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## **Course description**

This seminar considers evolutionary factors underlying how variations in diet and exercise affect the human body. Weekly readings and discussion will be used to explore how ancestral diets and forms of physical activity have shaped human anatomy and physiology, and how differences between past and present diets and forms of exercise may contribute to illness, mortality, and variations in reproductive success. In doing so, we challenge popular conceptions of what it means to be “healthy.”

## Course structure

Each week we will meet to discuss selected readings on core topics, organized around questions. Because we aim to use evolutionary theory and data to explore and critique some big, important questions, it is imperative that you read and think about these readings before class. To encourage you to think broadly and to stimulate debate, during class we may randomly assign you to advocate and defend one or another point of view. We anticipate learning as much from one another as we do from the readings, and so we encourage you to leverage your own research and expertise in assessing these topics. However, to assist others in internalizing and evaluating your contributions, please be prepared to share citations for any points you raise that are not covered in the assigned readings.

## Course requirements

- Informed, engaged, and thoughtful participation in class (40%)
- Mid-term paper (approximately 2,500 words) due March 21 (20% of final grade):  
*What did we evolve to eat? What physical activities did we evolve to do?*
- Final paper (approximately 5,000 words) due May 2 (40% of final grade):  
From a set of candidates compiled by the instructors, you will be assigned a disease to evaluate. *What is the present medical understanding of the disease, its causes, and its risk factors? How does consideration of our evolutionary history change this understanding? If you were a clinician, how (if at all) might this knowledge alter the way you practice?*

With the aim of maintaining fluid discussions and accommodating student backgrounds and interests, the required readings for this course will be assigned on a rolling basis. Readings will be available on the course website at least one week in advance, unless otherwise noted, and must be reviewed prior to the meeting for which they are listed. Please note that this is a reading-intensive seminar. We anticipate that the average student will require 6+ hours per week to complete the readings, with additional time required for contemplation and synthesis. Please do yourself a favor by starting early and granting yourself time to think!

## **Class Policies**

### ***Collaboration***

In this course, we hope that you learn as much from each other as you do from the readings. Therefore, you are encouraged to discuss class topics, readings, and assignments outside of class. However, your contributions in class discussions and the written work that you submit for evaluation must reflect your own efforts. In addition, we draw your attention to the Faculty of Arts and Sciences policy on the proper crediting of sources:

“It is expected that all homework assignments, projects, lab reports, papers, theses, and examinations and any other work submitted for academic credit will be the student’s own. Students should always take great care to distinguish their own ideas and knowledge from information derived from sources. The term “sources” includes not only primary and secondary material published in print or online, but also information and opinions gained directly from other people. Quotations must be placed properly within quotation marks and must be cited fully. In addition, all paraphrased material must be acknowledged completely. Whenever ideas or facts are derived from a student’s reading and research or from a student’s own writings, the sources must be indicated.” (Except from the Student Handbook)

### ***Attendance***

You are expected to attend all class meetings, except in extraordinary circumstances. If you cannot attend class due to illness or an emergency, you must notify the instructors in advance. You may be offered the opportunity to receive participation credit for the missed seminar by completing an opinion piece that will be shared with the entire class and graded for quality.

### ***Grading***

Grades will be assigned based on FAS guidelines, as follows:

- A: “excellent quality; full mastery of subject”
- B: “good comprehension of course material; and good commandment of skills“
- C: “adequate and satisfactory; basic requirements met”
- D: “unsatisfactory with minimal commandment of material”

## Weekly Questions

### Week 1 (January 24). The modern problem.

- What is health? Is it different under clinical, individual and evolutionary perspectives?
- How have patterns of morbidity and mortality changed over historical and evolutionary time?
- What is the state of health and healthcare today?
- How do we evaluate different lines of evidence about health and evolution? What are the strengths and weaknesses of different study designs?

### **Week 1 Readings:**

Shopping period – no reading required before the first meeting

### **For more information:**

- Huber M et al. (2011) How should we define health? *BMJ* 343: d4163.
- Finch CE (2010) Evolution of the human lifespan and diseases of aging: roles of infection, inflammation, and nutrition. *PNAS* 107: 1718–1724.
- Gurven M, Kaplan H (2007) Longevity among hunter-gatherers: a cross-cultural examination. *Population and Development Review* 33: 321-365.
- Kaplan HS et al. (2000) A theory of human life history evolution: diet, intelligence, and longevity. *Evolutionary Anthropology* 9: 156-183.
- Hawkes K, Smith KR, Robson SL (2009) Mortality and fertility rates in humans and chimpanzees: how within-species variation complicates cross-species comparisons. *American Journal of Human Biology* 21: 578-586.
- Blurton Jones NG et al. (1992) Demography of the Hadza, an increasing and high density population of Savanna foragers. *American Journal of Physical Anthropology* 89: 159-181.
- GBD 2015 Mortality and Causes of Death Collaborators (2016) Global, regional, and national life expectancy, all-cause mortality, and cause-specific mortality for 249 causes of death, 1980–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet* 388: 1459-1544.
- GBD 2015 DALYs and HALE Collaborators (2016) Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. *The Lancet* 388: 1603-1658.
- Makary M, Daniel M (2016) Medical error – the third leading cause of death in the US. *BMJ* 353.i2139. See also: <http://jamanetwork.com/journals/jama/fullarticle/2544638>.
- Paulsen HE (2009) Why epidemiological and clinical intervention studies often give different or diverging results? *Life* 61: 391-393.
- Concato J, Shah N, Horwitz RI (2000) Randomized, controlled trials, observational studies, and the hierarchy of research designs. *New England Journal of Medicine* 342: 1887-1892.

