# The Longevity Dividend: Altering the Course of Health and Longevity

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University of Illinois at Chicago
Co-founder and Chief Scientist, Lapetus Solutions, Inc.
September 16, 2015

# Why Do We Age?

Why do we live as long as we do; can we all live to 100; forecasting longevity.

# Breakthrough

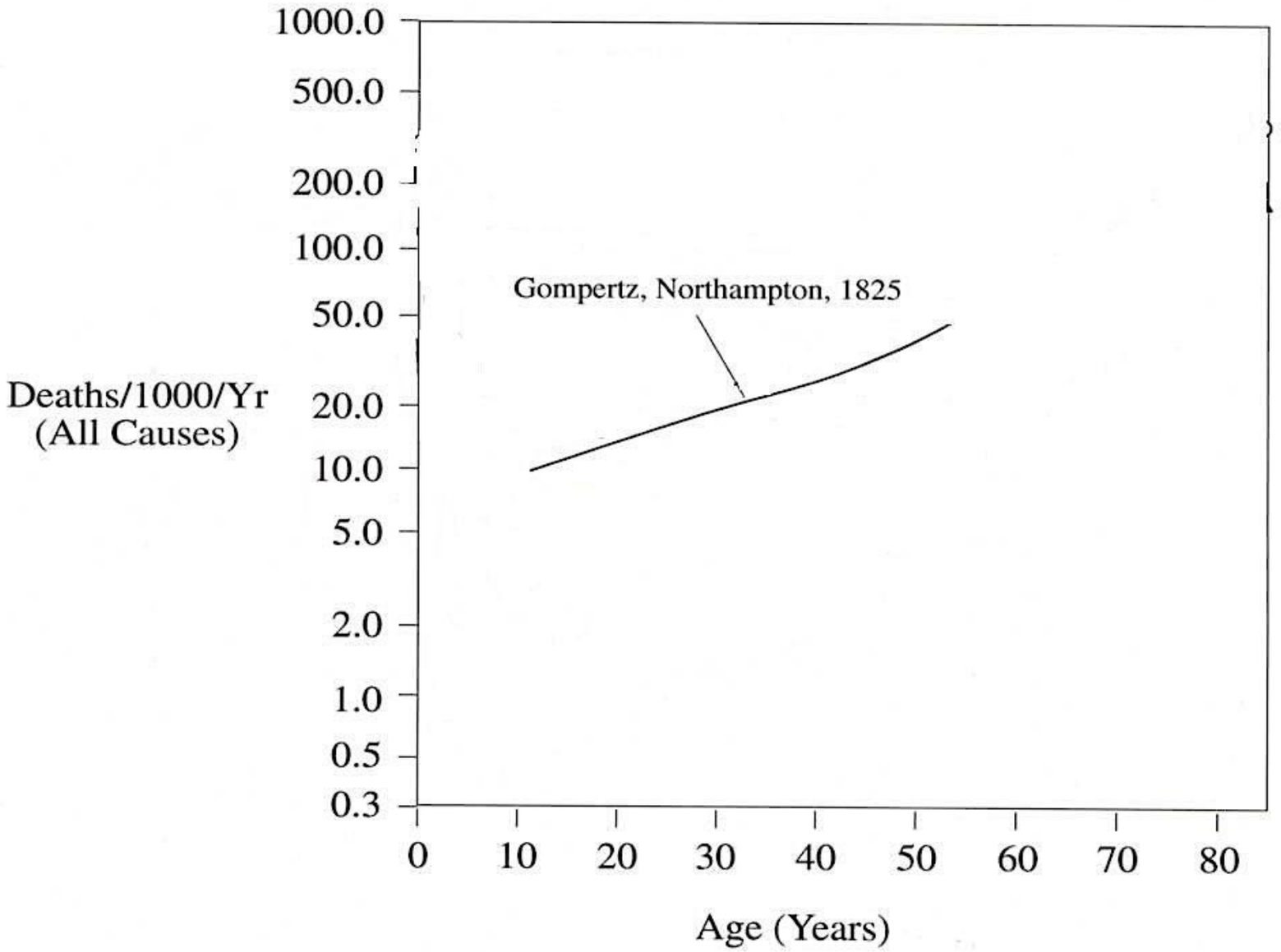
Aging science is leading us down a path toward an intervention that could slow the biological processes of aging.

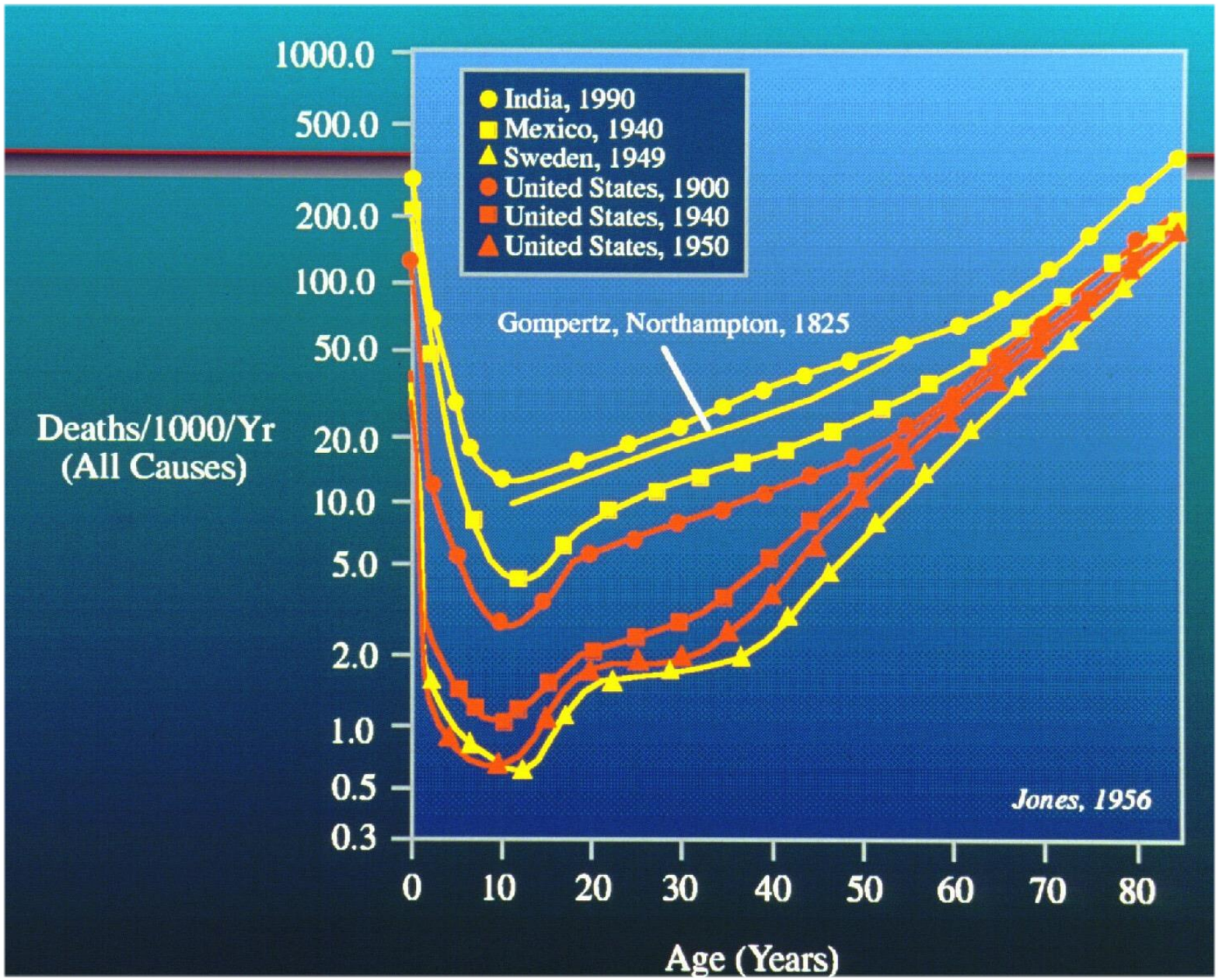
# Breakthrough

A quantum leap in underwriting technology has arrived.

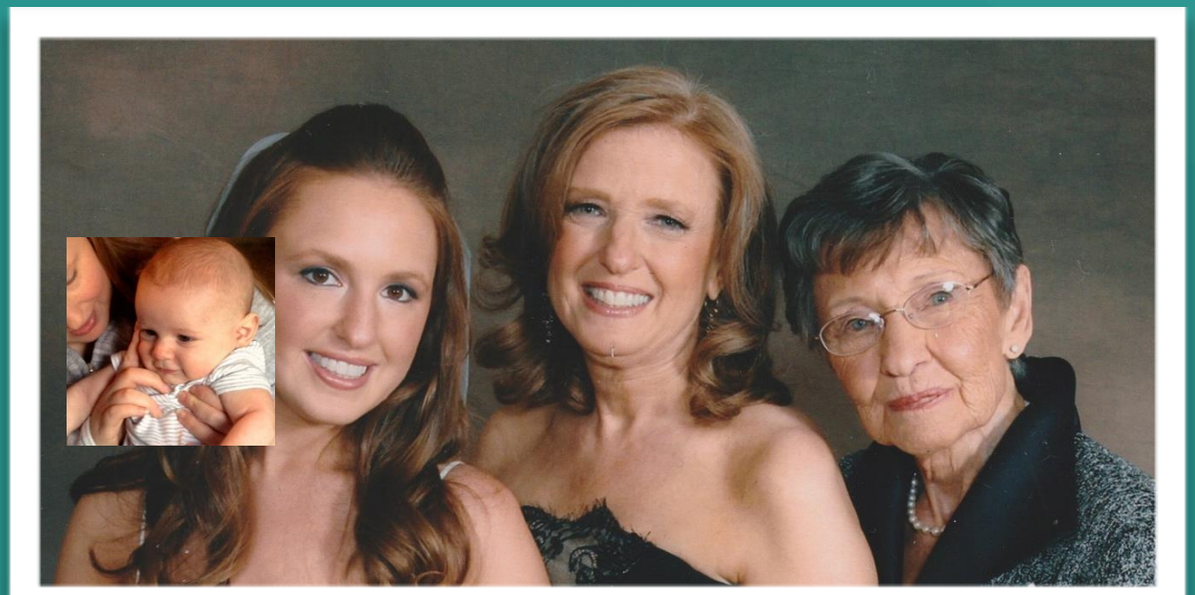
Live Demonstration

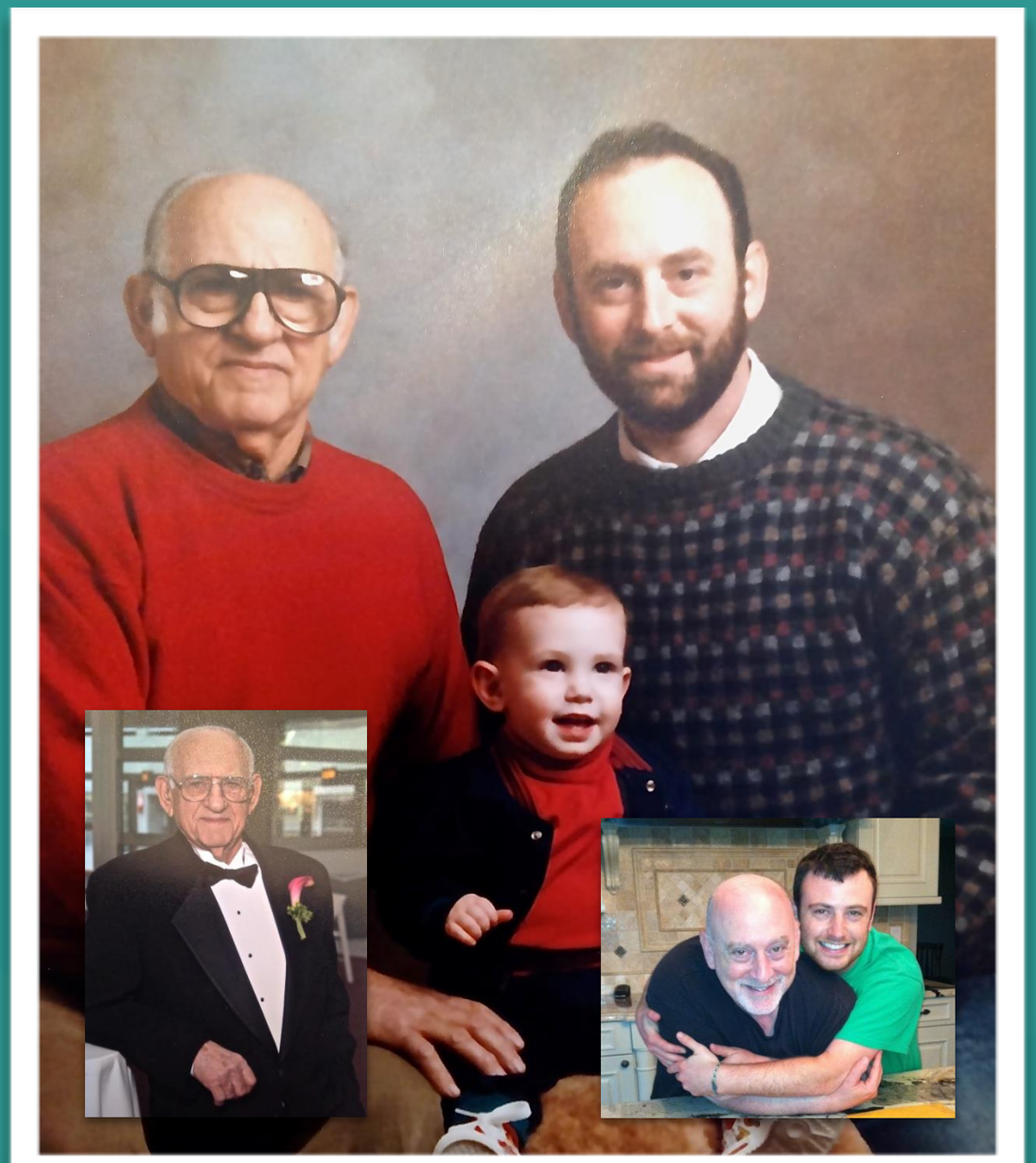
# Biology


1000.0
500.0
200.0
100.0
50.0
20.0
10.0
5.0
2.0
1.0
0.5
0.3
Deaths/1000/Yr
(All Causes)
Gompertz, Northampton, 1825
0
10
20
30
40
50
60
70
80
Age (Years)


