Обследования населения, биомаркеры и продолжительность здоровой жизни

Н.С. Гаврилова

Декомпозиция продолжительности жизни по возрасту и причинам смерти

Метод декомпозиции

- Предложен Андреевым (1982), Поллардом (1982) и Арриагой (1984)

Декомпозиция по возрасту

$$\Delta_x = \frac{l_x^1}{l_0^1} \cdot \left(\frac{L_x^2}{l_x^2} - \frac{L_x^1}{l_x^1} \right) + \frac{T_{x+n}^2}{l_0^1} \cdot \left(\frac{l_x^1}{l_x^2} - \frac{l_{x+n}^1}{l_{x+n}^2} \right)$$

где величины l_x, L_x, T_x представляют собой стандартные величины из обычной таблицы смертности, а индексы 1 и 2 соответствуют не возведению в степень, а популяции 1 и популяции 2 соответственно (то есть двум сравниваемым популяциям).

Необходимо рассчитать обычные таблицы смертности для двух сравниваемых популяций

Декомпозиция по возрасту

$$\Delta_{\omega} = \frac{l_{\omega}^{1}}{l_{0}^{1}} \cdot \left(\frac{T_{\omega}^{2}}{l_{\omega}^{2}} - \frac{T_{\omega}^{1}}{l_{\omega}^{1}} \right)$$

Последний открытый возрастной интервал

Декомпозиция вклада отдельных причин в различия по продолжительности жизни

$$\Delta_x^i = \Delta_x \cdot \frac{m_x^{i(2)} - m_x^{i(1)}}{m_x^{(2)} - m_x^{(1)}}$$

$$= \Delta_x \cdot \frac{R_x^{i(2)} \cdot m_x^{(2)} - R_x^{i(1)} \cdot m_x^{(1)}}{m_x^{(2)} - m_x^{(1)}}$$

где R^i_x обозначает пропорцию смертей от причины *i* в возрастной группе (x, x+n), то есть D^i_x/D_x. В данном случае D^i_x соответствует наблюдаемому чилу умерших от причины *i* в возрастном интервале (x, x+n), а D_x - соответсвующее число умерших от всех причин.

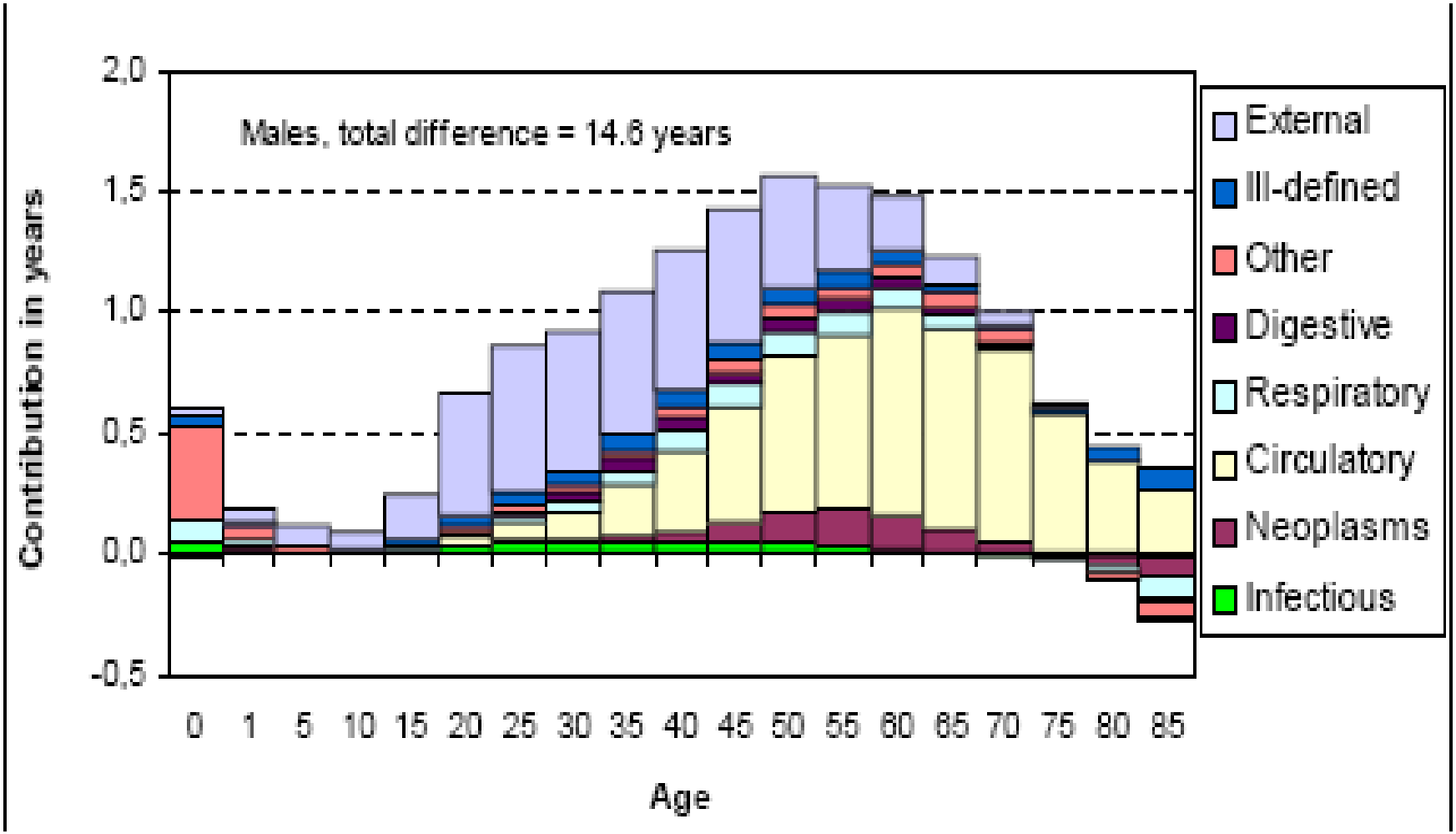
Декомпозиция по причинам смерти

Индексы (1) и (2) соответсвуют сравниваемым популяциям. Значения m_x соответсвуют табличным коэффициентам смертности от всех причин, которые можно получить из обычной таблицы смертности, поскольку $m_x = d_x/L_x$. В данной формуле величина Δ_x соответствует вкладу различий в смертности от всех причин в возрастном интервале (x, x+n) в наблюдаемые различия в ожидаемой продолжительности жизни. Можно показать, что $\Delta_x = \sum_i \Delta_x^i$

