Tutorial 1B
The Science of Nutrition
The goals of this tutorial are to describe the following:

1) the difference between an anecdote and scientific evidence.

2) the difference between a clinical indicator from negative clinical outcomes.

3) the different types of dietary studies.

4) the difference between a correlation and a causal factor.

5) What questions to ask when a nutritional study is mentioned in the news.

6) The role of statistics.

7) The Six points of causality.
“Anecdotal Evidence” versus Scientific Evidence

An “anecdote” is a story, so not surprisingly, “anecdotal Evidence” is based on a story or incident.

The following is a true example of a nutritional anecdote.

My dad who is in his mid 70s will often get leg cramps at Night, which is annoying because it’s a kind of a rude Awakening. Well, someone told him to drink orange juice When that happens because it works for him (this other guy).
Anecdotal evidence is really no evidence at all.

The major reason it isn’t evidence is that it’s not a properly controlled evaluation of what’s in question.

Scientific evidence, on the other hand is based on the design and execution of an experiment and evaluation of the results.

I suggest that if you are not familiar with the scientific method, you read pages 11 -15 in your textbook. It’ll make the rest of this tutorial more “palatable”.
Negative Clinical Outcomes Versus Clinical Indicators

I’d like to make a distinction between what you might call “Negative Clinical Outcomes” and “Clinical Indicators”. Either or both of these may be evaluated in a nutritional study.

We can define a negative clinical outcome as a condition that when it occurs has an immediate and significant effect on the individual. The most dramatic of these would be death.

This are innumberable negative clinical outcomes but a few of them include a heart attack, stroke, hip fracture, and blindness. I think you get the idea (obviously, there are many many others.)

A clinical indicator, on the other hand, is usually a measurement that when it reaches a particular value may indicate that the individual, or population of individuals, is at risk of developing something very serious – that is, some negative clinical outcome.
An example of a negative clinical outcome is stroke. This is an extremely serious condition that results in loss of functional brain tissue and often leads to major disability. In fact, more people in the U.S. suffer from disability due to stroke than to Alzheimer’s Disease.

A clinical indicator that suggests someone is at risk of getting a stroke is having consistently high blood pressure – which is of course a measured value.

If you are alive, you have blood pressure. And your blood pressure may go up considerably, for example, while exercising. This means that blood pressure is a good thing and even high blood pressure under situations is normal.

However, if your blood pressure is consistently high when you are at rest, then this is a clinical indicator that you are at risk of developing a stroke. (We’ll discuss hypertension later in the course in more detail.)
Some nutritional studies look at clinical indicators, some at negative clinical outcomes, and some look at both. It entirely depends on the study design and goals of the investigators.

For example, the oldest longitudinal/epidemiological study (we’ll define what that is shortly) in the U.S. is the one conducted in the town of Framingham Massachusetts.

In this study, they are looking at multiple negative clinical outcomes and clinical indicators. What’s more, they are even looking at this in the offspring now of the original study participants in hopes of evaluating genetic influences. In this study investigators are evaluating cause of death, diet, blood pressure, blood cholesterol levels, and various other blood constituents in hopes of establishing links to a number of negative clinical outcomes, such as heart attack, stroke and so on.

The following slide provides a simple illustration that indicates the relationship between a few negative clinical outcomes and clinical indicators.
Negative clinical outcomes are in red, while clinical indicators are in blue.
The following are different types of Nutritional Studies

Case Study (or Case Report)

Epidemiological Study

Longitudinal Study

Prospective Study (or Follow-up Study)

Dietary Intervention Trial (or clinical trial)

Animal Study

The next few slides describe each of these.
Case Studies

A case study is one that is based only on one individual. That is, all the data comes from just one person and not a group of subjects.

Often the data descriptive, sometimes quantitative, or may even be just a photograph.

An example of a case study is given in the following slide. It’s a simple report (published in the New England Journal of Medicine) that presents a radiograph as its data.
A 73-Year-Old Inuit Woman Was Referred for a Barium Enema After an Incomplete Colonoscopy. A preliminary abdominal radiograph showed that the appendix was completely full of lead shot, with the contour of the appendix easily visualized. The natives of northern and western Alaska hunt waterfowl in the spring and fall and often inadvertently swallow some of the lead shot embedded in the meat. Although most of the metal undoubtedly passes through the intestine over time, buckshot in the appendix is commonly seen in Alaskan natives (but usually not to the extent pictured here). Decades of ingestion probably resulted in this large accumulation. It is likely that poor dentition and advanced age are aggravating factors that prevent detection of the lead during mastication. A round piece of buckshot can be seen on the patient’s right above the appendix — probably evidence of a recent meal.

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Case studies might serve a couple of functions.

For one, they might serve to illustrate what can happen under rare, unusual, or extreme situations.

Secondly, they might stimulate ideas (hypothesis) for further experimental studies.

Nonetheless, one needs to appreciate their limitation.
The major limitation of a case study is that whatever the result is, you cannot reliably apply the results to population of people.