1000.0
500.0
200.0
100.0
50.0
20.0
10.0
5.0
2.0
1.0
0.5
0.3
Deaths/1000/Yr
(All Causes)
India, 1990
Mexico, 1940
Sweden, 1949
United States, 1900
United States, 1940
United States, 1950
Gompertz, Northampton, 1825
Jones, 1956
0
10
20
30
40
50
60
70
80
Age (Years)

# WHY Do We Age and Live as Long as We Do?



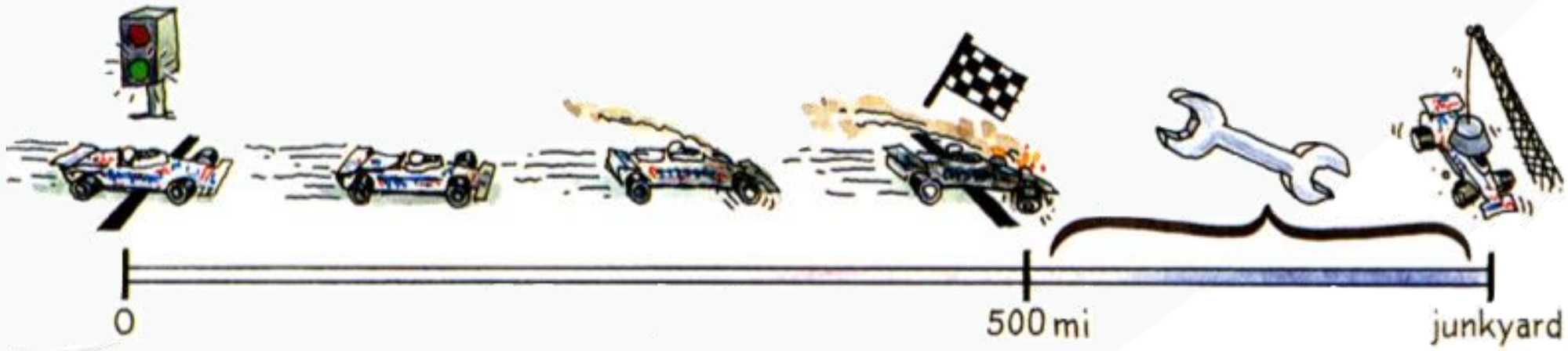


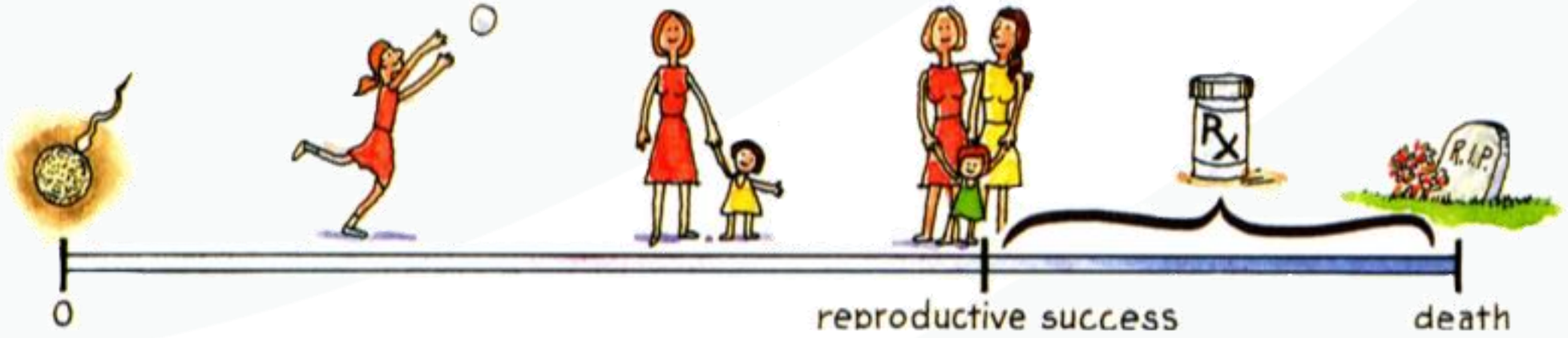
# Aging versus Senescence

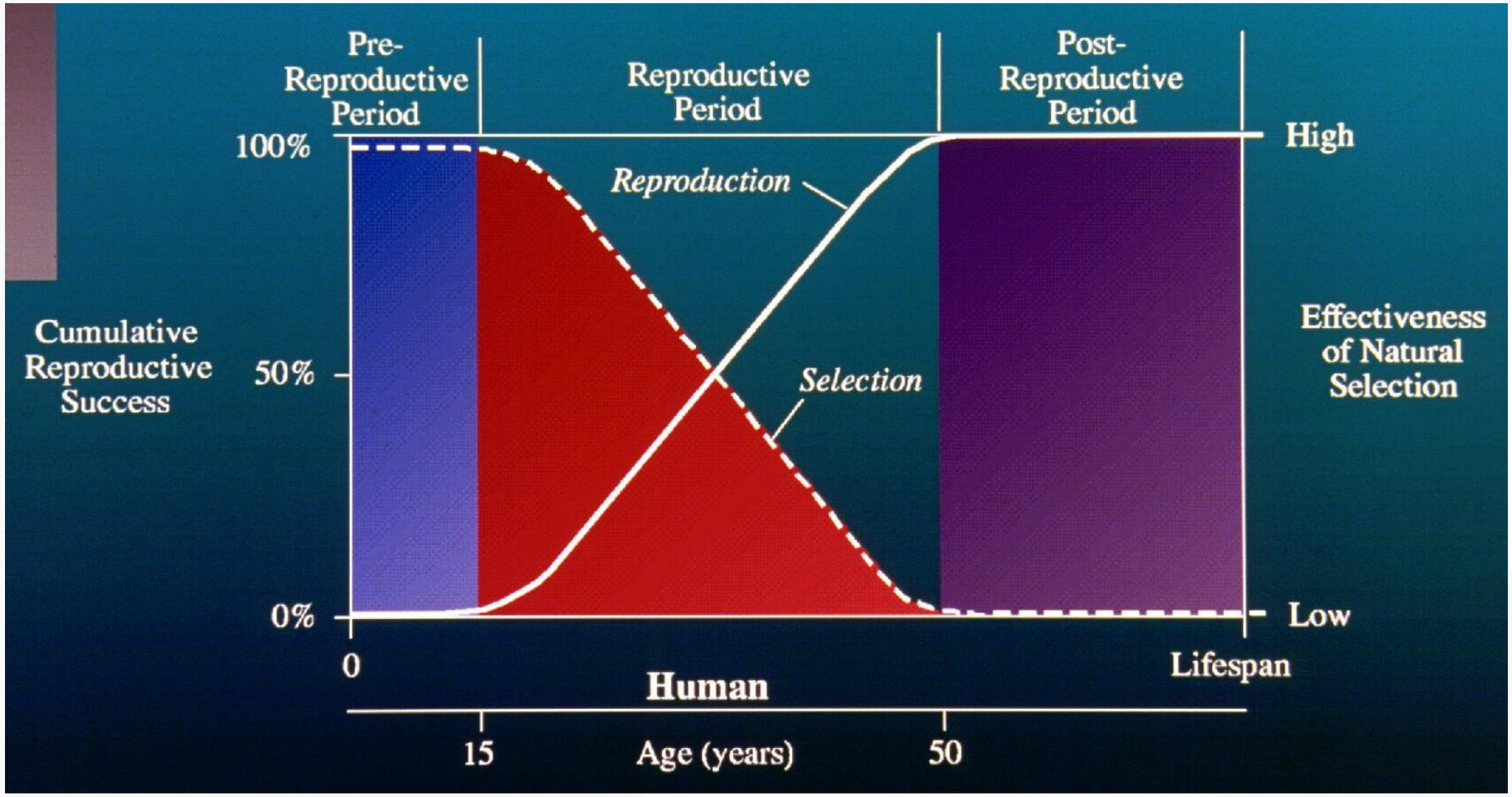
*Identical Twins*
*Source: Scientific American*

Aging: The Passage of Chronological Time
Senescence: The Passage of Biological Time


BENTLEY


0
500 mi
junkyard

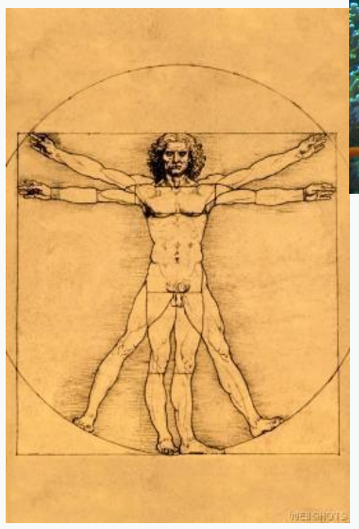

Rx
R.I.P.
0
reproductive success
death



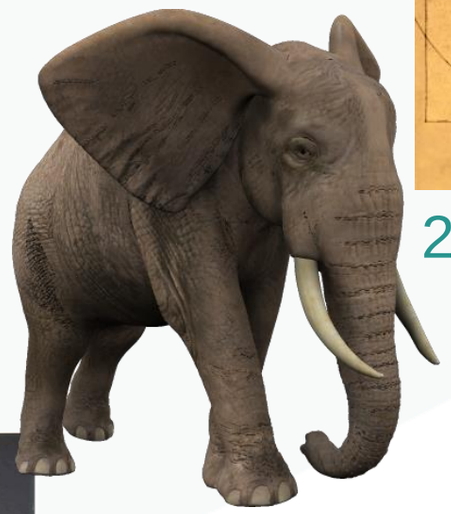

1. There is a remarkable consistency to the timing of death across species.
2. Duration of life is calibrated to the onset and length of a species' reproductive window.
3. There are no aging or death genes.

77,000 days
bowhead whale

55,000 days
sea turtle



26,000 days
elephant



29,000 days
human

5,000 days
dog

1,000 days
mouse

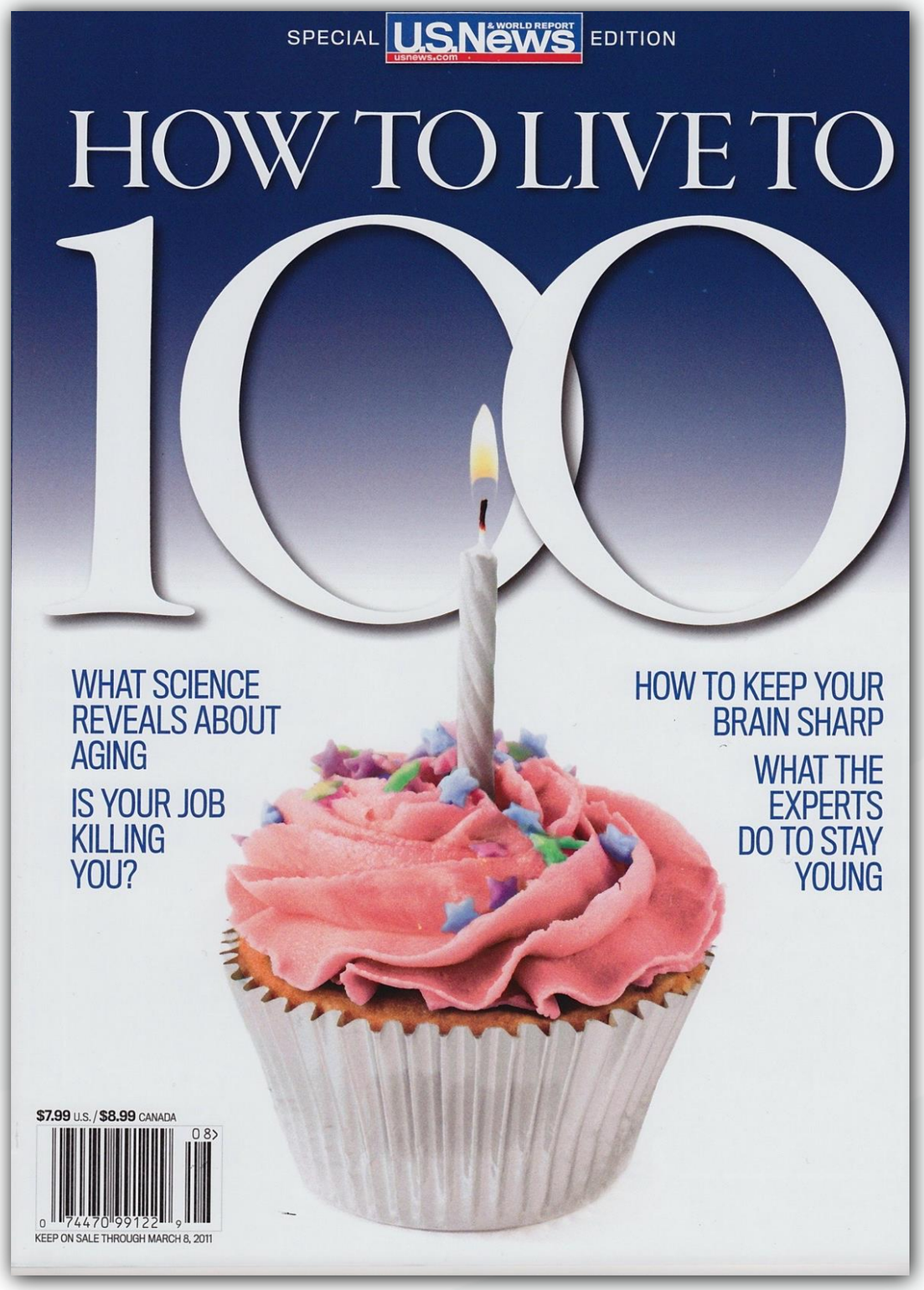
Aging or senescence
is an accident of surviving
beyond the warranty period
for living machines.

# Tip # 1

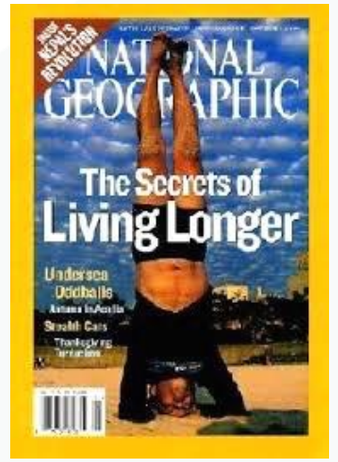
If you don’t understand biology, you’re missing a critical part of the picture of current and future health and longevity

Can most live to 100?

Can we really add decades of life to people aged 70+ today faster than we added decades of life to children born in the early 20th century?