а также что

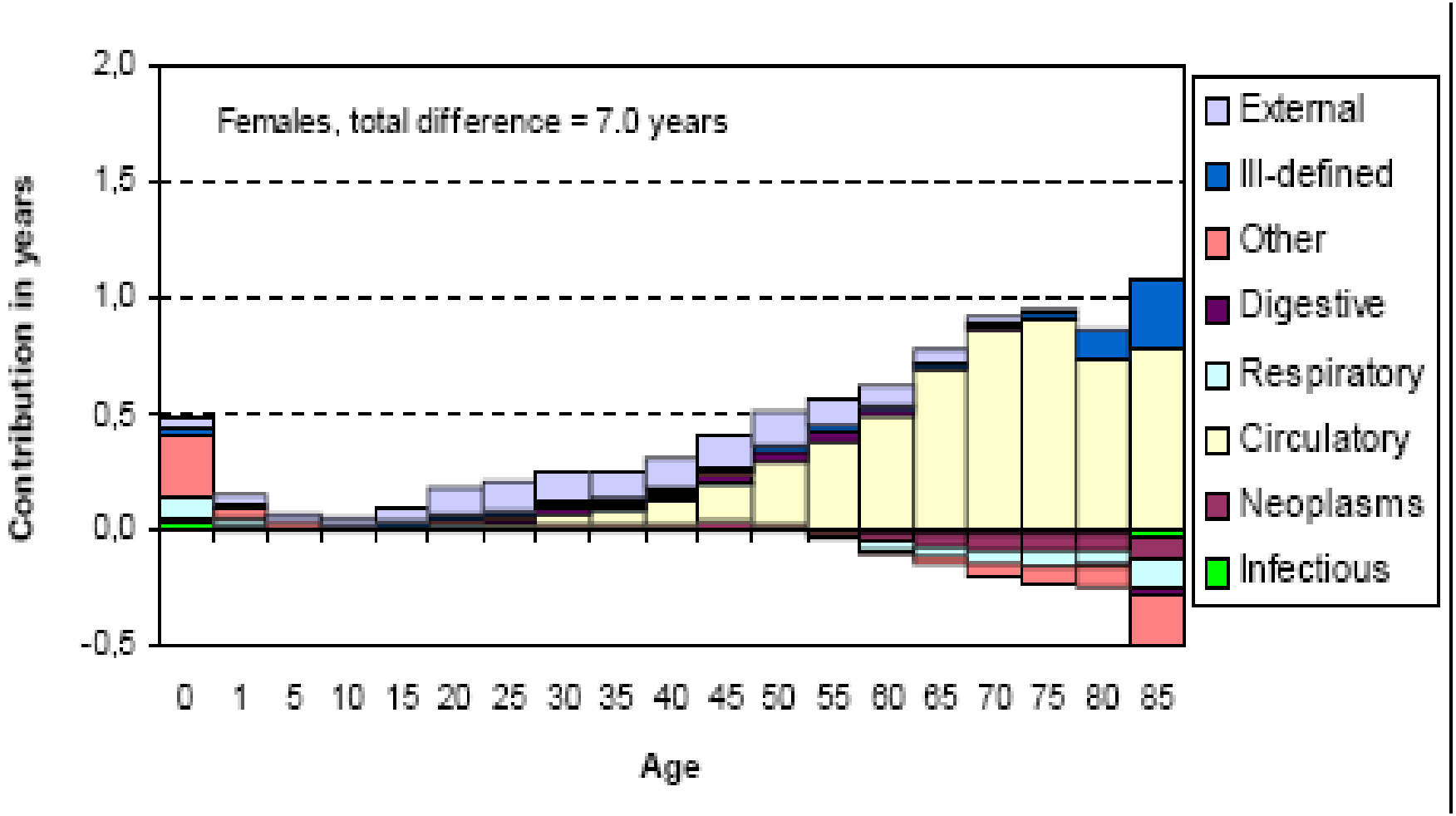
$$e_0^{(1)} - e_x^{(2)} = \sum_x \Delta_x = \sum_x \sum_i \Delta_x^i$$

Decomposition of the U.S.-Russia gap in life expectancy by cause



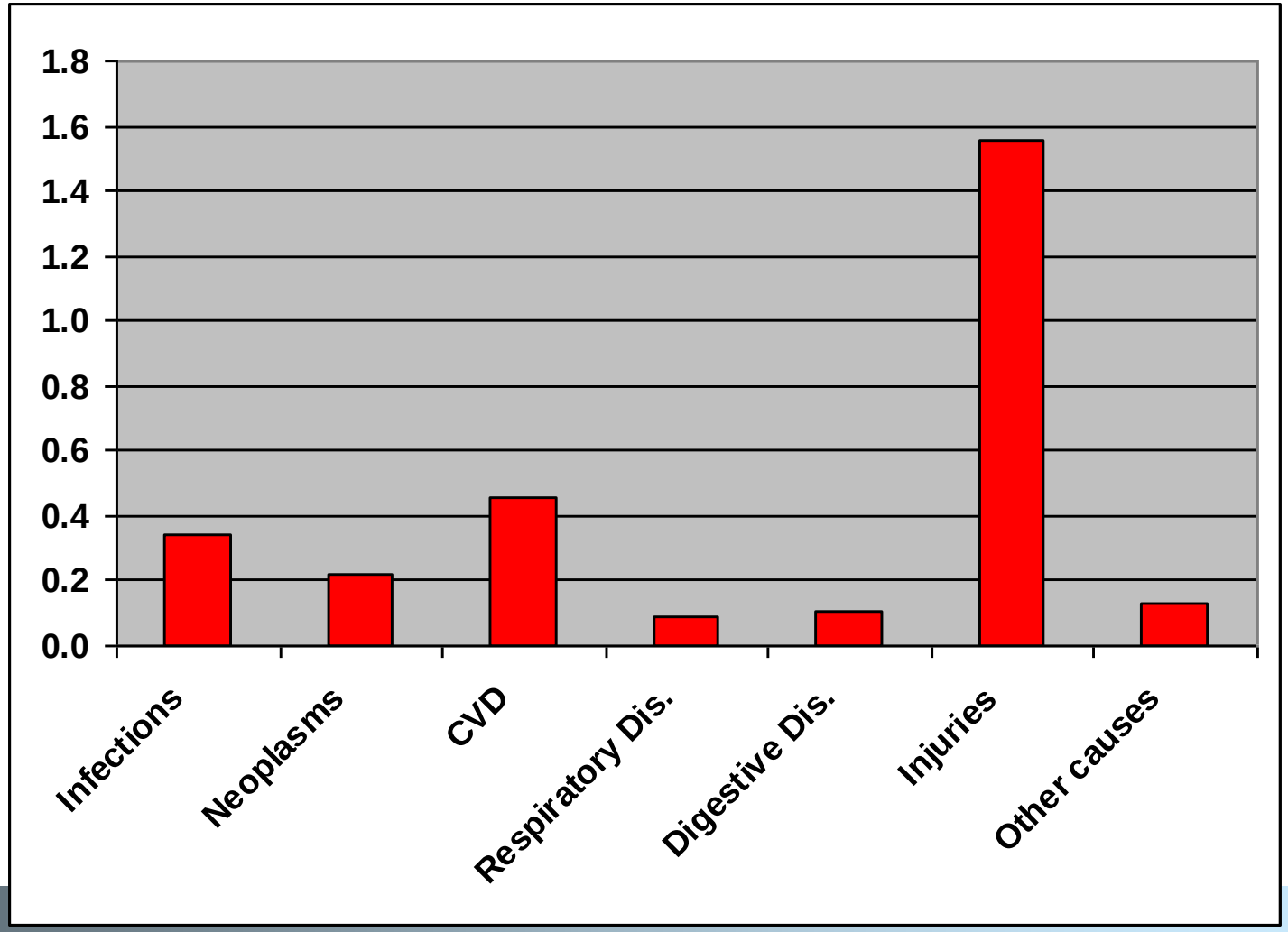
USA – 1999; Russia – 2001. Source: Shkolnikov et a. Mortality reversal in Russia.