## **Week 2 (January 31). Mismatch.**

- What is mismatch?
- How do you test hypotheses of mismatch?
- How do modern and Paleolithic diets and activity levels differ, and do they cause mismatches?
- What is the quality of evidence on mismatch?

### **Week 2 Readings:**

Wells JCK, Nesse RM, Sear R, Johnstone RA, Stearns SC (2017) Evolutionary public health: introducing the concept. *The Lancet* 390: 500-509.

Online exhibit of dietary changes over historical and evolutionary time:

<https://www.nationalgeographic.com/foodfeatures/diet-similarity/>

<https://www.nationalgeographic.com/foodfeatures/evolution-of-diet/>

Ludwig DS (2011) Technology, diet, and the burden of chronic disease. *JAMA* 305: 1352-1353.

Eaton SB, Konner M (1985) Paleolithic nutrition: a consideration of its nature and current implications. *New England Journal of Medicine* 312: 283-289.

Ding D et al. (2016) The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *The Lancet* 388: 1311-1324.

Lieberman DE (2015) Is exercise really medicine? An evolutionary perspective.

*Current Sports Medicine Reports* 14: 313-319.

Pontzer H et al. (2015) Energy expenditure and activity among Hadza hunter-gatherers.

*American Journal of Human Biology* 27: 628-637.

### **For more information:**

Lieberman DE (2013) "Chapter 7: Progress, Mismatch and Dysevolution" in *The Story of the Human Body: Evolution, Health and Disease*. Pantheon Books: New York.

Jasienska G, Bribiescas RG, Furberg AS, Helle S, Núñez-de la Mora A (2017) Human reproduction and health: an evolutionary perspective. *The Lancet* 390: 510-520.

Rook G, Bäckhed F, Levin BR, McFall-Ngai MJ, McLean AR (2017) Evolution, human-microbe interactions, and life history plasticity. *The Lancet* 390: 521-530.

Konner M, Eaton SB (2010) Paleolithic nutrition: twenty-five years later. *Nutrition in Clinical Practice* 25: 594-602.

Raichlen DA et al. (2016) Physical activity patterns and biomarkers of cardiovascular disease risk in hunter-gatherers. *American Journal of Human Biology*, doi: 10.1002/ajhb.22919.

O'Keefe JH et al. (2010) Organic fitness: physical activity consistent with our hunter-gatherer heritage. *The Physician and Sports Medicine* 4: 1-8.

Cordain L et al. (1998) Physical activity, energy expenditure and fitness: an evolutionary perspective. *International Journal of Sports Medicine* 19: 328-335.

Valero-Elizondo J et al. (2016) Economic impact of moderate-vigorous physical activity among those with and without established cardiovascular disease: 2012 Medical Expenditure Panel survey. *Journal of the American Heart Association* 5: e003614.

**Note:** Required readings for Weeks 3-13 will be assigned on a rolling basis. Readings will be available on the course website one week in advance, unless otherwise noted.

### **Week 3 (February 7). Does sugar make us fat?**

- How much and in what way has sugar consumption changed?
- How are fructose and glucose digested differently?
- How much sugar is too much and what are the consequences?

### **Week 4 (February 14). When does sugar lead to insulin resistance?**

- Why do some people but not others become insulin resistant?
- What accounts for healthy obese and diabetic thin people?
- Is insulin resistance a mismatch condition?

### **Week 5 (February 21). Does fat make us fat?**

- How has fat consumption changed over time?
- How good/bad are different fats?
- Can high-fat diets (e.g. Atkins, Inuit, ketogenic) really help people lose weight?

### **Weeks 6-7 (February 28 & March 7). Can diet and/or exercise prevent heart disease?**

- To what extent do diet versus exercise influence the risk of heart disease?
- How heart-unhealthy are “bad” cholesterol?
- Do microbial influences on atherosclerosis alter our view of traditional risk factors?
- Can a person exercise too much?

**SPRING BREAK – No meeting on March 14**

### **Week 8 (March 21). Why do so many diets fail?**

- What percentage of diets actually fail, over what time period, and why?
- How does weight loss affect energy expenditure?
- How does weight loss affect food intake?

**Note:** Midterm paper due March 21 by 5 pm (20% of final grade)

### **Week 9 (March 28). Does exercise help us lose weight?**

- How does physical activity affect metabolic rate and energy allocation?
- Does physical activity affect appetite and energy balance?
- Is physical activity useful for losing weight?
- How do different types of physical activity affect ectopic versus subcutaneous fat utilization?

### **Week 10 (April 4). How do diet and exercise affect aging?**

- Why do we age, get sick and die?
- Does caloric restriction and/or protein restriction slow aging? If so, how do we reconcile this with an adaptive view of energy allocation?
- How much does physical activity affect cardiovascular and/or skeletal aging?

### **Week 11 (April 11). How do diet and exercise affect inflammation?**

- What is inflammation and how important is it?
- Is systemic inflammation modulated by the gut microbiota?
- Why does exercise both elevate and depress systemic inflammation?
- Why and to what extent is visceral fat pro-inflammatory?

### **Week 12 (April 18). How do diet and exercise affect the brain and behavior?**

- How and why do diet and exercise affect mood and mental health?
- Why does exercise make you smart?
- Can diet and exercise alter neurodevelopment and/or neurodegeneration?
- How does the gut communicate with the brain?

### **Week 13 (April 25). Gene-environment interactions.**

- What explains inter-individual differences in response to diet and exercise?
- How do we test for gene-environment interactions?
- How can knowledge of gene-environment interactions improve human health?

**Note:** Final paper due May 2 by 5 pm (40% of final grade)