SPECIAL U.S.News & WORLD REPORT EDITION
usnews.com
HOW TO LIVE TO 100
WHAT SCIENCE REVEALS ABOUT AGING
IS YOUR JOB KILLING YOU?
HOW TO KEEP YOUR BRAIN SHARP
WHAT THE EXPERTS DO TO STAY YOUNG
$7.99 U.S. / $8.99 CANADA
KEEP ON SALE THROUGH MARCH 8, 2011


NATIONAL GEOGRAPHIC
THIS BABY WILL LIVE TO BE 120*


NATIONAL GEOGRAPHIC
The Secrets of Living Longer


TIME
ARMY SEX SCANDALS
1996 TECH BUYER'S GUIDE
How science is searching for ways to keep us
Forever Young


Election 2010:
Foreign money in the midterms?
Chilean Miners:
Their amazing journey
China's Fury:
Eyes on the Nobel Prize
40 Under 40:
The young pols to watch
TIME
Alzheimer's
At last, some progress against the most stubborn disease

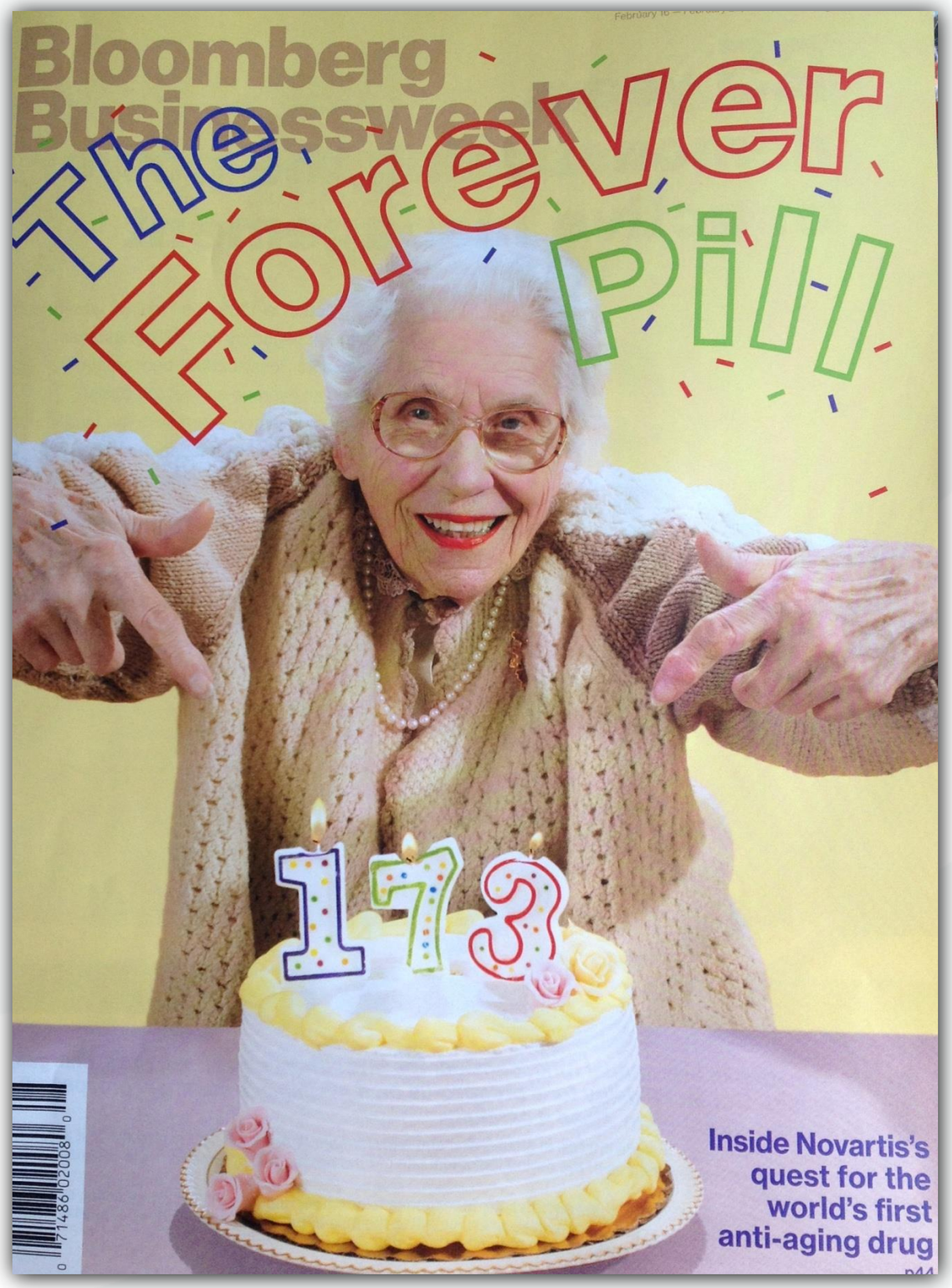

Afghanistan:
Racing to Save Lives
Toyota:
The Fall of An Icon
Reality TV:
Why It's Better Than You Think
The Oscars:
The Year's Best Performances
TIME
The Science of Living Longer
SPECIAL 22-PAGE HEALTH SECTION
THREE GENERATIONS
Laila, 7; mother Kristina, 37; grandmother Laila, 65


TIME
CAN
Google
SOLVE
DEATH?
The search giant is launching a venture to extend the human life span.
That would be crazy—if it weren't Google

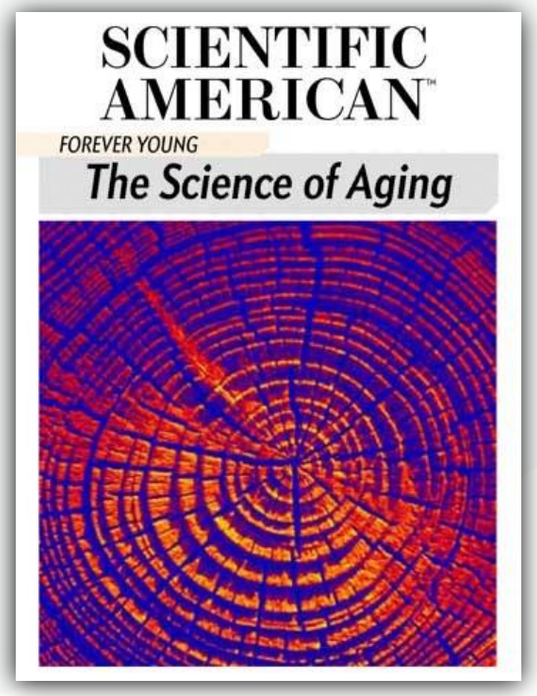

FEBRUARY 23 / MARCH 2, 2015
TIME
SPECIAL
HEALTH
DOUBLE
ISSUE
THIS BABY COULD LIVE TO BE
142 YEARS OLD
Dispatches From the Frontiers of Longevity
time.com


TIME
VOL. 185, NO. 6–7 | 2015
MOST CANCER INSTITUTES
HOW OLD CAN WE LIVE TO BE?
That remains to be seen, but if a promising drug does to humans what it does to mice—a big if—the answer is 142. Mice have a median survival time of 27 MONTHS, but with treatment, the longest-living mouse hit 48 MONTHS, a life 1.77 TIMES LONGER. The median human lifespan is 80 YEARS—so if the oldest person lived 1.77 times longer, he or she would reach 142.

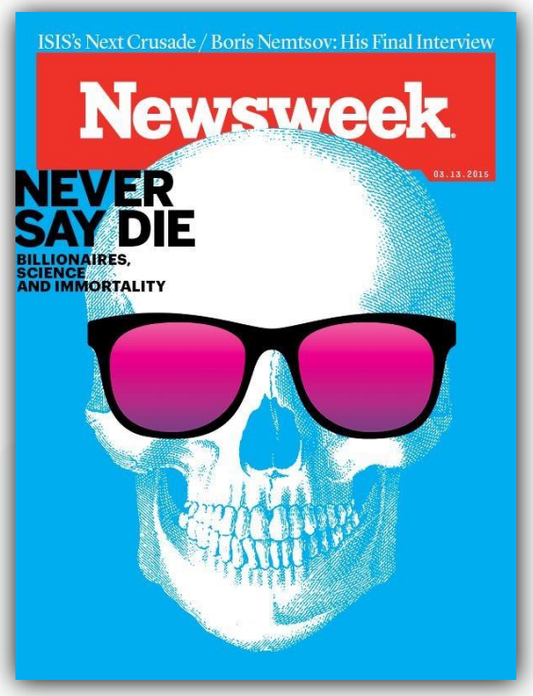

THE FIRST PERSON TO LIVE TO 150 IS ALIVE TODAY.
Let's get ready for a longer retirement.
Prudential
Bring Your Challenges!


Bloomberg Businessweek
The Forever Pill
Inside Novartis's quest for the world's first anti-aging drug


THE MODERN JOB HUNT: KIDS WHO BRING MOM & DAD TO THE INTERVIEW P. 64
SmartMoney
THE WALL STREET JOURNAL
THE HIGH COST OF LIVING...
...A LONG, LONG TIME
How to Make It To 100 With Your Health and Wealth
SPECIAL REPORT: 400% Returns From One Money Manager P. 72
PLUS:
4 Strategies To Keep Your Income Flowing P. 54
MARCH 2012 $4.99
SmartMoney.com


SCIENTIFIC AMERICAN™
FOREVER YOUNG
The Science of Aging


LIFE
CAN WE STOP AGING?


ISIS's Next Crusade / Boris Nemtsov: His Final Interview
Newsweek
03.13.2015
NEVER SAY DIE
BILLIONAIRES, SCIENCE AND IMMORTALITY

*Journals of Gerontology: BIOLOGICAL SCIENCES*
*Cite journal as: J Gerontol A Biol Sci Med Sci*
doi:10.1093/gerona/gls142



Perspective

# Can Human Biology Allow Most of Us to Become Centenarians?

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[2]Division of Epidemiology and Biostatistics, School of Public Health, University of Illinois at Chicago, Illinois.
[3]Department of Anatomy, University of California, San Francisco.