Decomposition of the U.S.-Russia gap in life expectancy by cause

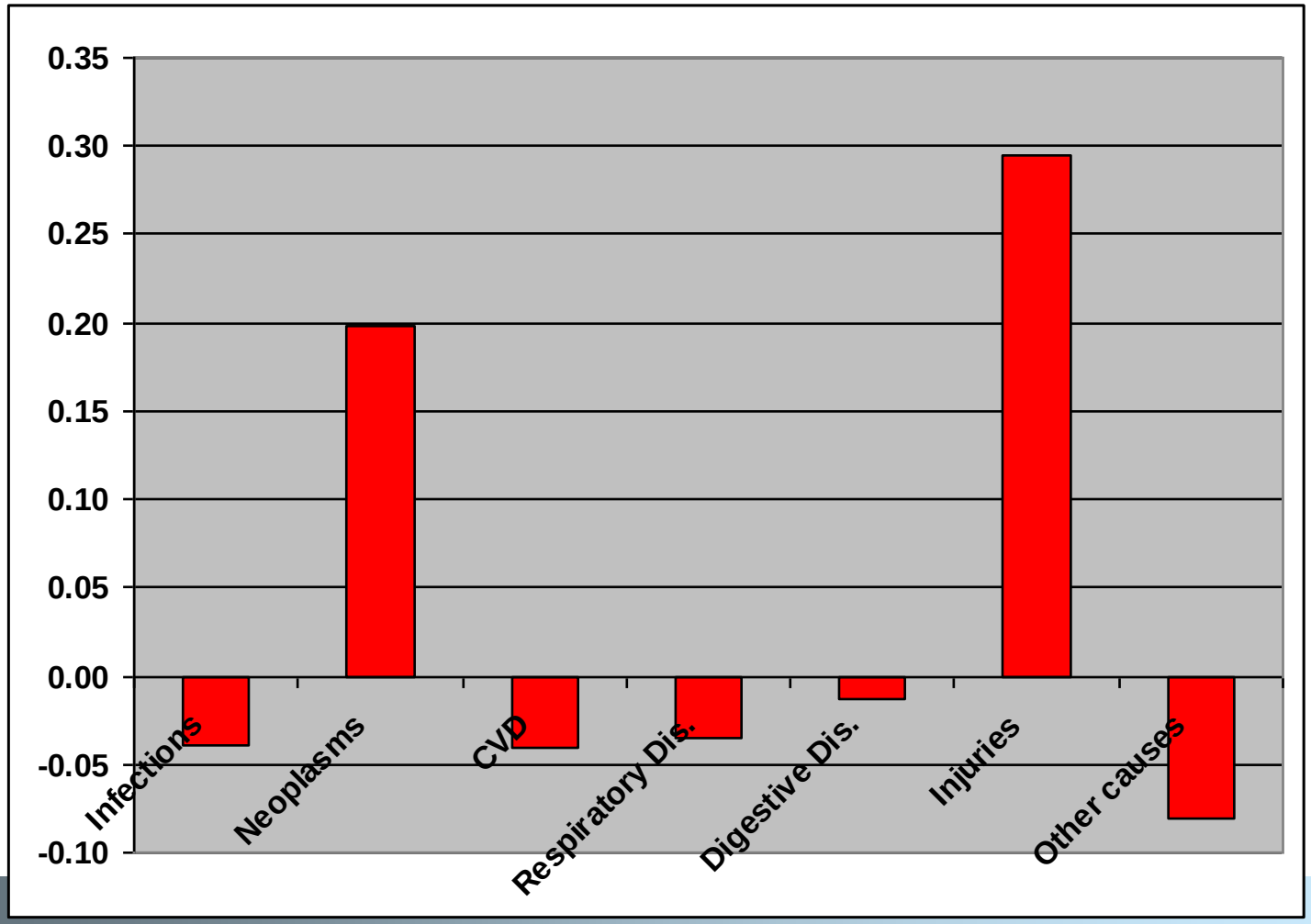


USA – 1999; Russia – 2001. Source: Shkolnikov et a. Mortality reversal in Russia.

Contribution of causes of death to $_{40}e_{20}$(CA) - $_{40}e_{20}$(Slav) Males (total difference = 2.90 years)



Contribution of causes of death to $_{40}e_{20}$(CA) - $_{40}e_{20}$(Slav) Females (total difference = .28 years)

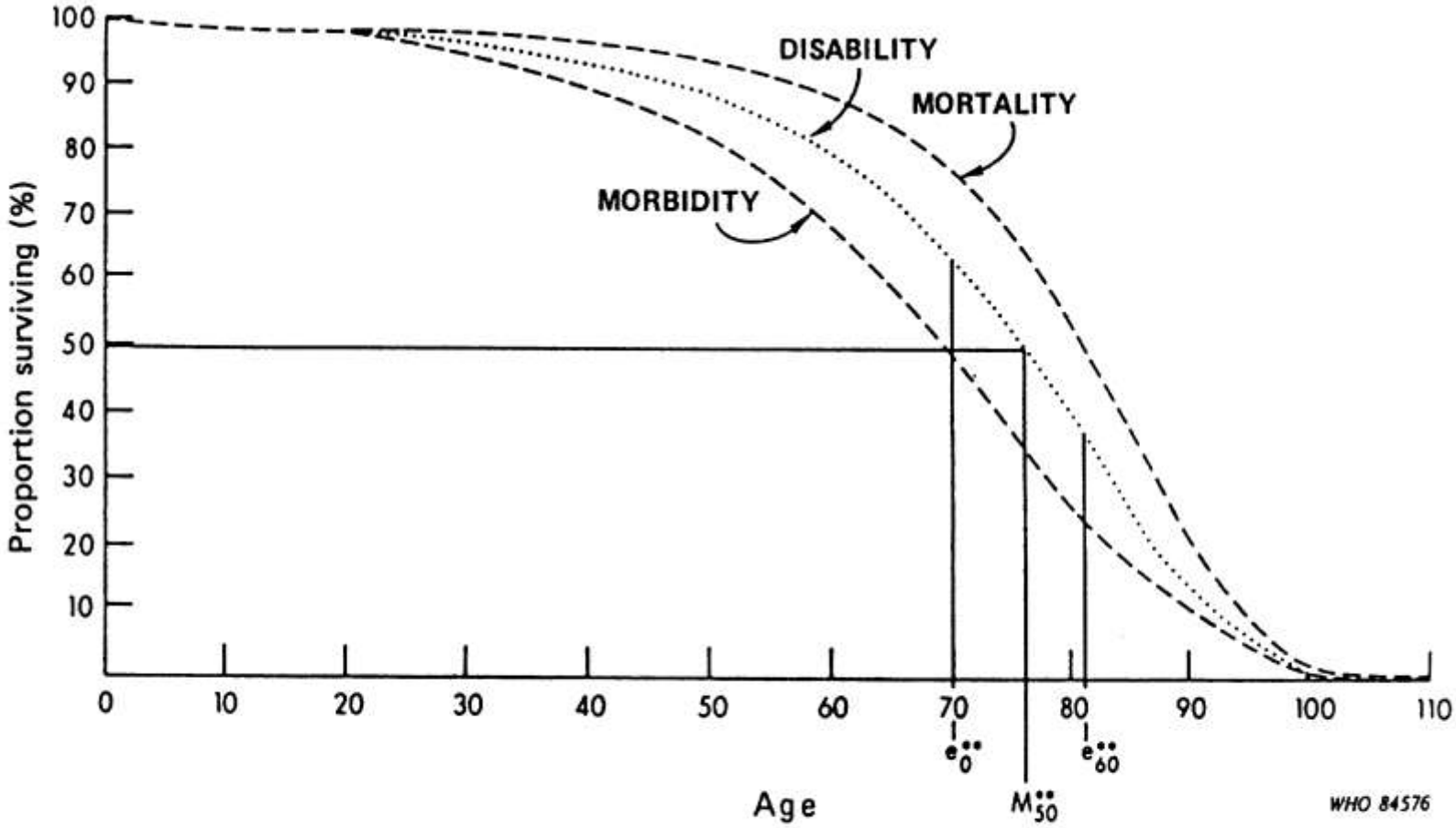


Measures of Population Health

Living longer but healthier?

- **Keeping the sick and frail alive**
  - *expansion of morbidity* (Kramer, 1980).
- **Delaying onset and progression**
  - *compression of morbidity* (Fries, 1980, 1989).
- **Somewhere in between: more disability but less severe**
  - *dynamic equilibrium* (Manton, 1982).

WHO model of health transition (1984)