For example, there was a case study published several years ago that described a person who developed a laceration in their esophagus after eating tortilla chips.

Now does this mean that everyone who eats tortilla chips is at high risk of developing esophageal lacerations? And maybe we should take tortilla chips off the store shelves because they pose a hazard to the general public?

Clearly not. But, this case study does indicate that it is possible to scratch your esophagus with tortilla chips if you don’t chew them well before you swallow.
Epidemiological studies

We’ll define an epidemiological study as one that involves the study of a “large number” of people. These studies are also “observational”. That is, there is no initial treatment or control group.

So what’s a large number?

Anytime the number of subjects are in the high hundreds, but more often, when the numbers are in the thousands, we can call that a “large number”.

This means that an observational study of 3,442 people could be considered epidemiological, but one that involves only 35 people would not.
Longitudinal studies

Longitudinal studies are ones that last, typically, more than a year.

In fact, they often last many years or even decades.
An example of a longitudinal study would be a 2 year study that evaluates the effect of vitamin E supplementation on the incidence of heart attacks in a particular population.

It could be that a study that is any shorter in length may not be long enough to detect any differences in the number of heart attacks, if there is a difference.

On the other hand, some studies suffer from the flaw being too short, and not long enough.

An example of this would be 6 month long studies that try to evaluate the effect of diet on bone mineral density (bmd). There is a consensus that changes in bmd can’t be reliably determined in studies that last less than an year long (due to the rate of human bone turnover).
Prospective Versus Retrospective studies

A prospective study is one that starts at a given time point and moves forward into the future.

The study described in the previous slide would qualify as being a prospective study.

A retrospective study, on the other hand, is one that starts at a given time point but looks backwards in time.
An example of a retrospective study might be one where subjects who recently had strokes were compared to matched subjects who never had strokes.

In this case, all the subjects might be asked to fill out a food frequency questionnaire to evaluate their diet for the previous ten years.

In this way, the investigators could look at what was different about the diet of the stroke subjects over the last ten years compared to the nonstroke subjects.

Not surprisingly, this is not a particularly reliable study design since the accuracy of the data, and therefore, conclusions, are so highly dependent on subject memory.
Clinical Trial or Dietary Intervention Trial

This kind of study is described in this week's weekly lecture notes and won't be covered here.
Animal Studies

Obviously, these studies deal with animals.

Typically they might be mice, rats, or primates.

The nice thing about animal studies is that the investigator can strictly control the conditions, and make measurements that may not be possible to make in humans.

Still, they are animals, and it may not be appropriate to generalize the results of these studies to humans.
The following are questions to ask when evaluating news reports of nutritional studies.

1. What type of study was it?
2. What were the characteristics of the subjects and how many are there?
3. If it involves a change in diet, does the report indicate how much of a change?
4. What are the potential confounding factors?
5. Was the length of the study appropriate?

Unfortunately, most of the time way too little information is provided to give the report any practical value. Or worse, it may imply something that is simply not true.
Correlations versus Causal Factors

Just because something is found to be correlated with something else doesn’t necessarily mean the first “something” causes the second “something”.

For example, there are studies that indicated that a diet rich in Lycopene is associated with a decreased incidence of prostate Cancer.

This doesn’t necessarily mean that the lycopene rich foods Inhibit prostate cancer. It could be that men who eat lycopene rich foods are more likely to consume less saturated fat, and maybe that’s the cause. (It always takes multiple studies to evaluate something like this.)
Correlations versus Causal Factors

And even if the lycopene rich foods did inhibit the development of prostate cancer, one has to be careful and not conclude that it must be the lycopene itself.

It might be some other plant chemical (phytochemical), or mineral, present along with lycopene, or the ratio of lycopene and something else in those foods.

A causal factor is something that as far as all data indicate truly does cause a specific “something else” to occur.

For example, not drinking fluids and eating low water-content foods in the summer in Tucson could be a causal factor for dehydration.
Role of Statistics

In any study comparisons are made. And statistics is used to help make these comparisons. Make sure you understand the statistics ideas presented in the following tutorials 1C and 1D).
The following slide is a list to help determine if something causes something else.

It’s not 100% error-proof, but it’s a good start.
Six Points of Causality
(Adapted from “The Environment and Disease: Association or Causation?” by Sir Austin Bradford Hill, Proc Royal Soc Med (1965) 58, 295-300)

1. Correlation………………. If something causes something else there will be a correlation (but just because there's a correlation doesn’t mean one thing causes another.

2. Timing …. If one thing causes something else, then the timing should make sense. In other words, the causal factor should occur first before the effect.

3. Dose-Response Effect….. Typically, but not always, if one thing causes something else, the more causal factor present, the large should be the effect it causes.

4. Biological Plausibility ...... In nutrition, whatever we think is causing something needs to make biological sense.

5. Consistency or reproducibility between different studies .... This is self explanatory.

6. Removal of the causal factor…. If the causal factor is removed, then the effect it causes should disappear.