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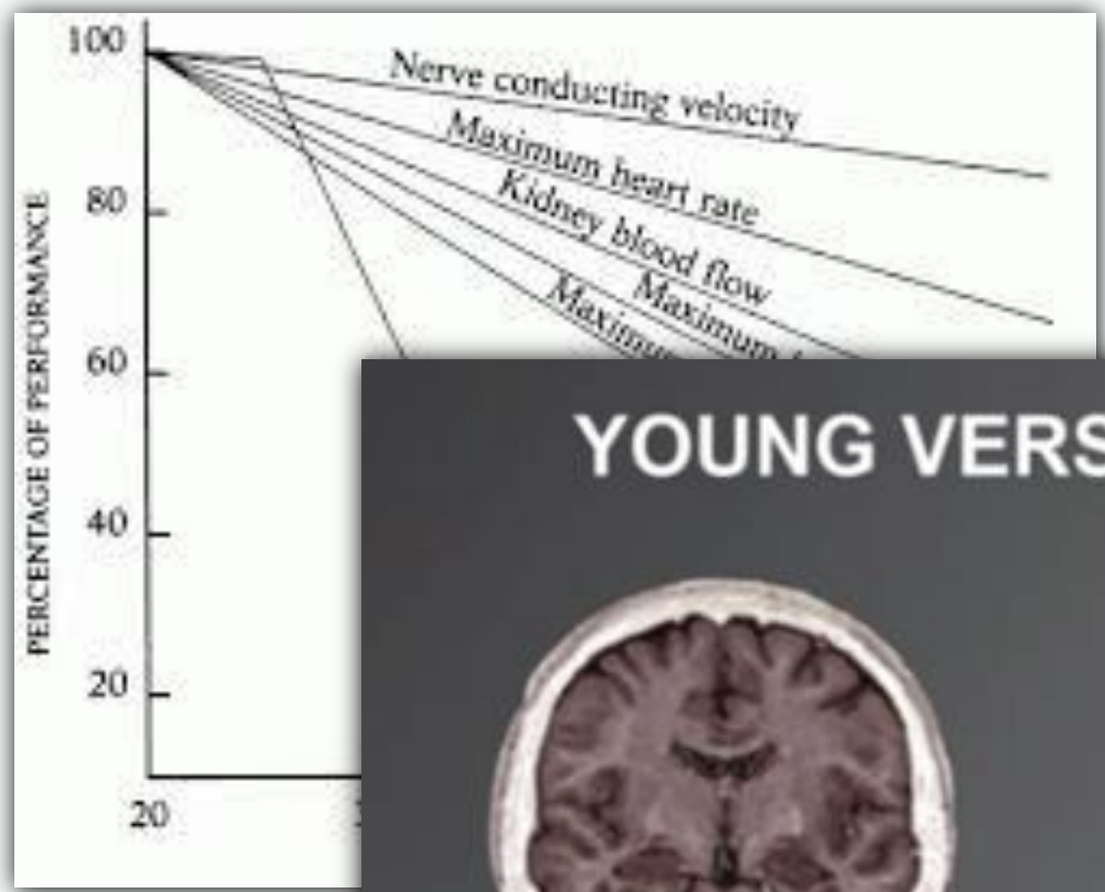
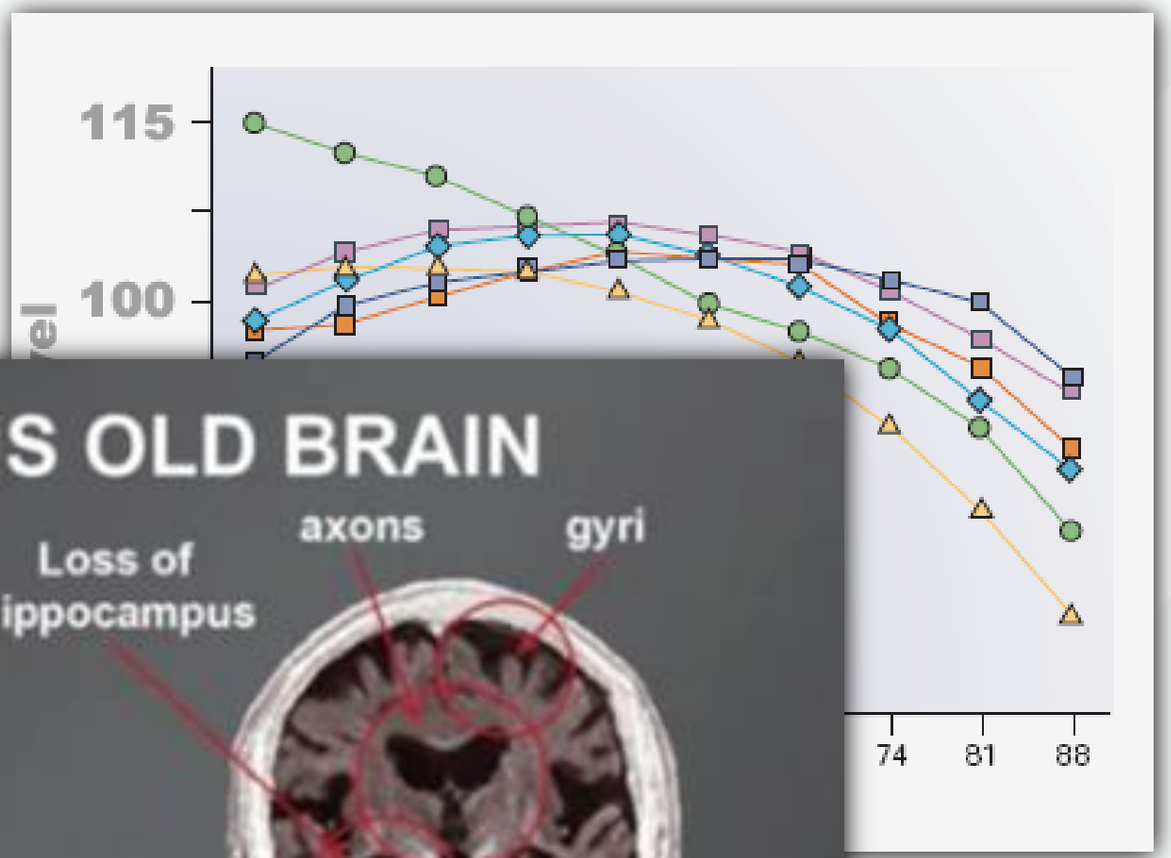
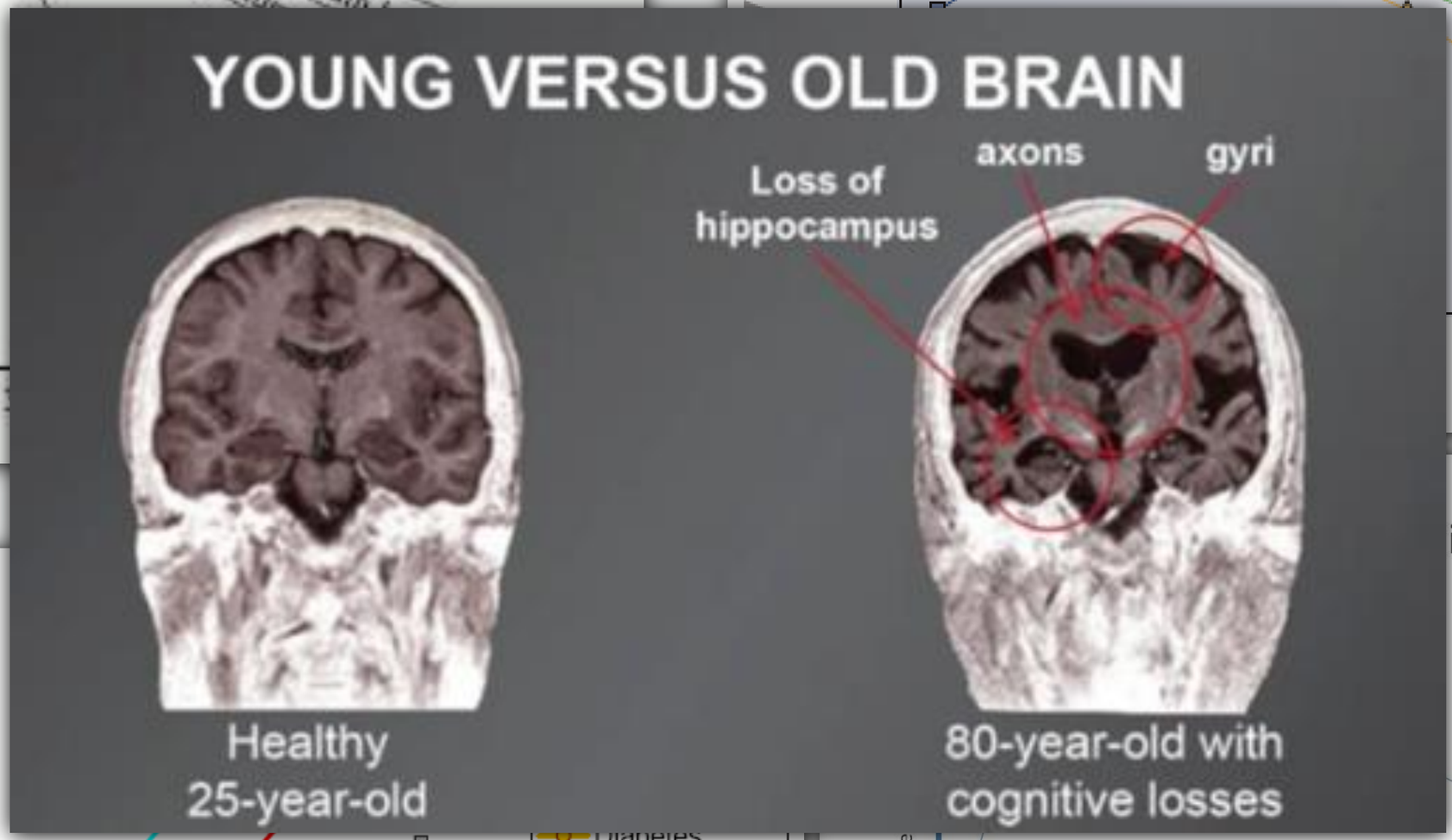
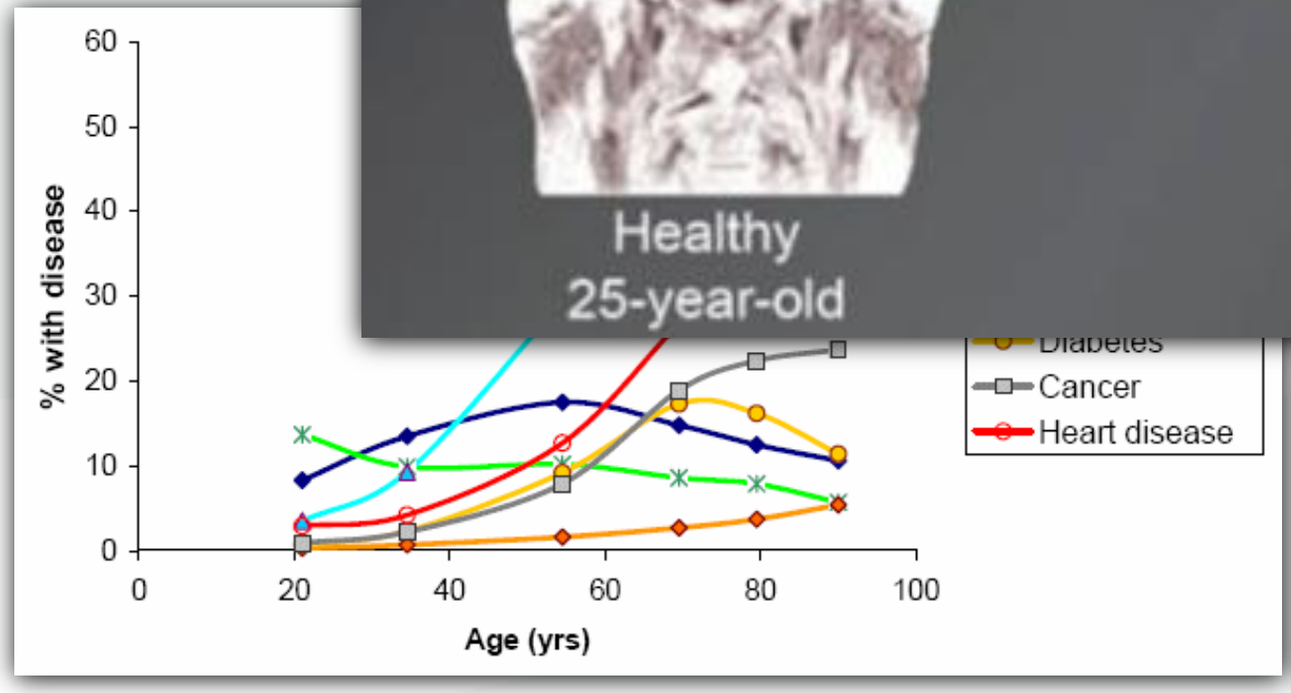
Life span is a topic of great interest in science, medicine and among the general public. How long people live has a profound impact on medical costs, intergenerational interactions, and the solvency of age-based entitlement programs around the world. These challenges are already occurring and the magnitude of their impact is, in part, proportional to the fraction of a population that lives the longest. Some demographic forecasts suggest that most babies born since the year 2000 will survive to their 100th birthday. If these forecasts are correct, then there is reason to fear that the financial solvency of even the most prosperous countries are in jeopardy. We argue here that human biology will preclude survival to age 100 for most people.

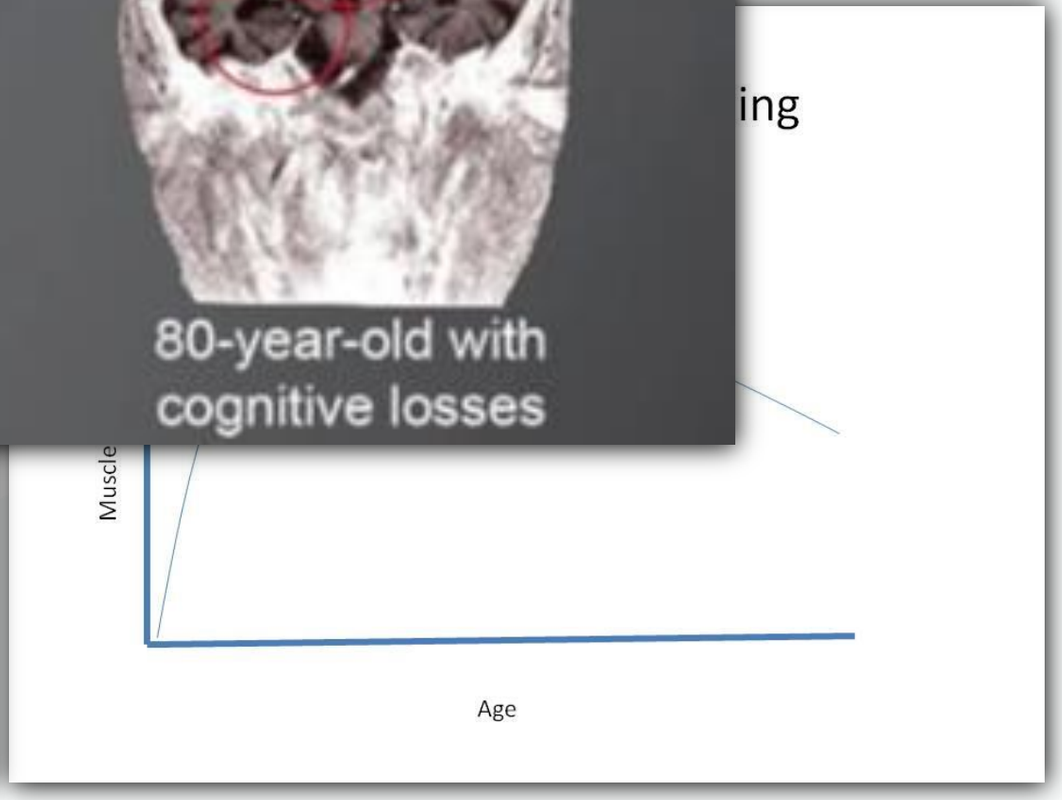
NO!


100
80
60
40
20
PERCENTAGE OF PERFORMANCE
Nerve conducting velocity
Maximum heart rate
Kidney blood flow
Maximum
20


115
100
74
81
88


YOUNG VERSUS OLD BRAIN
Loss of hippocampus
axons
gyri
Healthy 25-year-old
80-year-old with cognitive losses


% with disease
Age (yrs)
Diabetes
Cancer
Heart disease

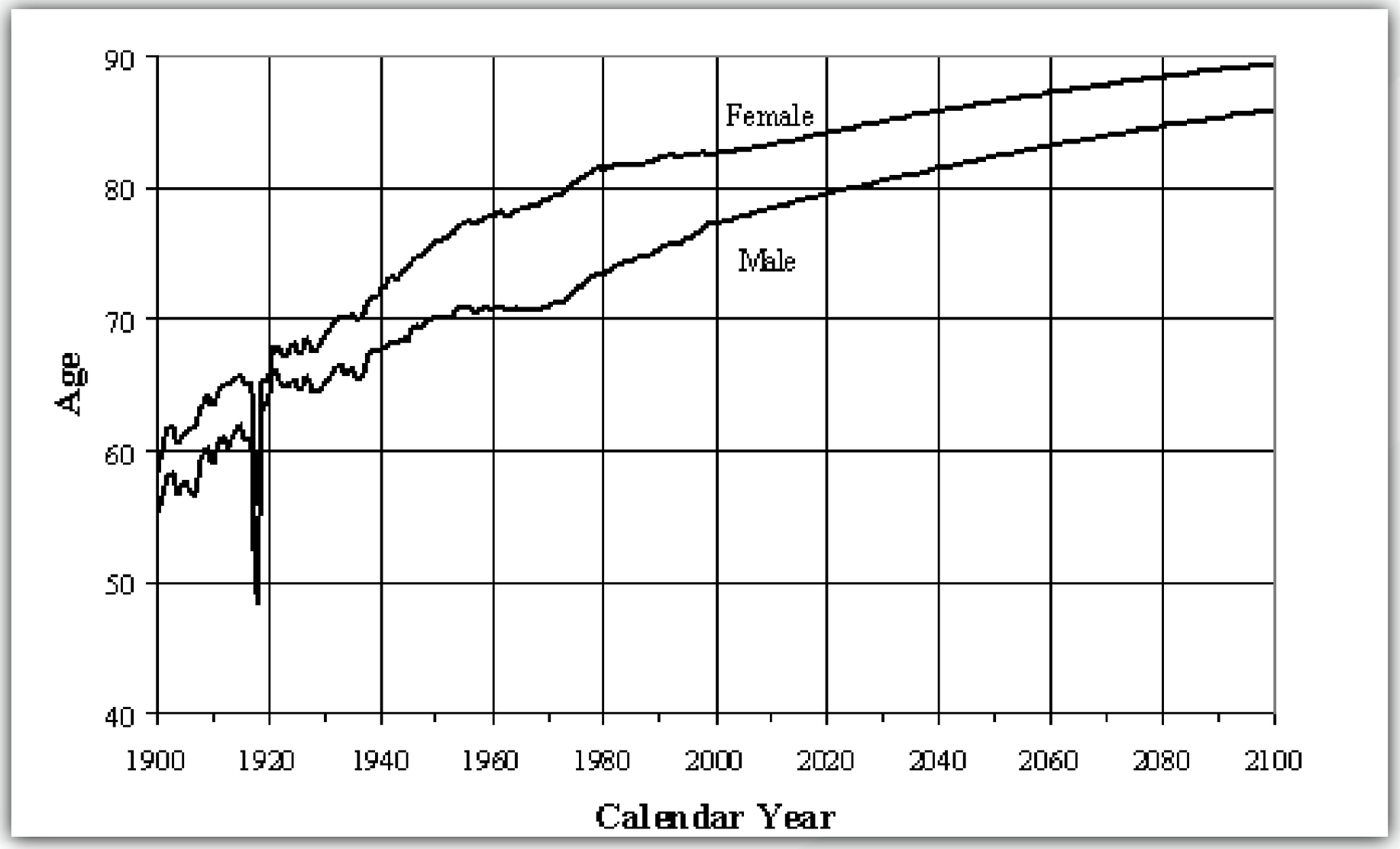

ing
Muscle
Age

# Tip # 2

There is no demographic, actuarial, or biological justification for concluding that most (or even half of the population) can live to 100