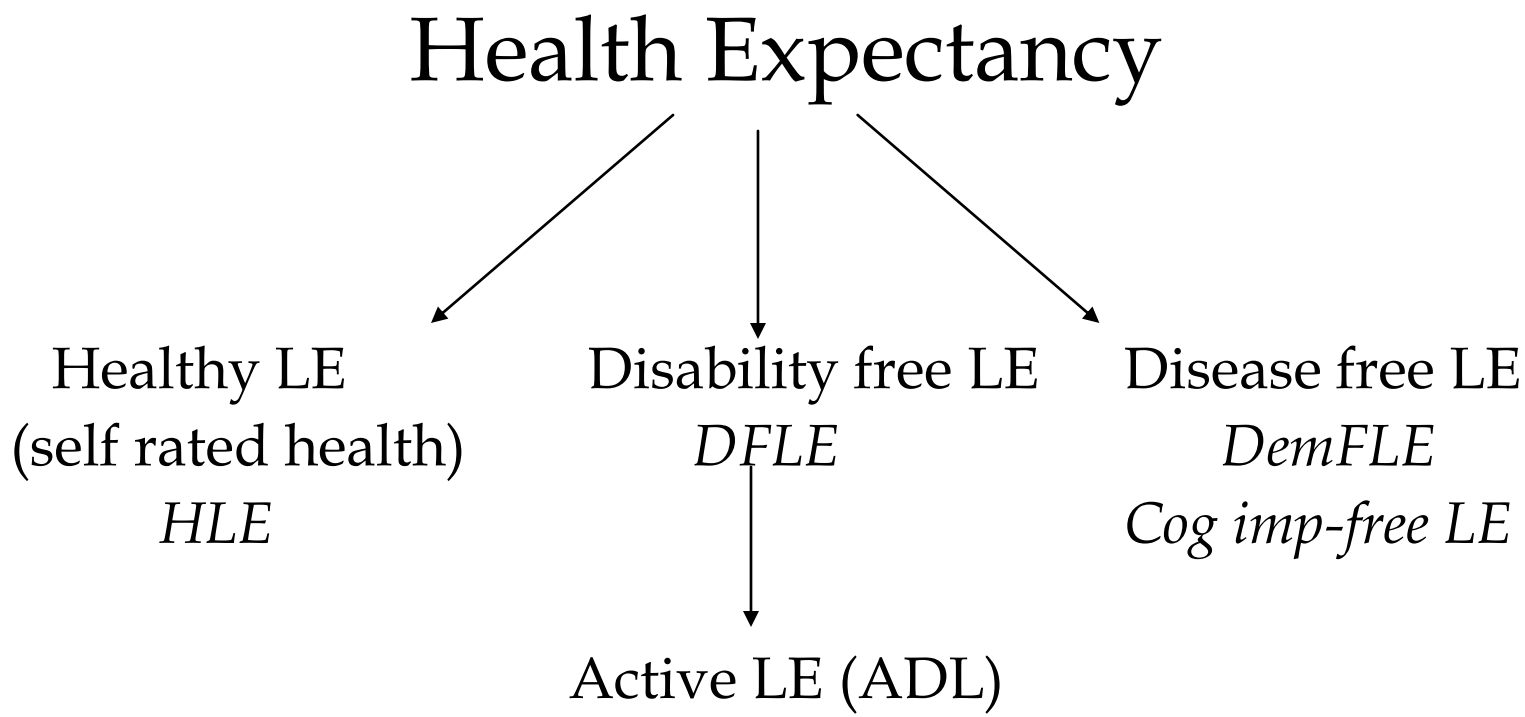
e_0^{**} and e_{60}^{**} are the number of years of autonomous life expected at birth and at age 60, respectively.
M_{50}^{**} is the age to which 50% of females could expect to survive without loss of autonomy.

Quality or quantity of life?

Health expectancy

- **partitions years of life at a particular age into years healthy and unhealthy**
- **adds information on quality**
- **is used to:**
  - monitor population health over time
  - compare countries (EU Healthy Life Years)
  - compare regions within countries
  - compare different social groups within a population (education, social class)

What is the best measure?

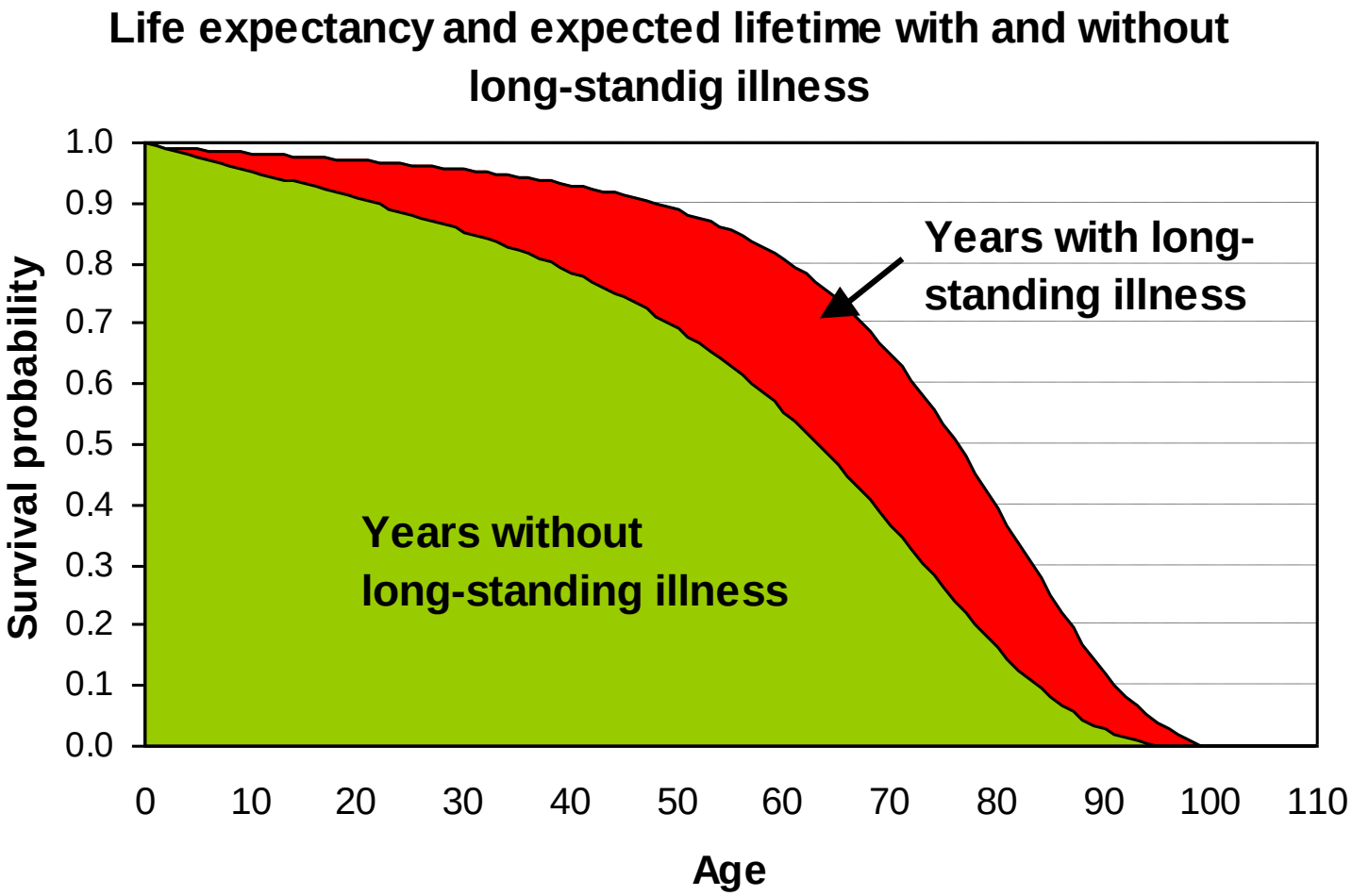


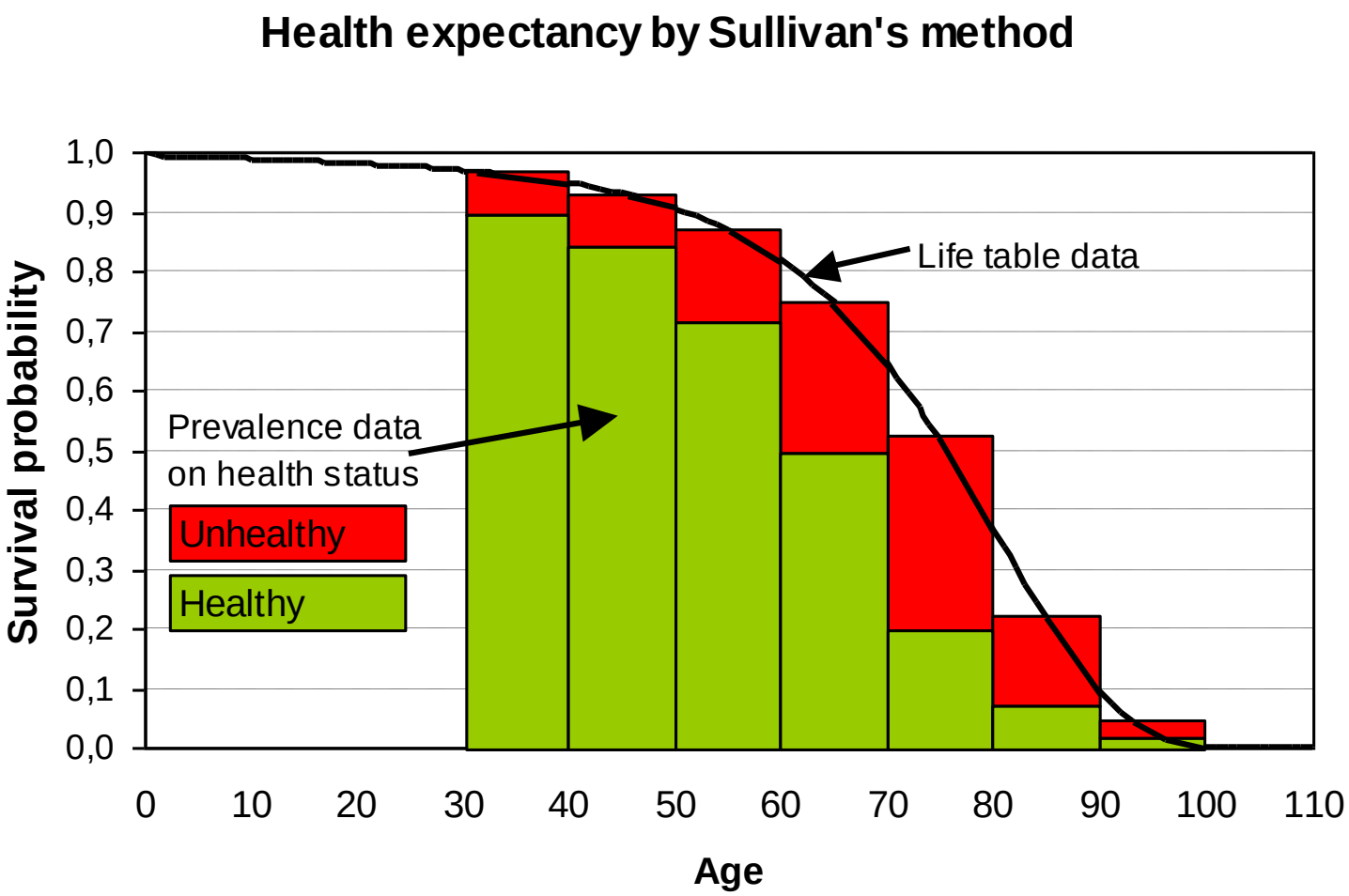
Many measures of health = many health expectancies!

