxins (a flatoxins),
  - inorganic contaminants (cadmium, lead),
  - chemicals formed in the cooking or processing of food (nitrosamines),
  - natural toxins (natural pesticides), and
  - other natural compounds (including DNA, enzymes, and enzyme inhibitors)

Issues with studying Nutrition-Disease relationship

- Multiple determinants (causes)
  - Diet, genetic, occupational, psychosocial, and infectious factors; levels of physical activity; behavioral characteristics
- Long latent periods
  - Cumulative exposure over many years, or relatively short exposure occurring many years before diagnosis
- Occur with relatively low frequency in cases of direct causal link
  - Most cases are indirect associations
- Conditions not readily reversible
- May result from excessive and/or insufficient intake of dietary factors

Issues cont'd

- Individuals rarely make clear changes in their diet at identifiable points in time

  - typically eating patterns evolve over periods of years

- Individuals are generally not aware of the content of the foods that they eat

  - consumption of nutrients determined indirectly, e.g. reported use of foods or level of biochemical measurements

Diet as exposure

- Do you eat?
  - Everyone eats
- What types of food eaten?
  - Eating patterns evolve over periods of years
  - People may not remember (recall bias)
  - Food = complex mixtures of compounds, with substantial differences

Smoking as exposure

- Do you smoke?
  - A subgroup smokes
- How many # of cigarettes?
- What age began smoking?
- What age stop smoking?

Methods of Dietary Assessment

- Anthropometric Methods
- Biochemical, Laboratory Methods
- Clinical Methods (signs and symptoms)
- Dietary Evaluation Methods*

*Most commonly used for research purposes.

Anthropometric method

Laboratory method

- Blood: serum retinol, serum iron, urinary iodine, vitamin D)
- Hemoglobin: anemia, protein & trace element nutrition.
- Stool: presence of ova and/or intestinal parasites
- Urine: albumin, sugar and blood
  - urinary creatinine/hydroxyproline ratio)
- Analysis of hair, nails & skin for micro-nutrients.

Clinical signs of nutritional deficiency

Mouth	
Glossitis	Riboflavin, niacin, folic acid, B12 , pr.
Bleeding & spongy gums	Vit. C,A, K, folic acid & niacin
Angular stomatitis, fissured tongue	B 2,6,& niacin
leukoplakia	Vit.A,B12, B-complex, folic acid & niacin
Sore mouth & tongue	Vit B12,6,c, niacin ,folic acid & iron

Clinical signs of nutritional deficiency

Eyes	
Night blindness, exophthalmia	Vitamin A deficiency
Photophobia-blurring, conjunctival inflammation	Vit B2 & vit A deficiencies
Nails	
Spooning	Iron deficiency
Transverse lines	Protein deficiency

Dietary Intake Assessment

- Food Dairy
- 24 Hours Dietary Recall
- Food Frequency Questionnaire
- Dietary History
- Observed Food Consumption

FOOD Record

- Individual records food intake (types & amounts) at the time of consumption.
- The length of the collection period range between 1-7 days.
  - Typically 3 – 7 days
  - 7 days is considered the "gold standard" used to validate other methods
- Most reliable in obtain day to day variations.

Food record example

Breakfast:	White Toast with Butter	2 slices
	Jelly (Smuckers)	2 teaspoons
	Brewed Coffee	1 cup
	Half and Half	1 tablespoon
	Sugar (Granulated)	1 teaspoon
Lunch:	Grilled Cheese Sandwich	
	(American Cheese and Margarine)	1 sandwich
	Tomato Soup	
	(Prepared with Whole Milk)	1 cup
	Whole Milk	1 cup
	Orange (Florida)	1 fruit
Dinner:	Spaghetti (Cooked with Salt)	1.5 cups
	Sauce (Prego, Meat Flavored)	½ cup
	Meatballs (Homemade)	2 mbl
	Italian Bread	2 slices
	Butter	2 pats
	Green Beans (Canned)	½ cup
	Water (Municipal)	8 ounces
Snacks:	Black Bean Dip (Tostitos)	4 tablespoons
	Tortilla Chips	
	(Nacho, Cheesier, Doritos)	2 cups
	Diet Coke	12 fluid ounces