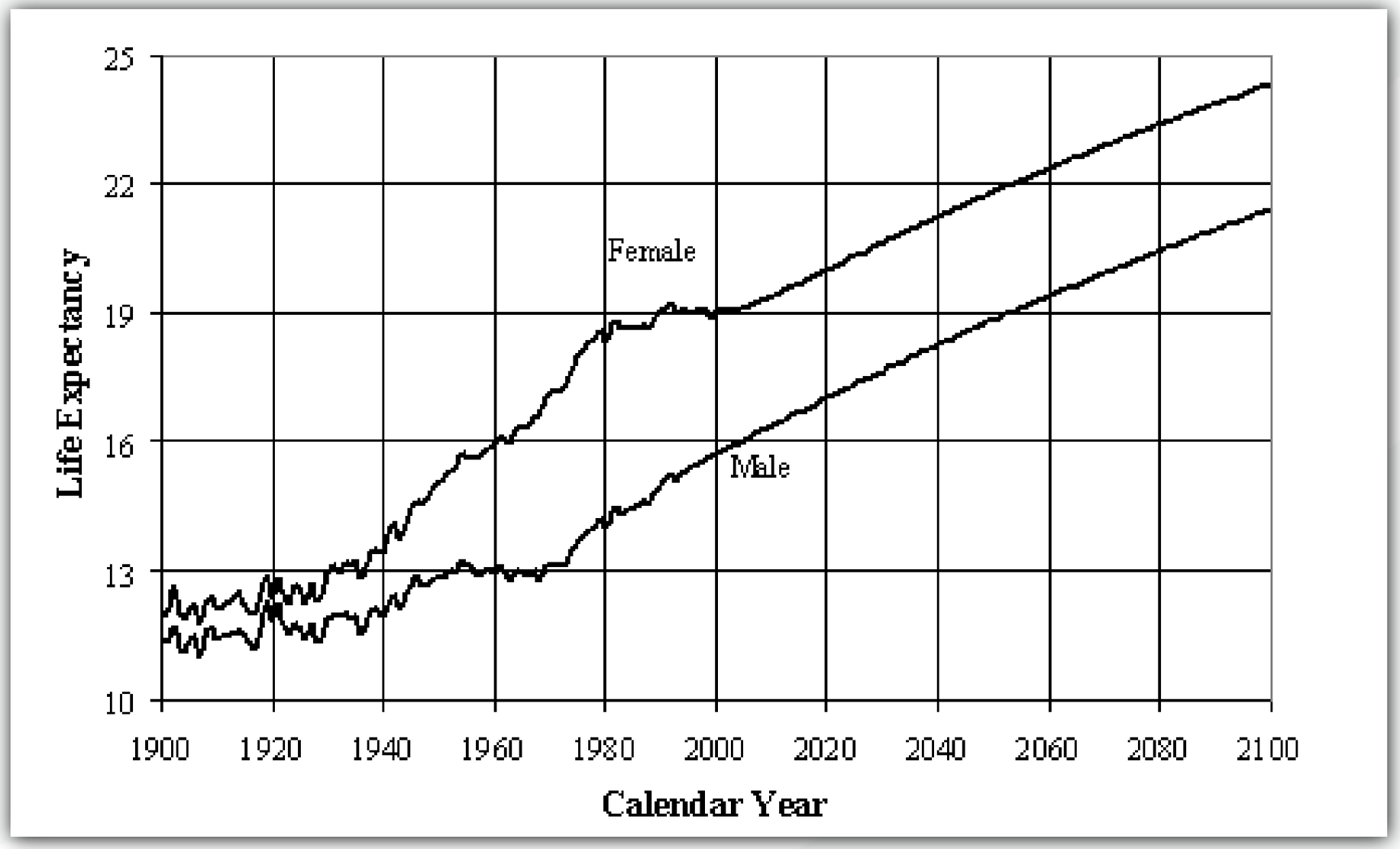
# Forecasting Life Expectancy

# Life Expectancy at Birth

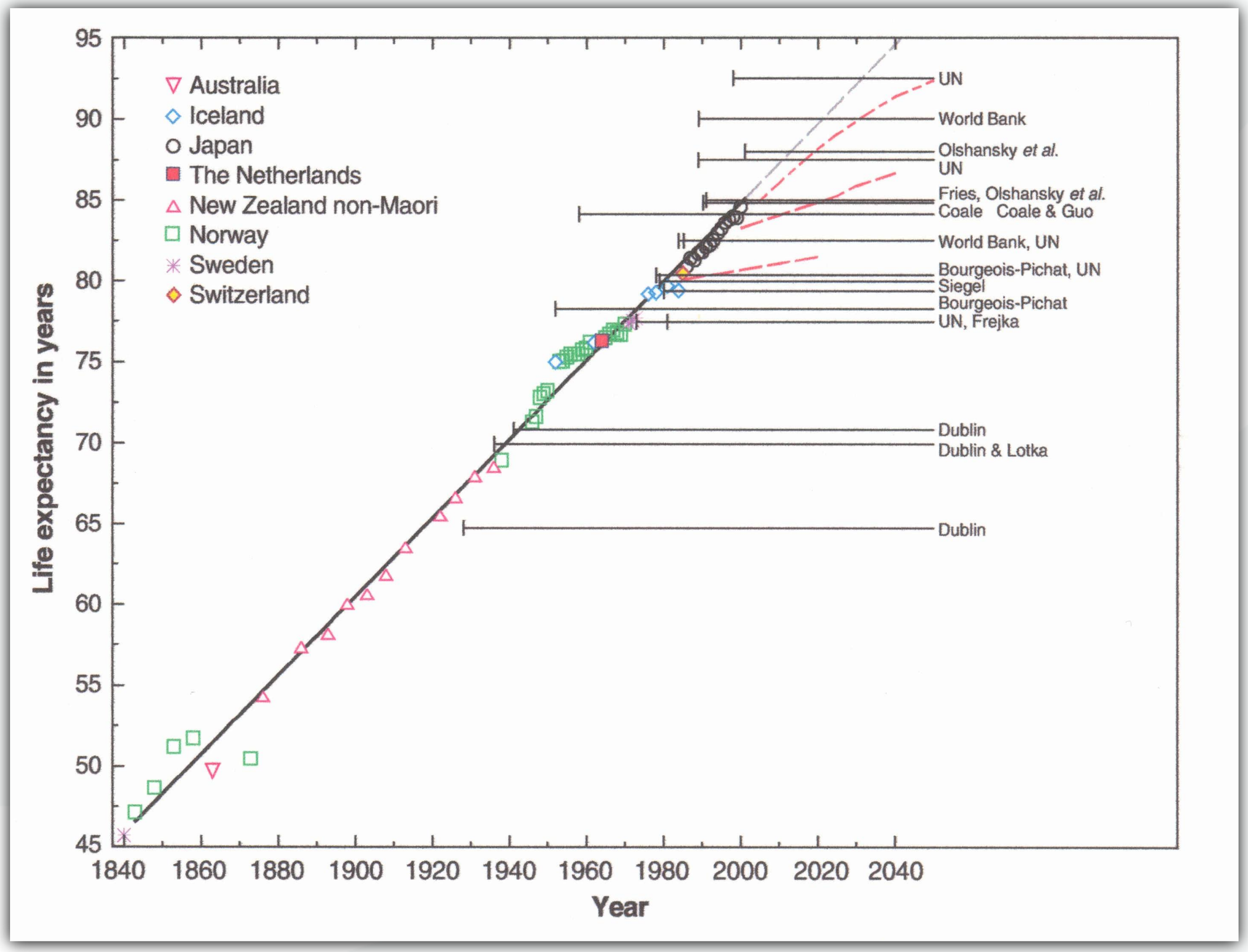


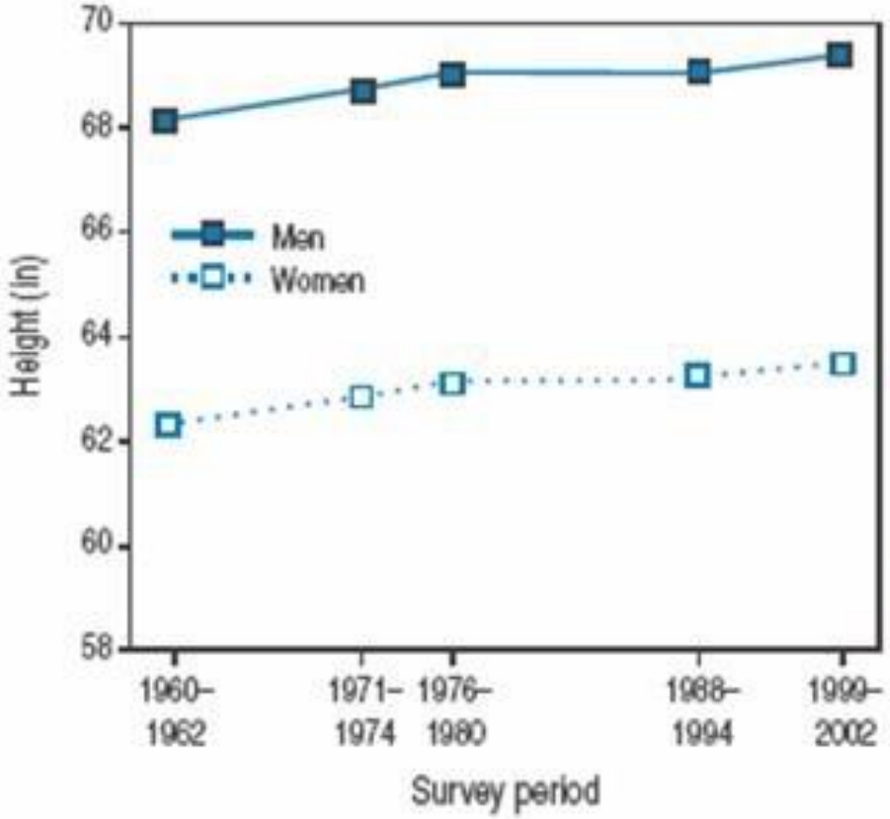

*Social Security Administration. Actuarial Study No. 116. 2002.*

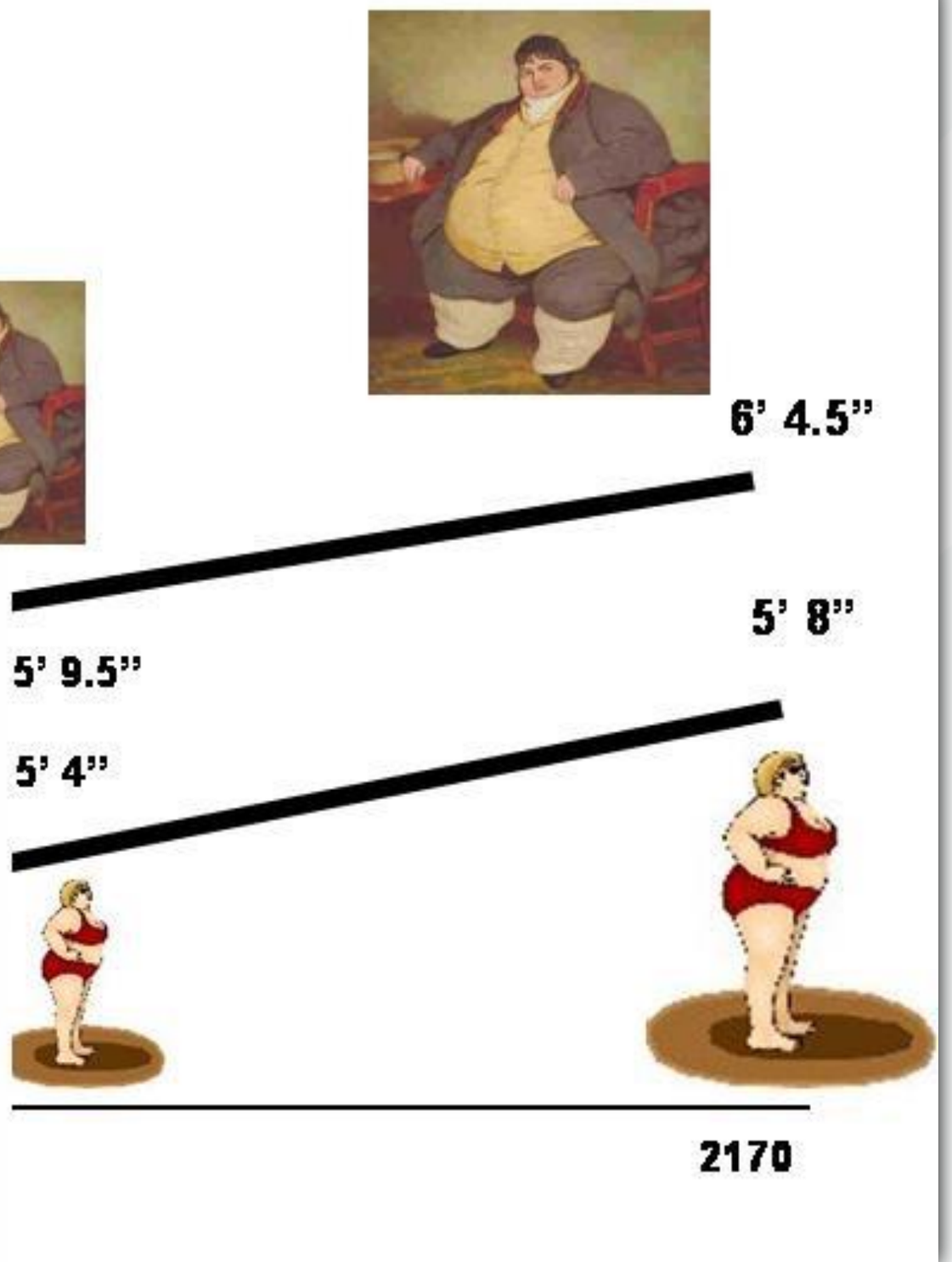
# Life Expectancy at Age 65

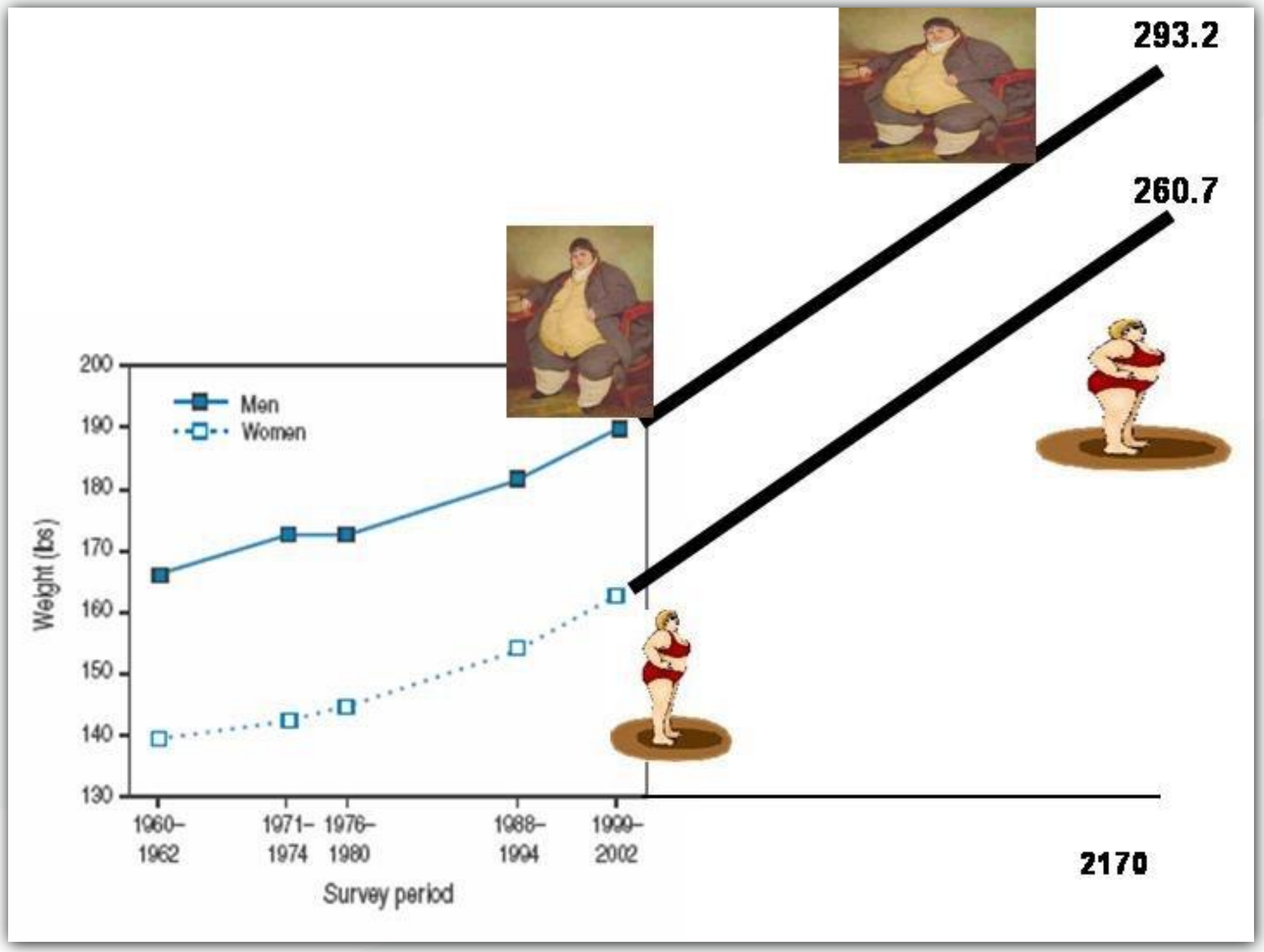



*Social Security Administration. Actuarial Study No. 116. 2002.*

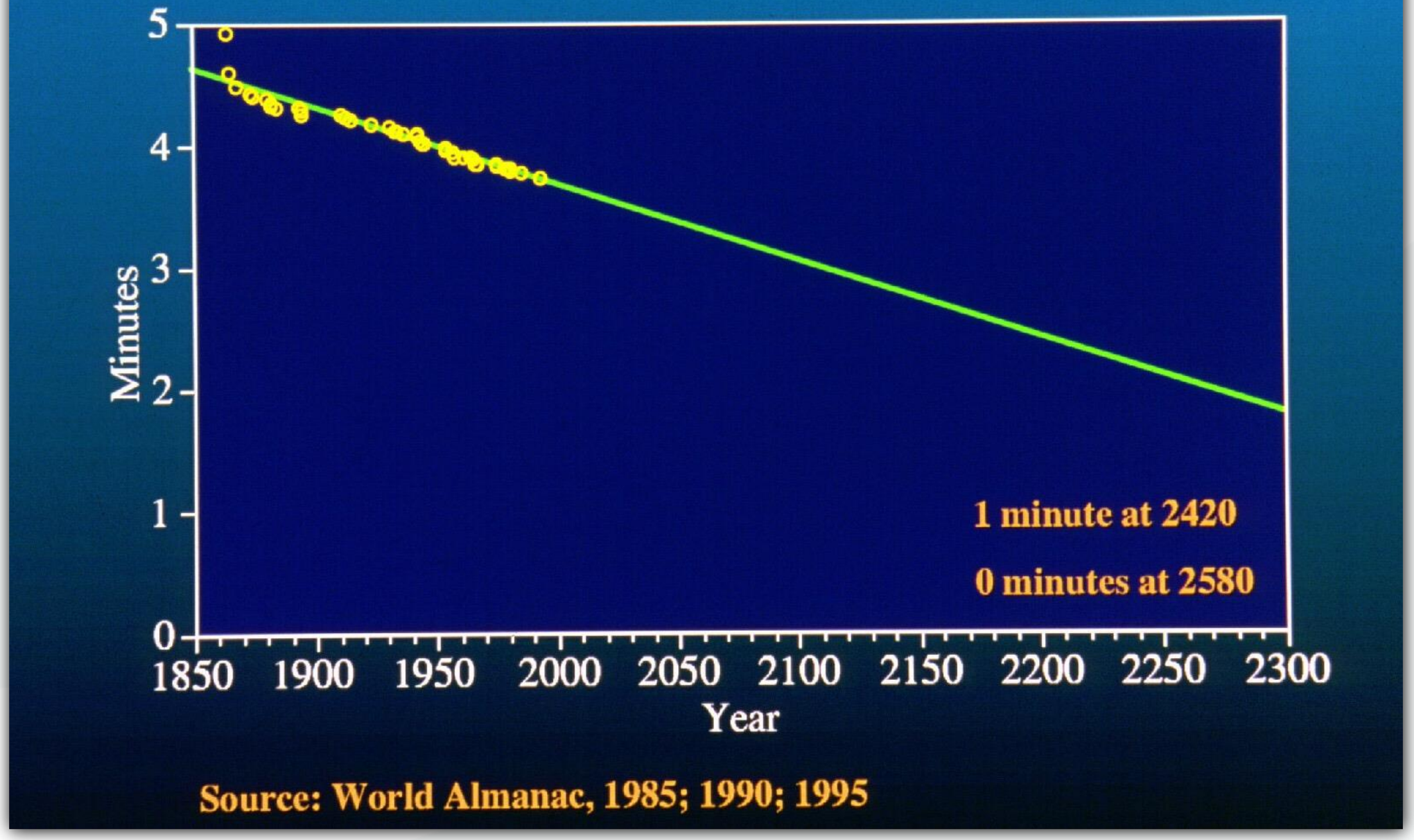

Australia
Iceland
Japan
The Netherlands
New Zealand non-Maori
Norway
Sweden
Switzerland
UN
World Bank
Olshansky et al.
UN
Fries, Olshansky et al.
Coale Coale & Guo
World Bank, UN
Bourgeois-Pichat, UN
Siegel
Bourgeois-Pichat
UN, Frejka
Dublin
Dublin & Lotka
Dublin
Life expectancy in years
95
90
85
80
75
70
65
60
55
50
45
1840
1860
1880
1900
1920
1940
1960
1980
2000
2020
2040
Year


70
68
66
64
62
60
58
Height (in)
Men
Women
1960–1962
1971–1974
1976–1980
1988–1994
1999–2002
Survey period


6' 4.5"
5' 8"
5' 9.5"
5' 4"
2170


293.2
260.7
200
190
180
170
160
150
140
130
Men
Women
Weight (lbs)
1960–1962
1971–1974
1976–1980
1988–1994
1999–2002
Survey period
2170