What is the best measure?

- **Depends on the question**
- **Need a range of severity**
  - dynamic equilibrium
- **Performance versus self-report**
  - cultural differences
- **Cross-national comparability**
  - translation issues

Estimation of health expectancy by Sullivan's method


Life expectancy and expected lifetime with and without long-standig illness
Survival probability
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
80
90
100
110
Age
Years with long-standing illness
Years without long-standing illness

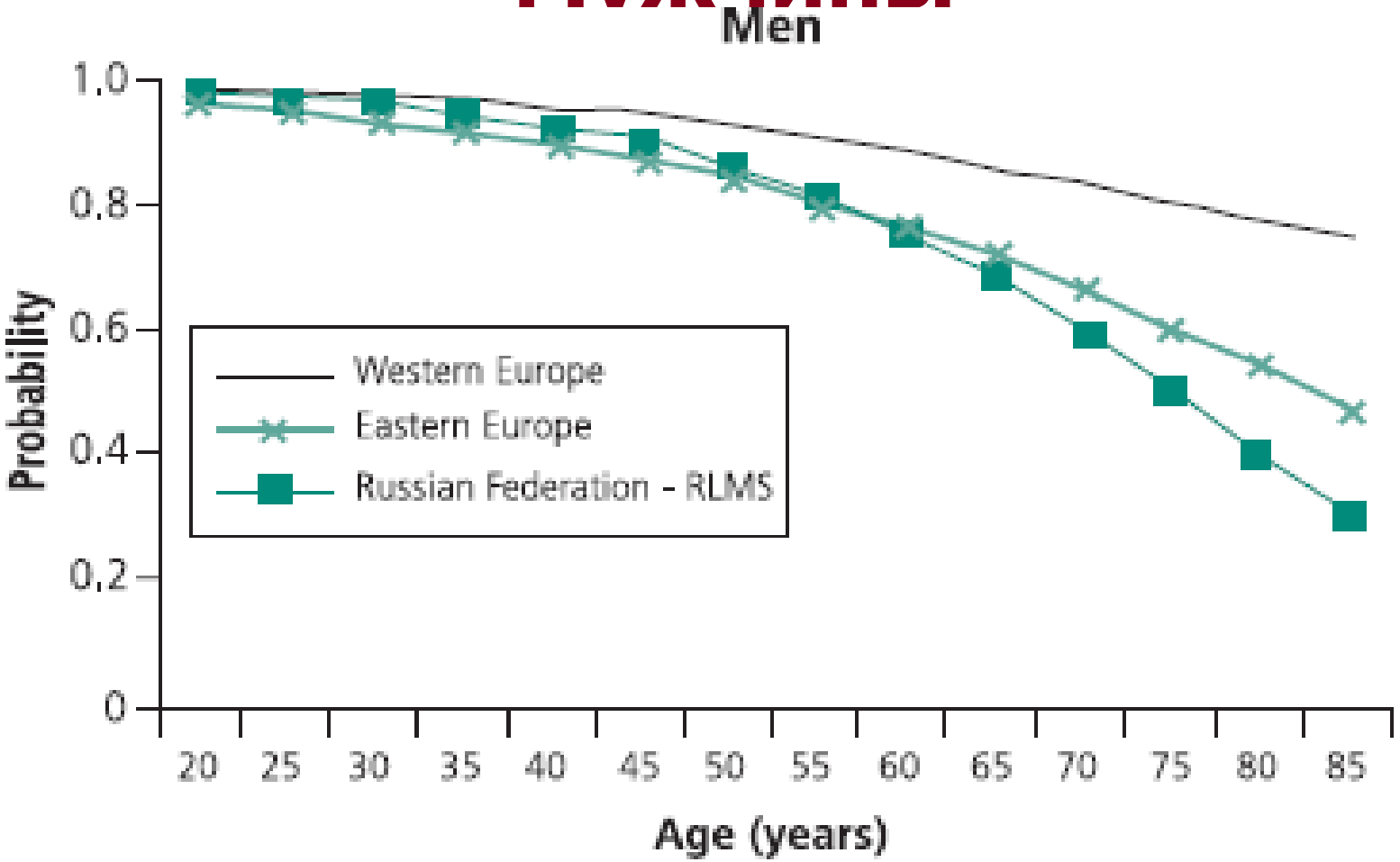

Health expectancy by Sullivan's method
Survival probability
1,0
0,9
0,8
0,7
0,6
0,5
0,4
0,3
0,2
0,1
0,0
0
10
20
30
40
50
60
70
80
90
100
110
Age
Life table data
Prevalence data
on health status
Unhealthy
Healthy

Calculation of health expectancy (Sullivan method)

