Why care about calories?

JUNE 27, 2014 50 COMMENTS

After the last blog post on calorie magic, my husband—whose intellectual response to people challenging me on the internet is to want to give them a virtual wedgie—asked me why I didn’t just engage those cute little white dude-o-scientists who are so pumped about how IT JUST MUST BE CALORIES CALORIES CALORIES CALORIES in some sort of PubMed duel to the finish.

My explanation: I don’t do PubMed duels. PubMed is a wonderful thing, and the internet has given us tremendous access to a great deal of information, much of which is used to confirm our own preconceived notions, even if (especially if?) we don’t fully understand what those notions actually are. As I’ve said before, a pastiche of PubMed citations frequently boils to a bunch of snapshots taken out of context of the larger literature—and out of context of a full understanding of physiological and biochemical realities, not to mention social and cultural ones—that may or may not express a physiologically significant or practically useful concept.

And this is problem: I’m not convinced that calories express a physiologically significant or practically useful concept. Here’s what I figure. If calories were so FREAKIN important, then my biochemistry books should be rife with information about them. But that does not seem to be the case.

[I took my first biochem class at age 45, weeping my way through one excruciatingly difficult exam after another. I emerged—bloodied by unbowed—to joyfully sign up for 3 more semesters. I don’t consider myself an expert by any stretch; I just feel that biochemistry is sort of the key to the universe, certainly the universe of nutrition. If something doesn’t make sense from a biochemical perspective—which would apply to about 90% of the Dietary Guidelines—it shouldn’t be part of nutrition policy.]

I did this a while back, just for my own peace of mind, and I don’t know how useful it will be to any of you, but here’s what my collection of biochem books has to say about calories. Spoiler alert: Not much. [So you can stop here if you have a life.]

My biochemistry books, in order of how much I love them, least to most:
I don't know why I have this book.

- “Calorie” is indexed to a passage on units of energy in a discussion of thermodynamics. Calories are not mentioned again.

- “Calorimetry, direct” and “calorimetry, indirect” are indexed to passages discussing the measurements of energy expenditure. It contains this notable summary:

"Although changes in energy balance produce weight changes, the extent of these changes varies from person to person."
I got this book with great anticipation, as it seemed to promise a better integration of biochemistry and physiology than most biochem texts. But like some sort of weird Asian-fusion spicy wonton Alfredo dish, I guess it is just trying to do too much. There is not enough detail here for me, and the reader is left to sort of assume “magic elves in a box” in too many places, which—as far as I am concerned—defeats the whole point of learning biochemistry.

—“Calorie” is not indexed.

—“Calorimetry” is indexed. This couple of pages highlights the limitations of measuring calorie expenditure in the human body.

**Biochemistry (4th Edition), Lippincott’s Illustrated Reviews, 2008**

*Pamela Champe, Richard Harvey, & Denise Farrier*

This is the boy-toy of my biochem texts. I don’t love this book, but it is much more portable than my other biochem texts, so I can take it out in public without too much embarrassment.

—“Calorie” is not indexed.

—“Caloric consumption,” “caloric restriction, weight reduction and,” and “calorimeter” are indexed.

“Caloric consumption” addresses the fact that the source of the increase in calories consumed by Americans since 1971 is carbohydrates.

“Caloric restriction, weight reduction and” is indexed to a page includes the following helpful information:

“Caloric restriction is ineffective over the long term for many individuals.”
I approach the Voets with the reverence and respect due a giant doorstop of a book like this. Like that scary old professor who knows everything, it is intimidating, but, well, it knows everything.

"Calorie (cal)" and "Calorie, large (Cal)" are indexed to the same place. The indexing refers to a table that compares thermodynamic units and constants as an adjunct to a passage on the First Law of Thermodynamics. This passage contains a little nugget of joy for those of us who insist that conversations about weight management may need to consider more than just how many calories go “in” and how many calories go “out.” Unless you are a fully registered and certified geek, you may want to just skip ahead:

“Neither heat [i.e. what is measured by calories] nor work is separately a state function [i.e. quantities that depend only on the state of the system] because each is dependent on the path followed by a system in changing from one state to another . . . If [the First Law of Thermodynamics] is to be obeyed, heat must also be path dependent. It is therefore meaningless to refer to the heat or work content of a system (in the same way that it is meaningless to refer to the number of one dollar bills and ten dollar bills in a bank account containing $85.00).”