# World Record for the 1-Mile Run (Males)



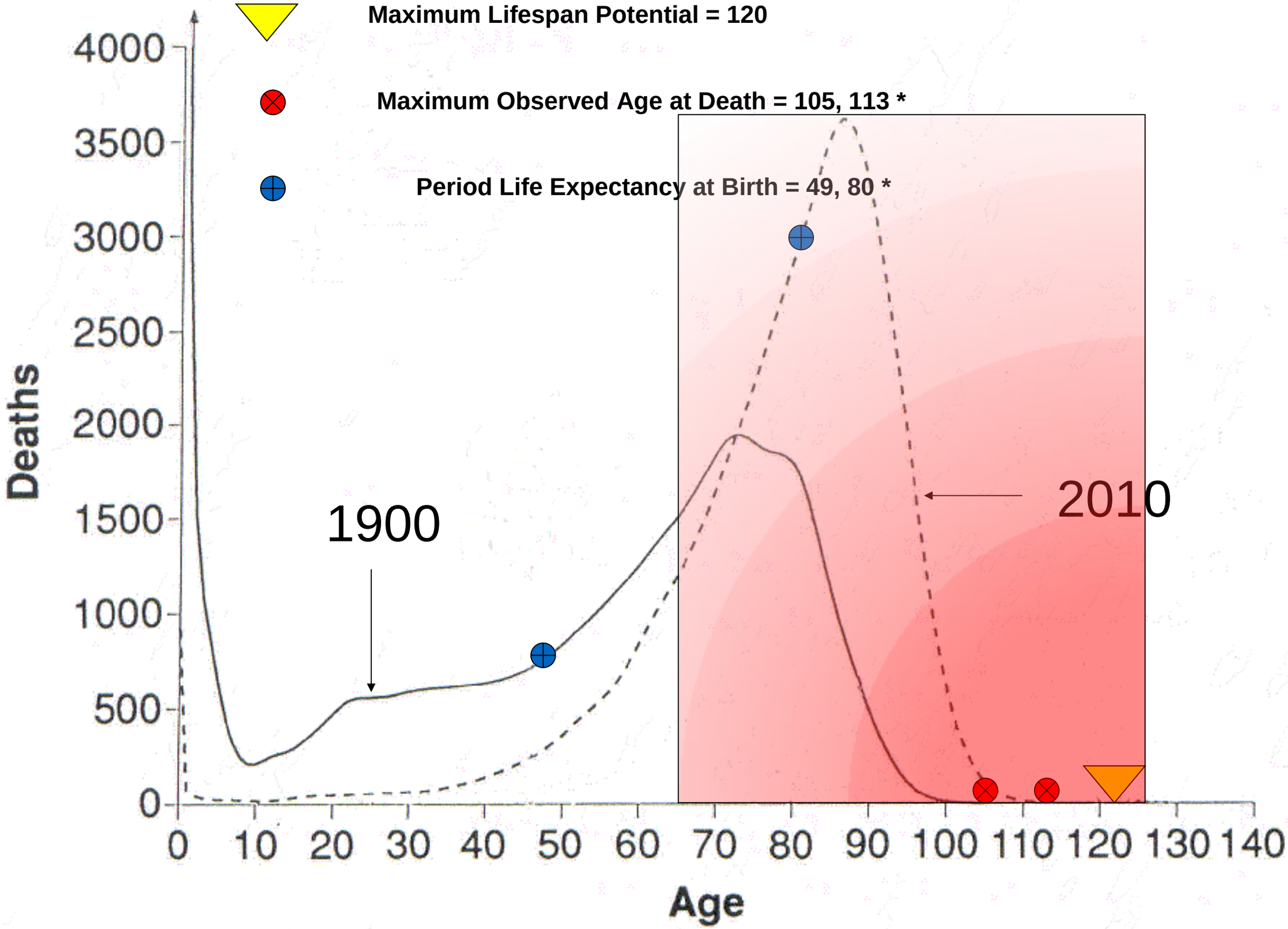

Source: World Almanac, 1985; 1990; 1995

# U.S. Females

**Maximum Lifespan Potential = 120**

**Maximum Observed Age at Death = 105, 113 ***

**Period Life Expectancy at Birth = 49, 80 ***



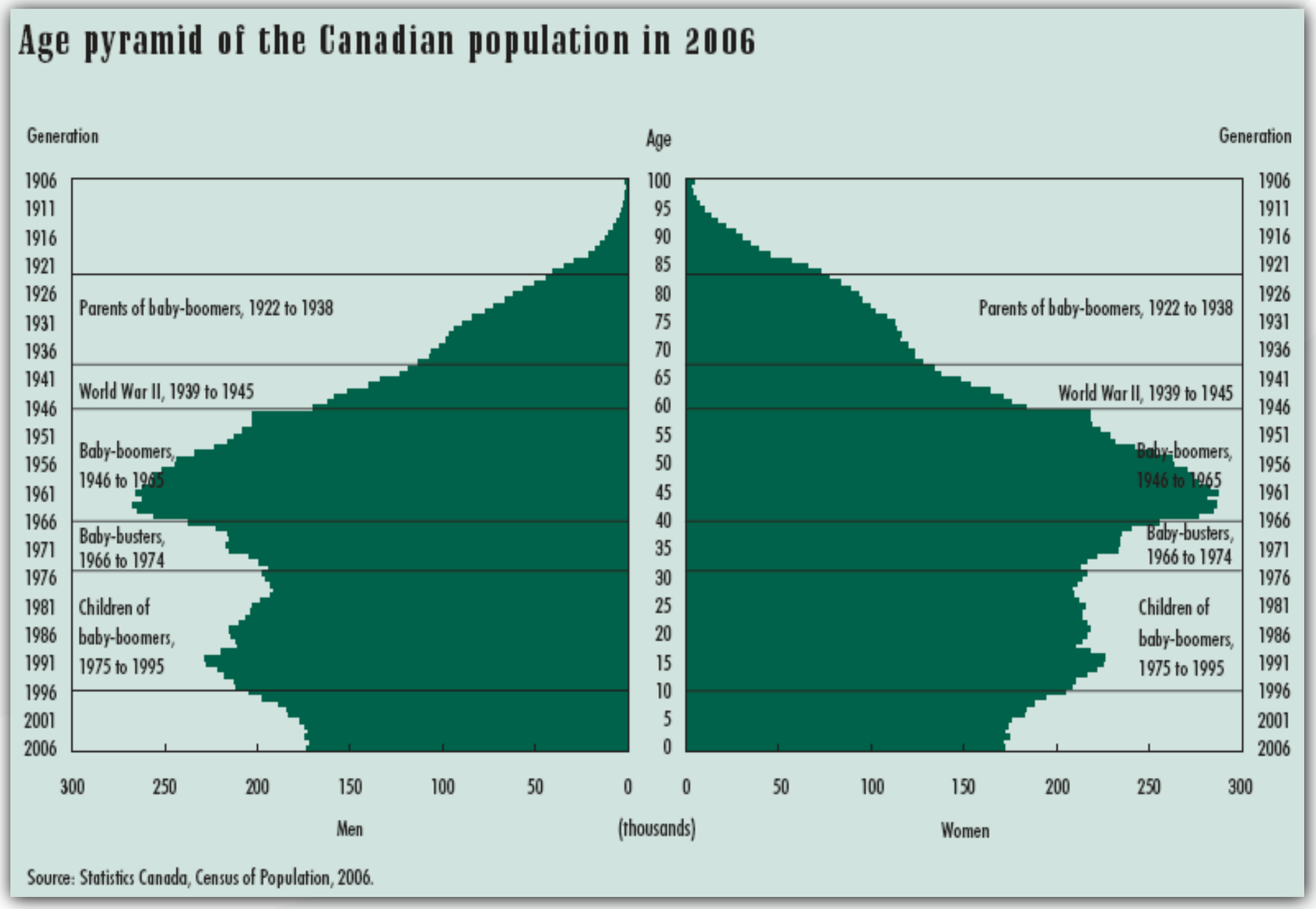
# Tip # 3

Past trends in life expectancy are routinely used to predict the future.

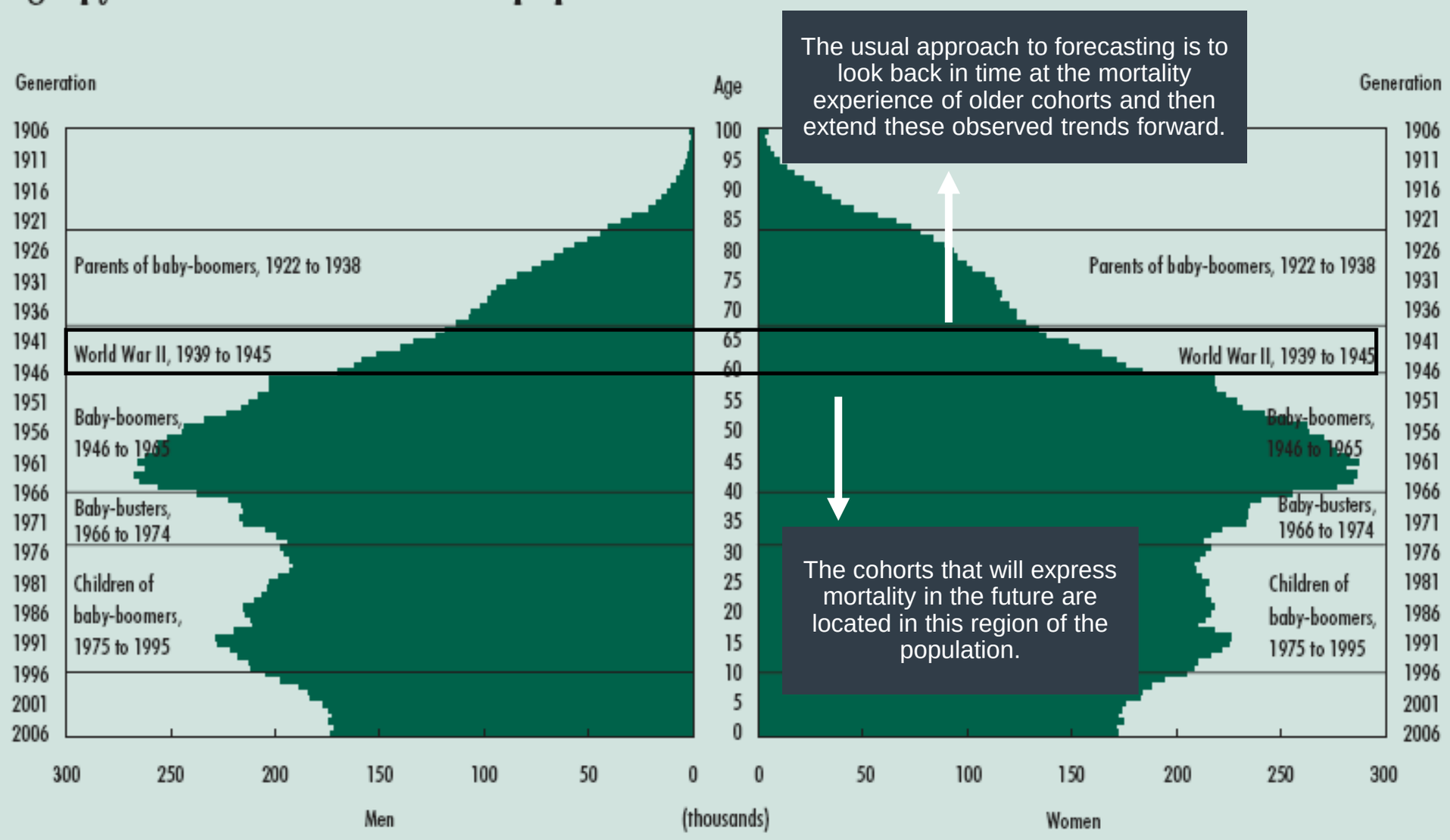
How long we will live in the future will be driven by our biology, not past trends.

# Subgroup Dynamics

# National Populations Are Composed of Subgroups Born in Different Time Periods With Varying Mortality Risks

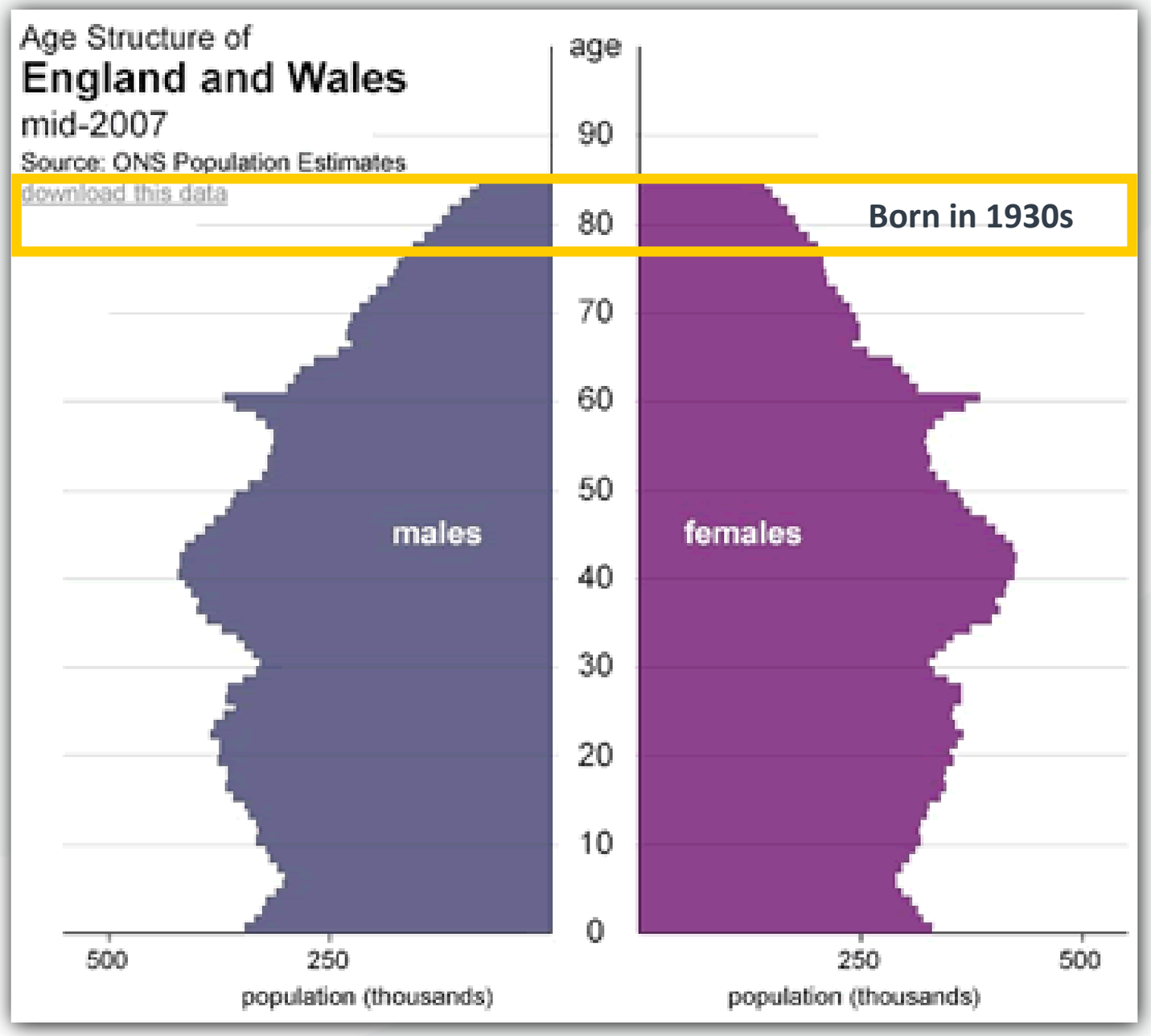


# Age pyramid of the Canadian population in 2006

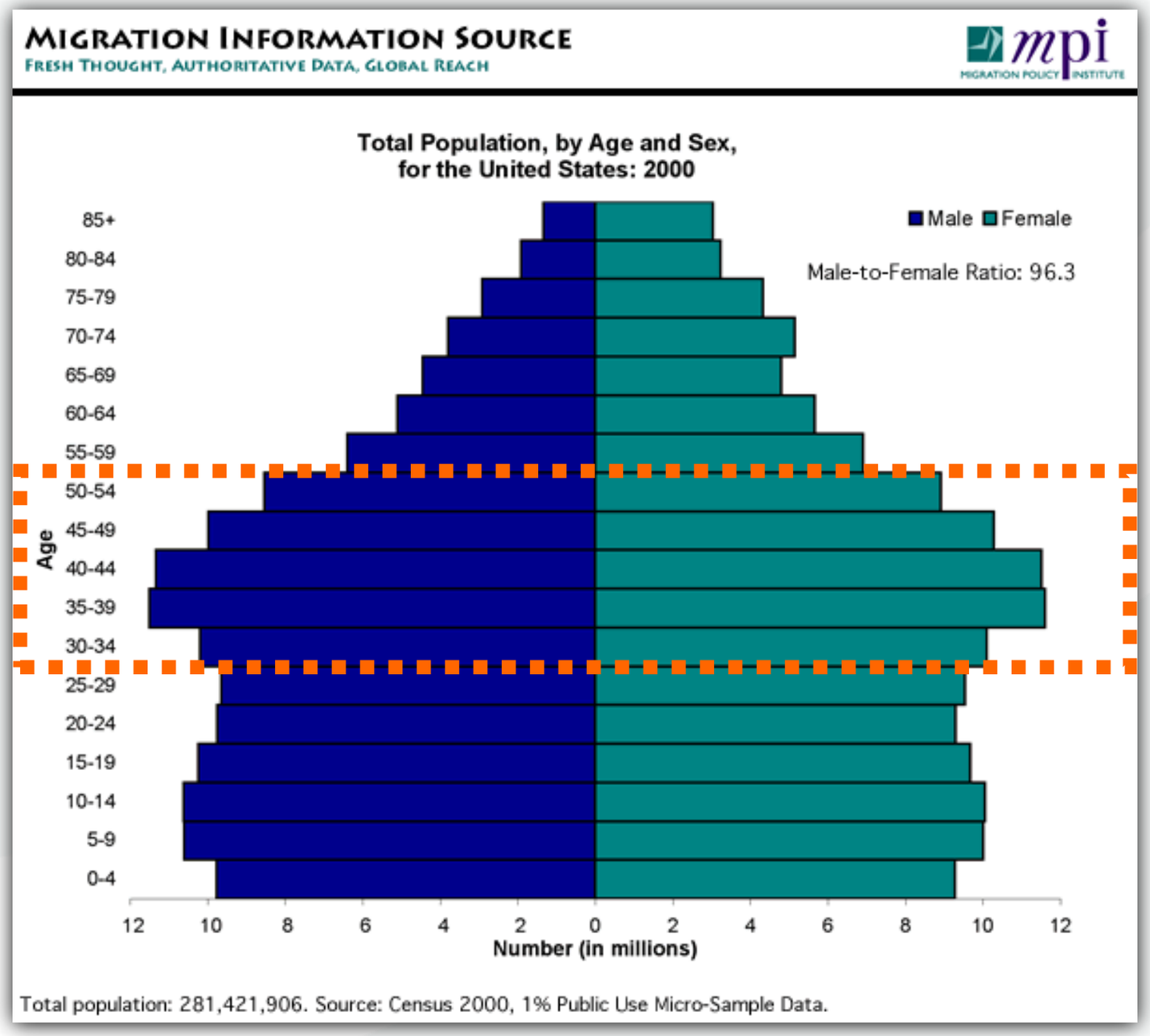



Source: Statistics Canada, Census of Population, 2006.