- $L_x^h = L_x \times \pi_x$

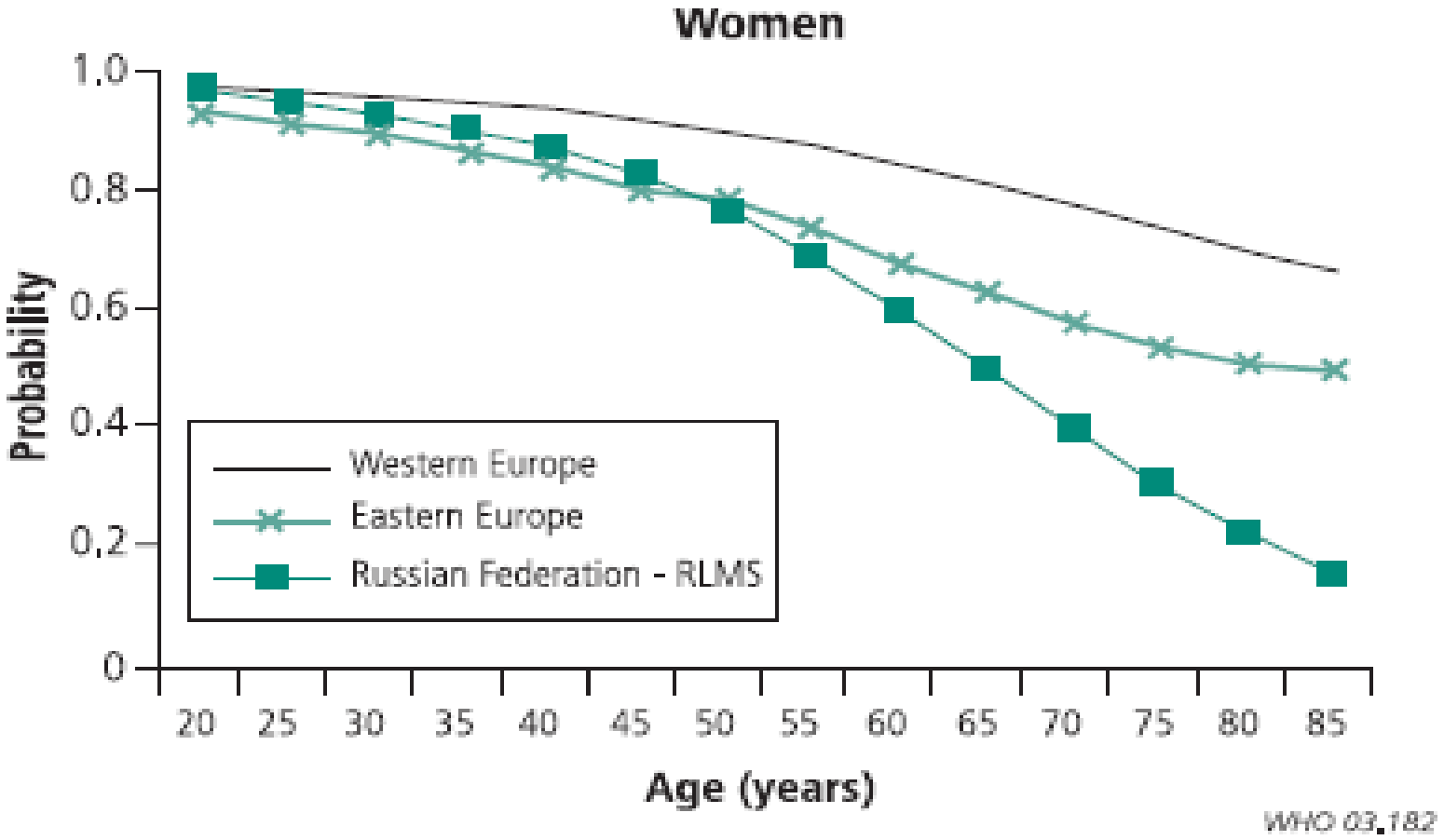
- Where π_x - prevalence of healthy individuals at age x
- L_x^h - person-years of life in healthy state in age interval (x,x+1)

Вероятность быть здоровым в зависимости от возраста Мужчины



Andreyev et al., Bull.WHO, 2003

Вероятность быть здоровым в зависимости от возраста Женщины



Andreyev et al., Bull.WHO, 2003

European Health Expectancy Monitoring Unit

Observatoire Européen des Espérances de Santé

Home
About EHEMU
Database
Training material
Publications
Useful links
Site contents

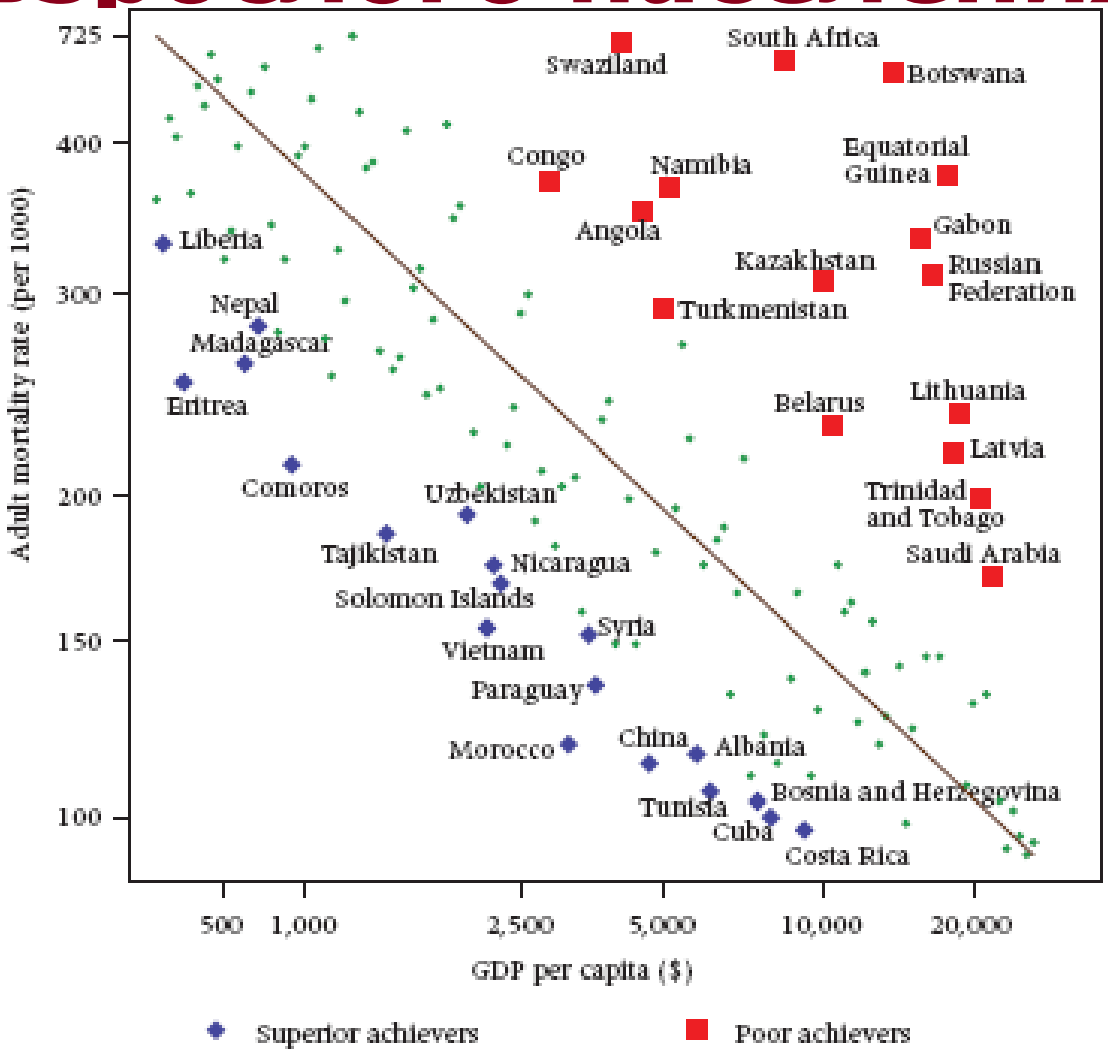
Contact us
EHEMU networks

About EHEMU

The main aim of EHEMU is to provide a central facility for the co-ordinated analysis and synthesis of life and health expectancies to add the quality dimension to the quantity of life lived by the European populations, provide evidence of inequalities between Member States (MS) and highlight potential targets for public health strategies both nationally and at a pan-European level. EHEMU is funded by the European Commission's Directorate General for Health and Consumer Affairs (DG SANCO) under the Community Action in Public Health programme. Health expectancy is one of the structural indicators for the EU sustainable development policy.

EHEMU will thus contribute to improving and developing the European health monitoring system through collaboration with initiatives aimed at improving the quality and comparability of EU data. Previous Community actions have aimed at harmonization of data and the Euro-REVES network has been instrumental in developing instruments in key health domains, where appropriate through consensus meetings with other EU groups. EHEMU is the next step in this process, since valid comparisons between MS require not only harmonized data but also harmonized calculations and analyses.

ВНП и смертность взрослого населения



Сравнение успешных стран и стран-неудачниц по росту СПЖ

- В экономическом развитиии опираются на человеческий капитал
- Этнически-социально-религиозно гомогенны
- Присутствует социальная солидарность

- В экономическом развитии опираются на природные ресурсы
- Этнически или социально гетерогенны, есть конфликты
- Плохая работа гос.институтов (коррупция и т.д.)