This is why when someone talks about a person storing “800 calories of energy as fat,” I hear something that makes about as much sense to me as saying a person can store “$85 dollars worth of money in his bank account as four twenties and a fiver.”

Calories are otherwise never mentioned again in the rest of the 1,310 pages of this book.
Biochemistry (6th edition), 2009

Mary Campbell & Shawn Farrell

Campbell y Farrell is my warm fuzzy teddy-bear of a biochem book. I LUV it. Cuddle up with C&F for a well-written, easy-to-understand (as these things go) romp through the wonders of biochem.

- "Calorie" is not indexed.

- "Caloric restriction" is indexed to a discussion of longevity and sirtuins, not weight loss or obesity.


David L. Nelson & Michael M. Cox

This is my favorite biochemistry book ever. If it were available and I were single, I would marry it in a hot second.

- "Calorie" is not indexed. Nor is "kilocalorie." Nor anything else that I could think of having to do with "calories."

There you have it. Seems to me that all those broscientists want to talk about is something that doesn’t have a lot to do with the keys to the universe of nutrition. I don’t mind talking biochemistry, but the basic biochemistry that I’m familiar with has virtually nothing to say about calories.

And if biochemistry isn’t too concerned with calories, why should you be?
Full disclosure: I happen to love biochemistry. I have a favorite transcription factor (ChREBP) and a favorite neurotrophic factor (BDNF). I think proteins are beautiful. If I were a biochemist who had discovered a novel protein, I would carry a picture of it around with me in my wallet.

An absolutely fabulous (looking) protein.

The animal and cells models used in biochemistry are great for looking at genetics, epigenetics, at biological mechanisms, and how these things interact. We can manipulate these models in ways that we can’t with humans, and this has given us some crucial insights into mechanisms, especially neural and epigenetic ones—critical to understanding the effects of nutrition—that would be virtually impossible to study in humans.
Nutritional biochemistry can also wear the mantle of "objective-er than thou" when it comes to science. As one of the biochem profs at UNC noted: If you have to use statistics to discuss the results of your experiment, you need to redesign your experiment. Sure, the questions asked, the interpretation of results, and what gets published in biochem are influenced by funding sources, social/scientific contexts and dominant paradigms. But unless you are a truly bad scientist, you can't make the experimental results come out in a way that supports your hypothesis.

(This is in marked contrast to observational studies in nutrition epidemiology where the whole point of the data analysis "experiment" is to find results that support your hypothesis. Sometimes you don't find them, and those findings should be reported, although they may not be because who's to know? Just you and your SAS files. My point is that you are actively seeking results that confirm a particular idea, and this just might influence what "results" are found. More on this in another post.)

But beyond the utility and elegance of nutritional biochemistry, the problems with regard to health policy are two-fold.

The first problem: In many ways, nutrition policy has become almost completely divorced from the basic science investigations done in biochemistry. The Dietary Guidelines Advisory Committee (DGAC)—the committee of scientists that, at least theoretically, reviews the science upon which the US Dietary Guidelines are based—started in 1985 as mostly MDs and biochemistry professors. As time went on, the DGAC became more heavily populated with epidemiologists. This would be fine if epidemiology was meant to generate conclusive (or even semi-conclusive) results. It isn’t. Epidemiology gives us associations and relationships that are meant to be understood through a reasonably plausible, preferably known, biological mechanism. Note these interesting conclusions from the 2010 DGAC Report and the 2010 Dietary Guidelines policy document with regard to dietary cholesterol:

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Here's our mechanism: "Exogenous, or dietary, cholesterol down-regulates cholesterol synthesis in the liver to maintain cholesterol balance."
[D3-1, Reference 1, emphasis mine]

Here's our epidemiology: "Traditionally, because dietary cholesterol has been shown to raise LDL cholesterol and high intakes induce atherosclerosis in observational studies, the prevailing recommendation has been to restrict dietary cholesterol intake, including otherwise healthy foods such as eggs."
[D3-2, Reference 1, emphasis mine, "induce"? really? how does one "observe" that cholesterol "induces" atherosclerosis? I'm assuming committee fatigue had set in at this point because that word should have been "are associated with"]

Here's our policy recommendation: "Consume less than 300 mg per day of dietary cholesterol."
[Ch. 3, p. 21, Reference 2]

See, wasn't that easy?