Food record

- Limitations
  - Difficult to maintain, especially with longer periods
  - Require literate, motivated subjects
  - Place a high burden on the patients
  - Quality of the record declines in relation to the number of days recorded
  - The actual process of recording food intake can lead patients to change their food-intake patterns

24 Hours Dietary Recall

- Designed to quantitatively assess current nutrient intake
- Subjects asked to recall all food & drink taken in the previous 24 hours
- Interview can be in person or by phone
- It is quick, easy, & depends on short-term memory
- Low literacy is not a barrier

24 hours dietary recall

- Limitations
  - Does not representative of the person's "usual intake"
  - Requires a trained interviewer
  - Depends on memory, cooperation, and communication ability

Food Frequency Questionnaire

- Designed to estimate usual dietary intake over time (typically 6 months to 1 year).
- Subject is given a list of food items to indicate his or her intake (frequency & quantity) per day, per week & per month.
- Inexpensive, more representative & easy to use.
- Can be customized to assess specific food groups (e.g. intakes of fruits/vegetables, fibre)
- Can be developed to assess diverse diets, ethnic groups (e.g. Hawaiians, Japanese, Mexican)

FFQ: *Answer the following questions based on your intake over the last 12 months.*

Food Frequency Questionnaire

LIMITATIONS

- Long questionnaire (e.g. > 100 questions)
- Errors with estimating serving size.
- Needs updating with new commercial food products to keep pace with changing dietary habits.
- Requires long term recall

DIETARY HISTORY

- Combines a 24 hour recall, with a FFQ and then a 3-day food record
- This method covers usual/habitual diet and can provide reasonably accurate estimations of energy and nutrients
- Details about usual intake, types, amount, frequency & timing needs to be obtained.
- Allow for cross-checking to verify data.

Dietary history

- Limitations
  - Unsuitable for large population (epidemiological) studies
  - Expensive
  - Time consuming
  - High participant burden

Observed Weighed food record

- The meal eaten by the individual is weighed and contents are exactly calculated
  - Requires fieldworkers to be present before, during and after each meal. Snacks consumed between meals are often estimated.
- Useful if individuals are illiterate or non-numerate.
- Characterized by having a high degree of accuracy

Observed weighed food record

- Limitations
  - Invasive – likely to lead to change in habitual diet
  - Expensive, time and resource intensive
  - Not feasible for clinical practice; recommended for research purposes, but too expensive for large scale studies


Got (Dietary) data, now what?

- Canadian Nutrient File databAse
- http://webprod3.hc-sc.gc.ca/cnf-fce/index-eng.jsp
- USDA National Nutrient Database for Standard Reference
- http://www.ars.usda.gov/Services/docs.htm?docid=8964
  - Dietary Supplement Ingredient Database,
  - Food and Nutrient Database for Dietary Studies
- USDA Food Patterns Equivalents Database:
- http://www.ars.usda.gov/Services/docs.htm?docid=23871

Interpreting Nutritional Epi Data: Cautionary note

- Hypothetical relationship between intake of a nutrient & health
  - A dose-response gradient (non-linear)
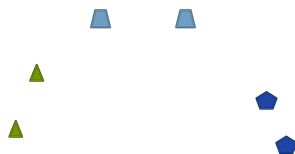
Mertz,

Merits of Nutritional Epi

- Direct relevance to human health.
  - Epidemiologists study real life. they do not need to extrapolate from animal models or in vitro systems.
- Results can be used to calculate direct estimates of risk
  - Translate more directly into specific recommendations for changes in nutrient intakes or food consumption patterns.
- Findings can have direct implications for food processing and technology
  - E.g. Trans fatty acids and increased risks of coronary heart disease

Limitations of Nutritional Epi

- Potential for a number of biases, leading to measurement errors.
  - E.g. Recall or reporting bias
- Difficulty in determining whether observed associations are causal.
  - E.g. Long latency period, repeated exposure required, large sample size
- Apparent simplicity and "real life" relevance of findings may be misused and misinterpreted
  - E.g. Preliminary or unconfirmed findings come to the attention of the news media and the general public

Thank You ☺

Questions??