Introduction to:

Public Dataset

NATIONAL ARCHIVE OF COMPUTERIZED DATA ON AGING

http://www.icpsr.umich.edu/NACDA/

ICPSR

National Institute on Aging

NSHAP Design Overview

- **Interview 3,005 community-residing adults ages 57-85**
- **Population-based sample, minority over-sampling**
- **75.5% weighted response rate**
- **120-minute in-home interview**
  - Questionnaire
  - Biomarker collection
- **Leave-behind questionnaire**

NSHAP Biomeasures

- Blood: hgb, HgbA1c, CRP, EBV
- Saliva: estradiol, testosterone, progesterone, DHEA, cotinine
- Vaginal Swabs: BV, yeast, HPV, cytology
- Anthropometrics: ht, wt, waist
- Physiological: BP, HR and regularity
- Sensory: olfaction, taste, vision, touch
- Physical: gait, balance

NSHAP Biomeasures Cooperation

Measure	Eligible Respondents	Cooperating Respondents	Cooperation Rate*
Height	2,977	2,930	98.6%
Weight	2,977	2,927	98.4%
Blood pressure	3,004	2,950	98.4%
Touch	1,502	1,474	98.4%
Smell	3,004	2,943	98.3%
Waist circumference	3,004	2,916	97.2%
Distance vision	1,505	1,441	96.0%
Taste	3,004	2,867	95.9%
Get up and go	1,485	1,377	93.6%
Saliva	3,004	2,721	90.8%
Oral fluid for HIV test	972	865	89.2%
Blood spots	2,493	2,105	85.0%
Vaginal swabs	1,550	1,028	67.6%

* Person-level weights are adjusted for non-response by age and urbanicity.

Principles of Minimal Invasiveness

- **Compelling rationale: high value to individual health, population health or scientific discovery**
- **In-home collection is feasible**
- **Cognitively simple**
- **Can be self-administered or implemented by single data collector during a single visit**
- **Affordable**
- **Low risk to participant and data collector**
- **Low physical and psychological burden**
- **Minimal interference with participant's daily routine**
- **Logistically simple process for transport from home to laboratory**
- **Validity with acceptable reliability, precision and accuracy**

Lindau ST and McDade TW. 2006. *Minimally-Invasive and Innovative Methods for Biomeasure Collection in Population-Based Research*. National Academies and Committee on Population Workshop. *Under Review.*

NSHAP Biomeasures

"Laboratory Without Walls"

McClintock Laboratory
(Cytology)

UC Cytopathology
(Cytology)

Jordan Clinical Lab
Magee Women's Hospital
(Bacterial, HPV Analysis)

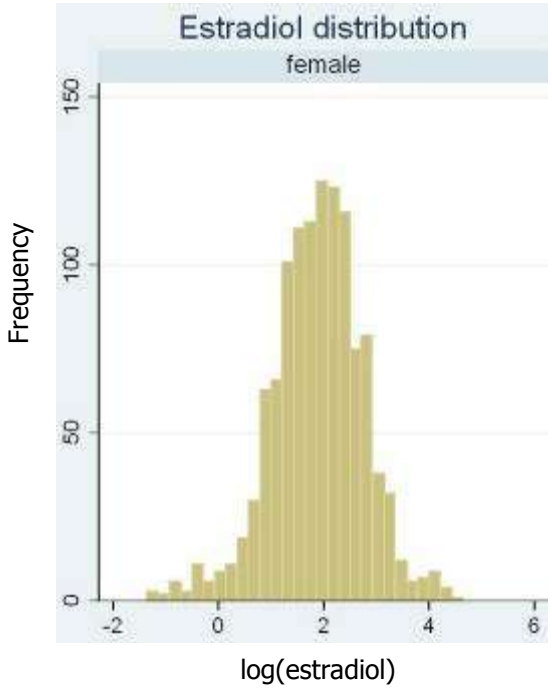
Salimetrics
(Saliva Analysis)

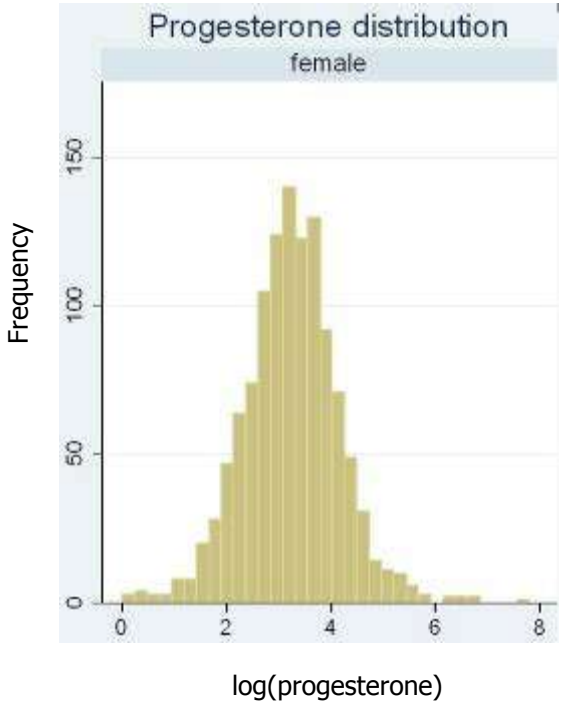
McDade Lab
Northwestern
(Blood Spot Analysis)

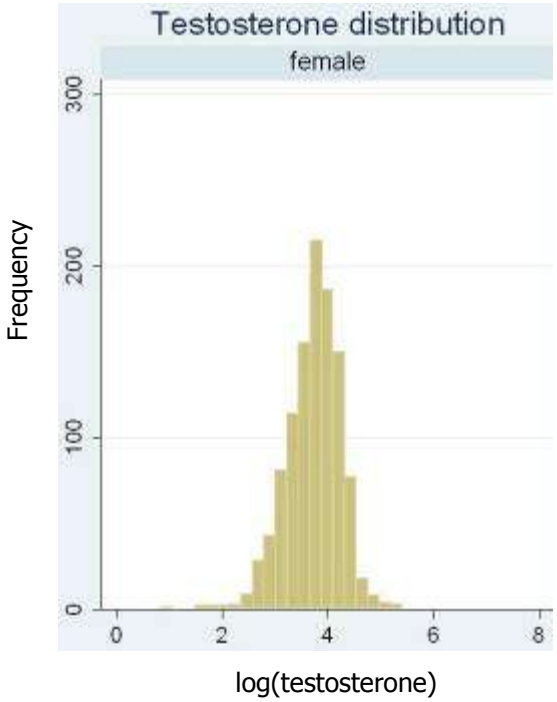
Salivary Biomeasures

- **Sex hormone assays**
  - Estradiol
  - Progesterone
  - DHEA
  - Testosterone
- **Cotinine**

Salivary Sex Hormones (preliminary analysis)