This brings me to the second problem, which is sort of the flip-side of the first: Biochemical processes that are understood primarily through mouse or cell models only work as the basis for dietary recommendations for chronic disease if you're making them for cells or mice.

As one of my favorite professors in the Nutrition department likes to quip, "We know how to cure obesity—in mice. We know how to cure diabetes—in mice. We have all the knowledge we need to keep our rodent population quite healthy."

Obviously this knowledge has not been translatable to humans. In some ways, basic nutrition biochemistry should be divorced from public health policy.

The reason for this is that the equivalency of animal models to humans is limited in ways that go beyond simple biological comparisons—although the biological differences are significant.
My knowledge of comparative physiology is limited at best, but my understanding is that most rodents used in nutrition biochemistry work (rats included) have a cecum (an intestinal pouch that facilitates the breakdown of cellulose), an adaptation that would be necessary in a diet composed of hard-to-digest plant material such as seeds and grains. Because this process is not terribly efficient, many rodents also recycle nutrients by eating their feces. Humans don’t have a functional cecum for fermentation; we don’t tend to reingest our own poops (or anyone else’s poop, unless you’re starring in a John Waters film) in order to extract further nutrition from them as our bodies are already very efficient at this during the first go-round.

Furthermore, due to inherent difference in physiology, animals may not accurately model the physiological conditions that produce disease in humans. For example, in some species of rodents, a high fat diet will induce insulin resistance, but there is no definitive evidence that higher fat intake per se impairs insulin sensitivity in humans [3]. Why this is so is not entirely clear, but likely has something to do with the diet each species has consumed throughout its evolution. In a natural setting, rodents may do well on a diet of mostly grains. On the other hand, humans in a natural setting would do okay on a diet of mostly rodents.

What is more critical is that animal and cell life can’t imitate the complex environmental inputs that humans encounter throughout their lives and during each day. Animals and cells only get to consume what they are given. If you’ve ever been at a conference where the breakfast is low-fat muffins, whole grain bagels, fat-free yogurt, orange juice, and fruit, you know what that feels like. But typically our food choices are influenced by a multitude of factors. Mice, unlike humans, cannot be adversely affected by labeling information on a box of Lucky Charms.
Mice don't know that whole grains are supposed to be good for you.  
Bad on them.

Does that matter? You bet it does.

Where do most Americans get their nutrition information these days? From media sources including the internet, from their grocery stores, from the packages holding the food they buy. People who have never read a nutrition book, much less the actual Dietary Guidelines, still “know” fat is bad and whole grain is good [4, 5]. These environmental exposures affect food choices. Whether or not the person still decides to consume food with a high fat content depends on another set of cultural factors that might include socioeconomic status, education, race or ethnicity, age, gender—in other words, things we can’t even begin to replicate in animal or cell models.

Human biochemistry is unique and complex, as are our social and cultural conditions, making it very difficult to study how these primary contributors to health and food choices are related to each other.

Can we do a better job with nutritional epidemiology? I know you’re on the edge of your seat waiting for the next episode in the unfolding drama, N of 1 Nutrition, when we get to hear Walter Willett say:

"I never met a statistical man I didn't like."

Stay tuned.

References:


3. Report of the Panel on Macronutrients, Subcommittees on Upper Reference Levels of Nutrients and Interpretation
Below that is my menu (menu-primary) and all of that mentioned falls into the header. My template does not allow me to insert a logo in the header in settings or customizations. I would like to insert a site-logo about half-way down the page right underneath the menu section. I suppose I should probably make it clickable to my homepage or something and make sure it is a valid XHTML clickable header image? I am not sure if that is a bad idea or not seeing as the site title will link back to the homepage. Primary Header is a default header provided by the Astra. You can customize the primary header with this option. You can find the setting under Appearance > Customize > Layout > Primary Header. Alignment. You can set three different positions for the logo in the header. Left. If you need to disable the Menu from the Primary header you can easily do it with Disable Menu option. This option is useful while designing the custom headers. Custom Menu Item. It allows you to add a custom menu item at the end of the primary menu. Just as you might suspect, a primary menu is the top-level menu used on a WordPress site. In WordPress, menus are clickable options that are displayed on your website both on the front page as well as on each individual page or post. You can set up multiple menus or just one, and where these menus are displayed on the screen is determined by your theme. Menus can be stacked and nested in a hierarchy so that clicking on one menu option opens up a new menu.