KNES 495 Physiological Aspects of Aging, Disease and Physical Activity

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Course content is divided into three parts:

1. Cellular basis of aging

2. Effect of aging on human performance and its physiological basis

3. Effect of aging on disease incidence and the effect of physical activity
Focus

• Physiology
  – It will be assumed that you know and understand basic human physiology
  – It will be assumed that you know and understand basic exercise physiology

• Challenge
  – There is no textbook because we will be dealing with current information
  – Working at the boundary between the unknown, the theoretical, and reality
    • Thinking is encouraged...
Resource Materials

• Course Notes (posted to web prior to class)

• Course Pack (mandatory) – available in “Bound and Copied” (downstairs of Mac Hall)

• Physiological Basis of Aging and Geriatrics. 3rd Edition, by P.S. Timiras. CRC Press, 2003 – recommended only if you think you will go on learning about aging
  – There is also a copy in the library
Evaluation

• Midterm 1 – 30%

• Pop Quizzes on readings – 10%

• Hand-in Assignments – 20%

• Final Exam – 40%
Quizzes

• Quizzes will be based upon the assigned readings from the course pack

• There is no guesswork – the syllabus tells you when there is a quiz

• Each of the quizzes is based upon a current topical review article
Hand-in Assignments

- Beginning in second part of course
- Assignments are based upon a question and an associated reading or two

- Two parts to assignment:
  - Part I – hand-in at beginning of class denoted by the date in the syllabus
  - Part II – hand-in at beginning of next class
Website

http://www.kin.ucalgary.ca/courses/knes495/

- Login: knes495 (this is case sensitive!)
- Password: mortality
- Notes will be posted prior to each class in pdf format
Important terms & concepts

• **Aging** – Latin “aetas”, age or lifetime – the condition of becoming old
• **Sensescence** – Latin “senex”, old man – the condition of being old
• **Geriatrics** – Greek “geron”, old man, and “iatros”, healer – a medical specialty dealing with the problems of diseases of the elderly
• **Gerontology** – Greek “geron”, old man, and “logos”, knowledge – the study of aging and the problems of old age
• **Fitness** – as related to survival, not exercise. For example, reproductive fitness

From: Table 1.2 in Timiras. Physiological Basis of Aging and Geriatrics, 2003
Life Span

- Refers to the period between birth and death
- May be applied to individuals or to a population
- When applied to a population, we need to qualify the definition
  - Maximal observed life span refers to the highest recorded age at death (record life span)
  - The theoretical highest attainable age is the maximum potential life span, maximum theoretical life span, or species-specific life span
  - Thus, depending on context, maximum life span refers to either the observed (oldest individual) or the theoretical life span (potential for a population)
Concepts of Life Span

• In some organisms, events related to reproduction result in death
  – Spawning salmon, drone honeybees, etc.

• In most species, life span is indeterminate
  – There is no internal clock signalling the end of life
  – Thought experiment: If it were possible to live a life repeatedly under exactly the same conditions, would life span be the same each time?
Consequences of Aging

• Wide variability in function between individuals

• Changes in function do not affect all systems/tissues simultaneously

• Changes in function are variable between systems/tissues
What is Aging?

• A single process or multiple processes?
  – Do atoms age?

• Does aging cause death?
  – Does anyone die of old age?

• Why do we live longer than some other organisms?

• Why do we age?
• Why do we die?
Aging defined

• Functional definition: aging refers to a time-dependent decline in function
Are there any examples of immortal cells?

• Cancer cells are immortal because they can undergo an unlimited number of population doublings – the only thing that stops their growth is treatment or the death of the patient

• Germ cells – you know, down “there”
Germ Cells

• All of your body’s cells came from the fertilized ovum, which came from your mother and father.
• Note that their egg and sperm came from their own cells (which are adult) yet your cells begin as embryonic – why, how?
• Also note that this process has been going on since life first appeared, so germ cells are immortal and can trace their lineage to the very first organism to have somatic and germ cells, the volvox.
Volvox carteri
Aging & Disease

• Increased incidence of disease with aging
  – Makes studying the aging process difficult: how do you separate one from the other?
• Is aging a disease?
• Both are distinct processes that interact
  – E.g., physiological changes associated with aging make us more susceptible to certain diseases in old age; some diseases may accelerate cellular aging
• Environmental influences (e.g., nutrition, physical activity, occupational/environmental hazards) strongly influence both the decrement in function with aging and disease incidence
If you slow down aging, you also delay disease onset.

Research on Aging: Biggest Bang for the Buck?

- Just Like Today—average 50-year-old woman lives to 81
- Cure Cancer Today
- Cure Heart Disease Today
- Cure Cancer and Heart Disease Today
- Cure Cancer, Heart Disease, Stroke, and Diabetes Today
- Slow Down Aging

What is the link between Aging and Disease?

- Does slowing down aging delay disease because aging renders us more susceptible to disease?
  - E.g., reduced sensitivity of apoptosis pathway renders us more susceptible to cancer

- Or, is the link between aging and disease merely coincidental?
  - E.g., It takes time to accrue tissue damage that leads to disease and thus, diseases tend to accumulate at older ages

- Or, are there common factors that cause disease and aging?
  - Excessive caloric intake increases insulin signalling which not only blunts insulin responsiveness but also accelerates aging by increasing oxidative stress
Causes of death

• **Disease**
  1. Coronary artery disease (CAD)
  2. Cancer
  3. Cerebrovascular disease (stroke)
  4. Pulmonary disease

• **Accidents**

• **Aging?**
  – In theory, “death from old age” should only occur when organ failure occurs due to aging-related cell death
Causes of disease

- Although there is great excitement about uncovering the genetic aspects of disease, environmental influences are extremely important.

- Physical Inactivity and poor diet are the most important environmental influences on disease incidence with aging.
  - This applies not only to cardiovascular diseases (CVD, stroke), but also to diabetes (type II), obesity, and cancer.
Physical Inactivity

• A major study by *Andersen et al. found that leisure time activity was inversely related to all-cause mortality
• In the ≥ 65 y age group, being highly active reduced your risk of dying by 40%!
• Highly physically active = perform vigorous physical activity > 4 h per week or regularly exercise/compete several times per week