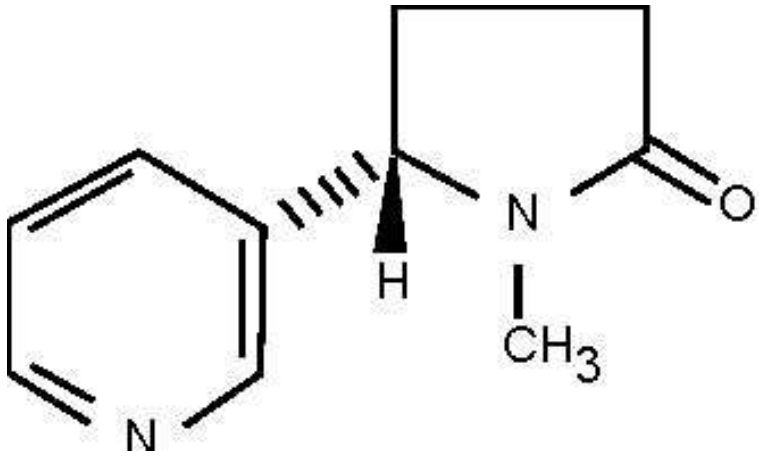




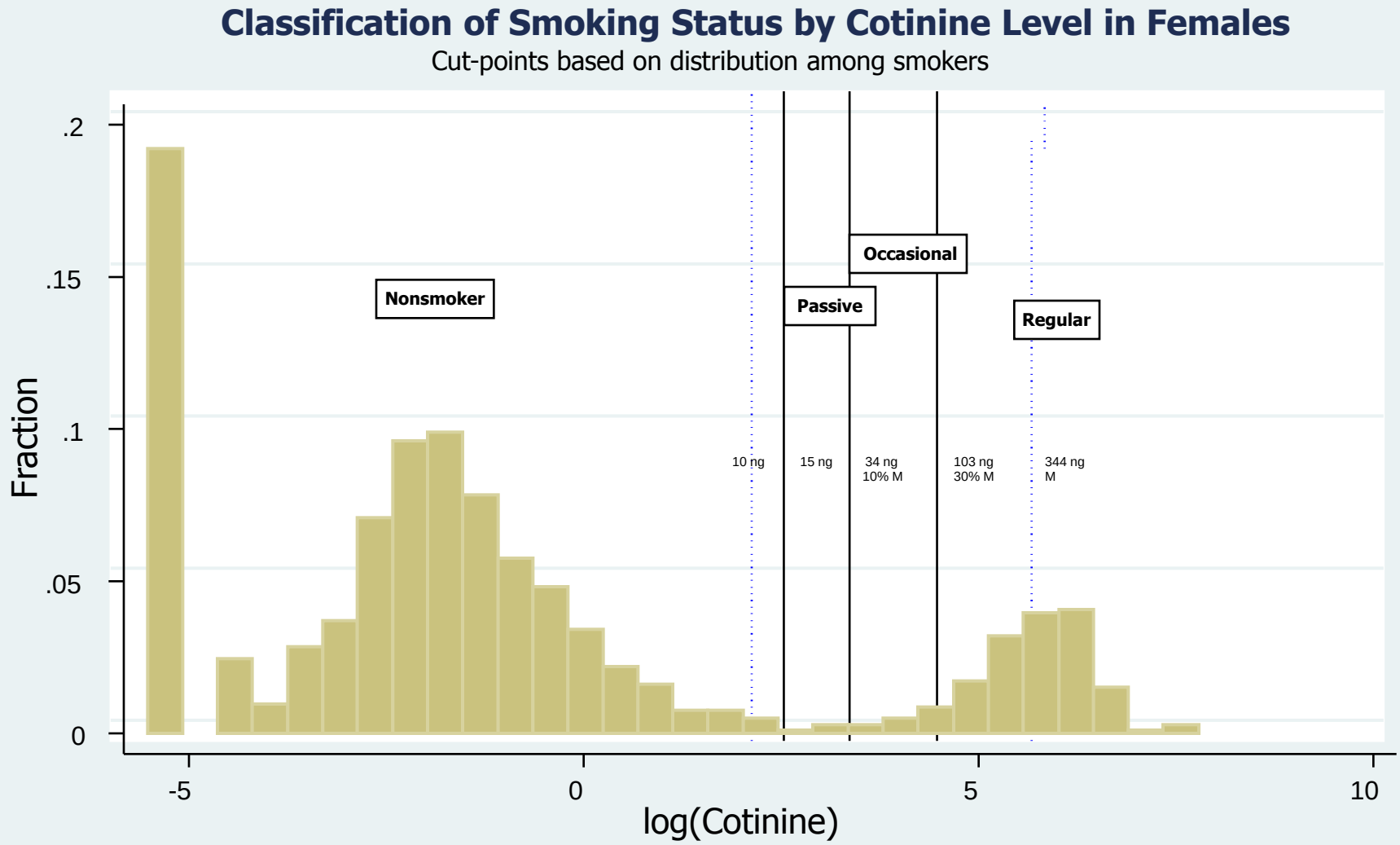
Units: pg/ml

Salivary Cotinine

- Nicotine metabolite
- Objective marker of tobacco exposure, including second-hand
- Non-invasive collection method (vs. serum cotinine)



Distribution of Salivary Cotinine



M = mean cotinine among female who report current smoking

Bar on left corresponds to cotinine below level of detection

Dried Blood Spots

- C-Reactive Protein (CRP)
- Epstein-Barr Virus (EBV) Antibody Titers

Thanks, Thom and McDade Lab Staff!

Self-Report Measures

- **Demographic Variables:**
  - Age
  - Race/Ethnicity
  - Education
  - Insurance Status

Self-Report Measures

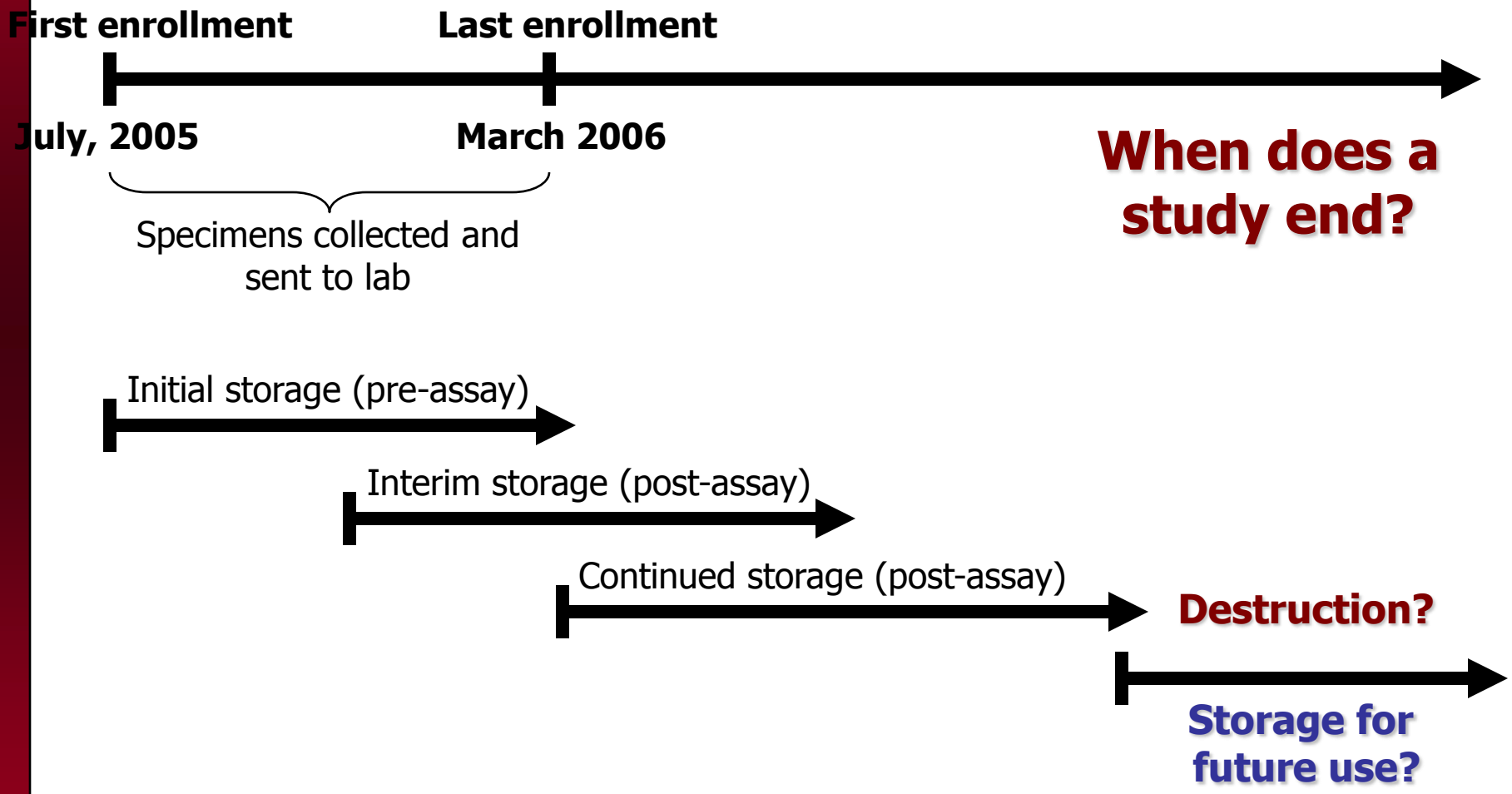
- **Social/Sexuality Variables:**
  - Spousal/other intimate partner status
    - Cohabitation
  - Lifetime sex partners
  - Sex partners in last 12 months
  - Frequency of sex in last 12 months
  - Frequency of vaginal intercourse
  - Condom use

Self-Report Measures

- **Health Measures:**
  - Obstetric/Gynecologic history
    - Number of pregnancies
    - Duration since last menstrual period
    - Hysterectomy
  - Physical health
    - Overall health
    - Co-morbidities
  - Health behaviors
    - Tobacco use
    - Pap smear, pelvic exam history
  - Cancer

Challenges

Specimen Storage



CCBAR

Chicago Core on Biomarkers in Population-Based Aging Research
The Center on Aging at NORC and the University of Chicago

More Information on Biomarkers is Available at the CCBAR website

http://biomarkers.uchicago.edu/