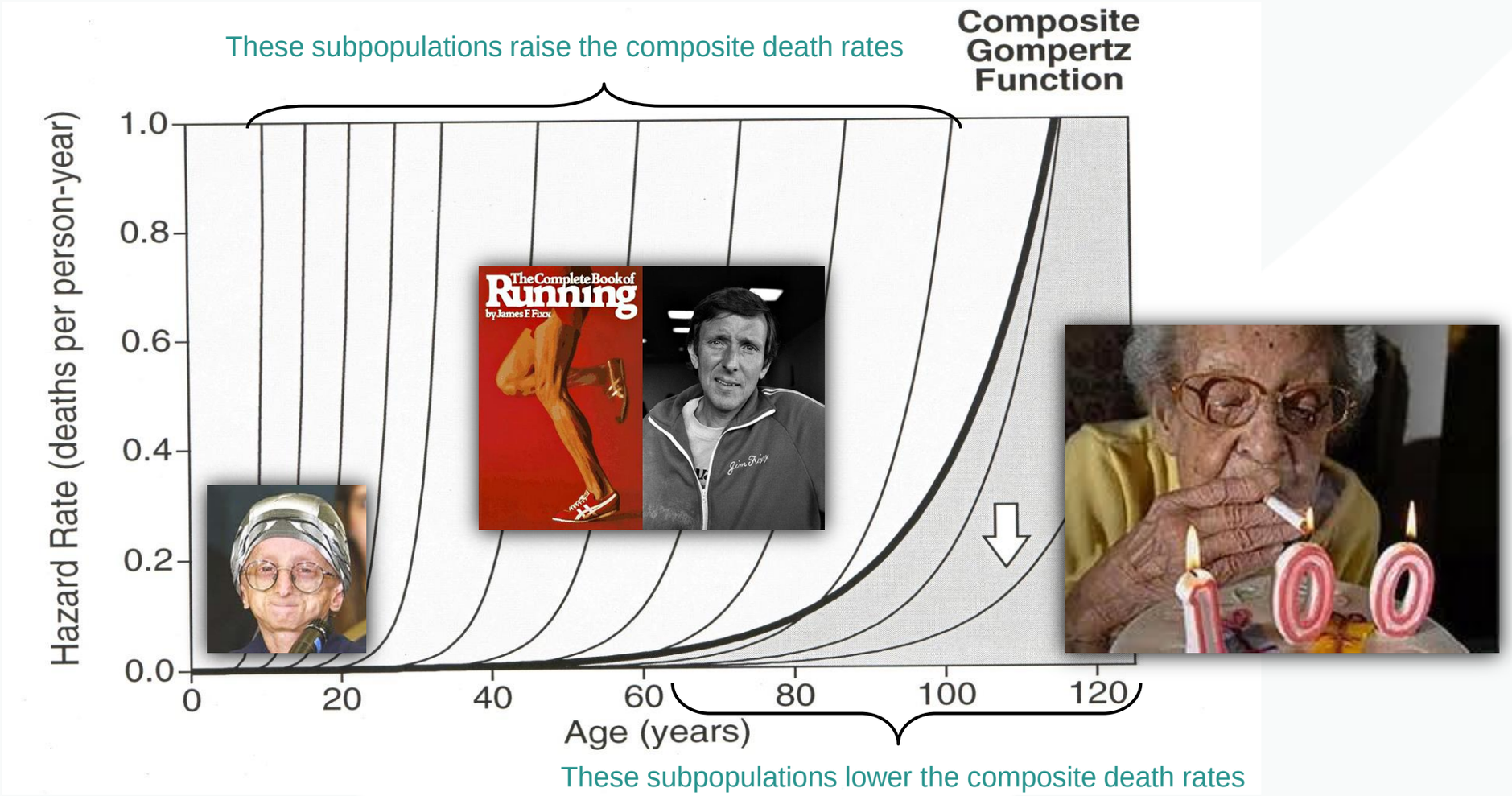
# The Golden Cohort




# Endangered Cohorts



# Populations Are Heterogeneous Mixtures




The usual approach to mortality is to see and measure only the dark black line, which represents the risk of death for an entire population or an insured cohort. We know that national and insured populations are heterogeneous, with varying mortality risks.

# Tip # 4

To predict the future, track the health status of the living, not the mortality experience of extinguishing cohorts.

# The Next Revolution in Aging Science

# 300 word video


TheScientist
$4.95 | VOL. 20 NO. 3 | MARCH 2006 | WWW.THE-SCIENTIST.COM
MAGAZINE OF THE LIFE SCIENCES
fight
AGING
JAY OLSHANSKY & COLLEAGUES HAVE A PLAN
Daniel Perry Richard A. Miller Robert N. Butler
THE TOP 50 PLACES TO POSTDOC
A TOWN BOUNCES BACK AFTER BIG PHARMA LEAVES
MARC VIDAL CALLS FOR A $100 MILLION INTERACTOME PROJECT
A JOURNAL EDITOR SHOWS HOW HE AVOIDS IMAGE FRAUD
PLUS:
WHAT MEDICAL TOURISM MEANS FOR BIOTECHS


In pursuit of the
LONGEVITY DIVIDEND
What should we be doing to prepare for the unprecedented aging of humanity?
S. JAY OLSHANSKY, DANIEL PERRY, RICHARD A. MILLER, ROBERT N. BUTLER
Imagine an intervention, such as a pill, that could significantly reduce your risk of cancer. Imagine an intervention that could reduce your risk of stroke, or dementia, or arthritis. Now, imagine an intervention that does all these things, and at the same time reduces your risk of everything else undesirable about growing older: including heart disease, diabetes, Alzheimer and Parkinson disease, hip fractures, osteoporosis, sensory impairments, and sexual dysfunction. Such a pill may sound like fantasy, but aging interventions already do this in animal models. And many scientists believe that such an intervention is a realistically achievable goal for people. People already place a high value on both quality and length of life, which is why children are immunized against infectious diseases. In the same spirit, we suggest that a concerted effort to slow aging begin immediately – because it will save and extend lives, improve health, and create wealth.

BMJ
British Medical Journal

*July, 2008*

**Robert N Butler** president, International Longevity Center, New York, USA

**Richard A Miller** professor, University of Michigan, Ann Arbor, MI, USA

**Daniel Perry** executive director, Alliance for Aging Research, Washington, DC, USA

**Bruce A Carnes** professor, University of Oklahoma, Oklahoma City, OK, USA

**T Franklin Williams** professor emeritus, University of Rochester School of Medicine and Dentistry, Rochester, NY, USA

**Christine Cassel** president, American Board of Internal Medicine, Philadelphia, PA, USA

**Jacob Brody** professor, University of Illinois at Chicago, 1603 West Taylor Street, Chicago, IL 60612, USA

**Marie A Bernard** professor, University of Oklahoma, Oklahoma City, OK, USA

**Linda Partridge** director , Institute of Healthy Ageing, University College London, London

**Thomas Kirkwood** director, Institute for Ageing and Health, Newcastle University, Newcastle

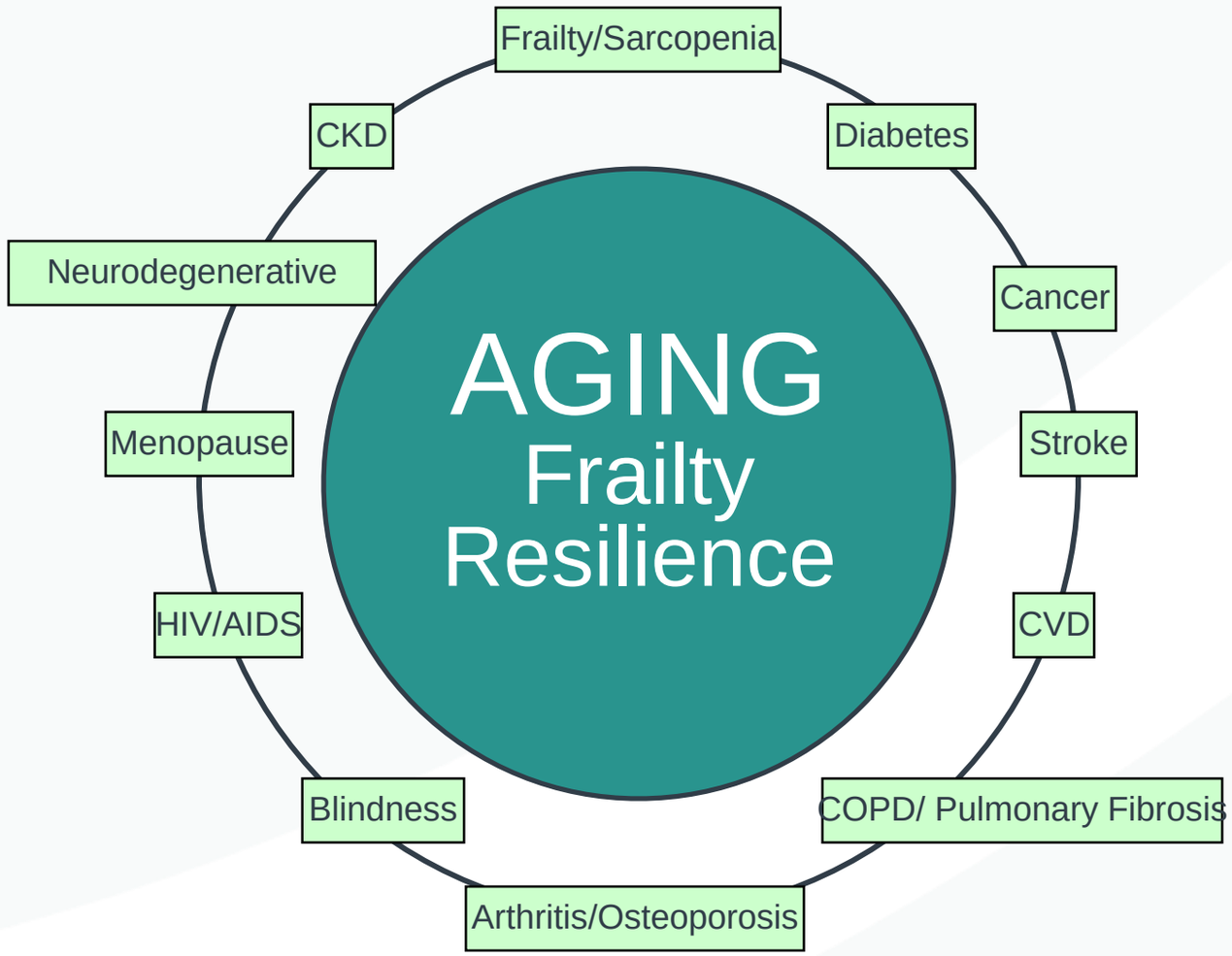
**George M Martin** scientific director, American Federation for Aging Research, Seattle, WA, USA

**S Jay Olshansky** professor, University of Illinois at Chicago, 1603 West Taylor Street, Chicago, IL 60612, USA

# New model of health promotion and disease prevention for the 21st century

Our susceptibility to disease increases as we grow older. **Robert Butler and colleagues** argue that interventions to slow down ageing could therefore have much greater benefit than those targeted at individual disease

# Aging Biology is at the core of chronic diseases



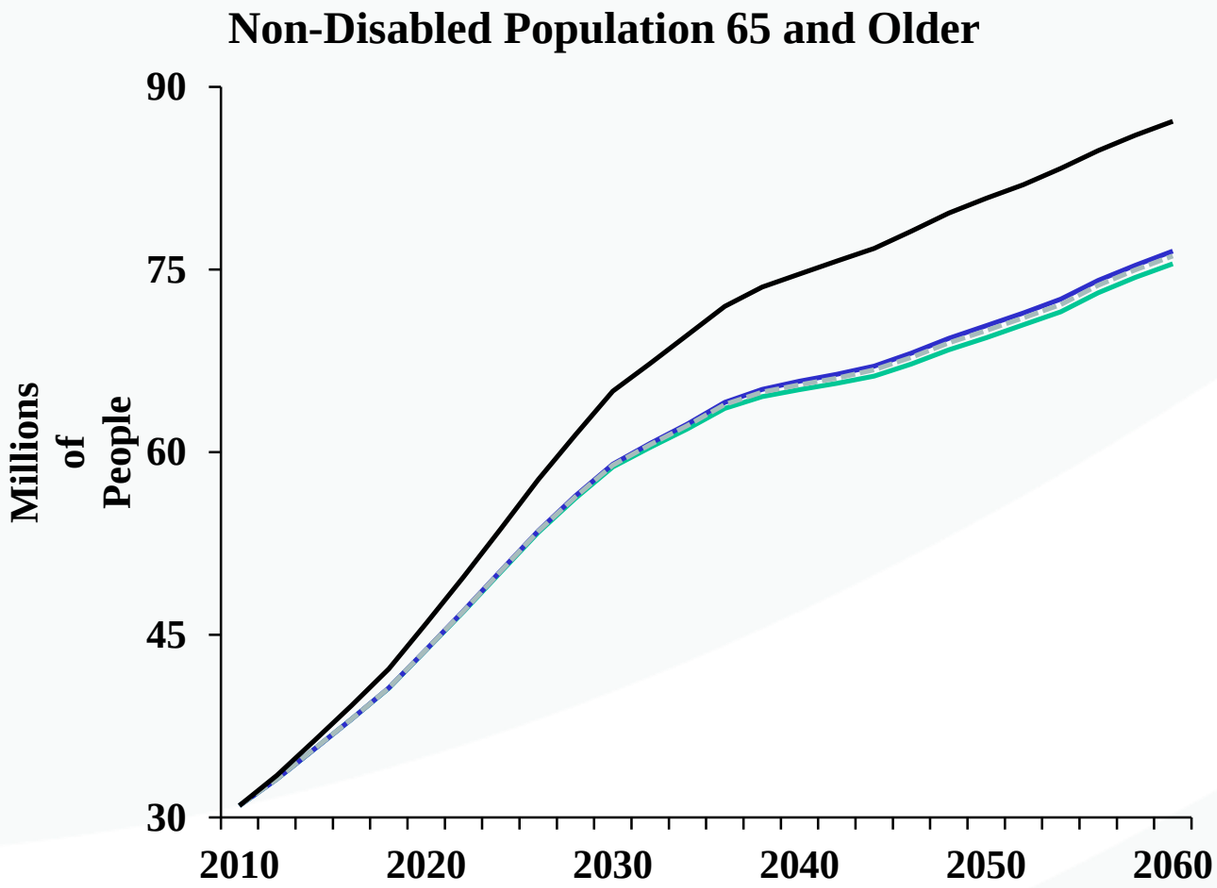

*Source: Dr. Felipe Sierra*

# LDI Leading Organizations / Research Advisory Committee

**Affiliated Research Institutions and Universities**

*Source: Dr. Felipe Sierra*

# Delayed aging would have the largest impact on the number of healthy, older adults…

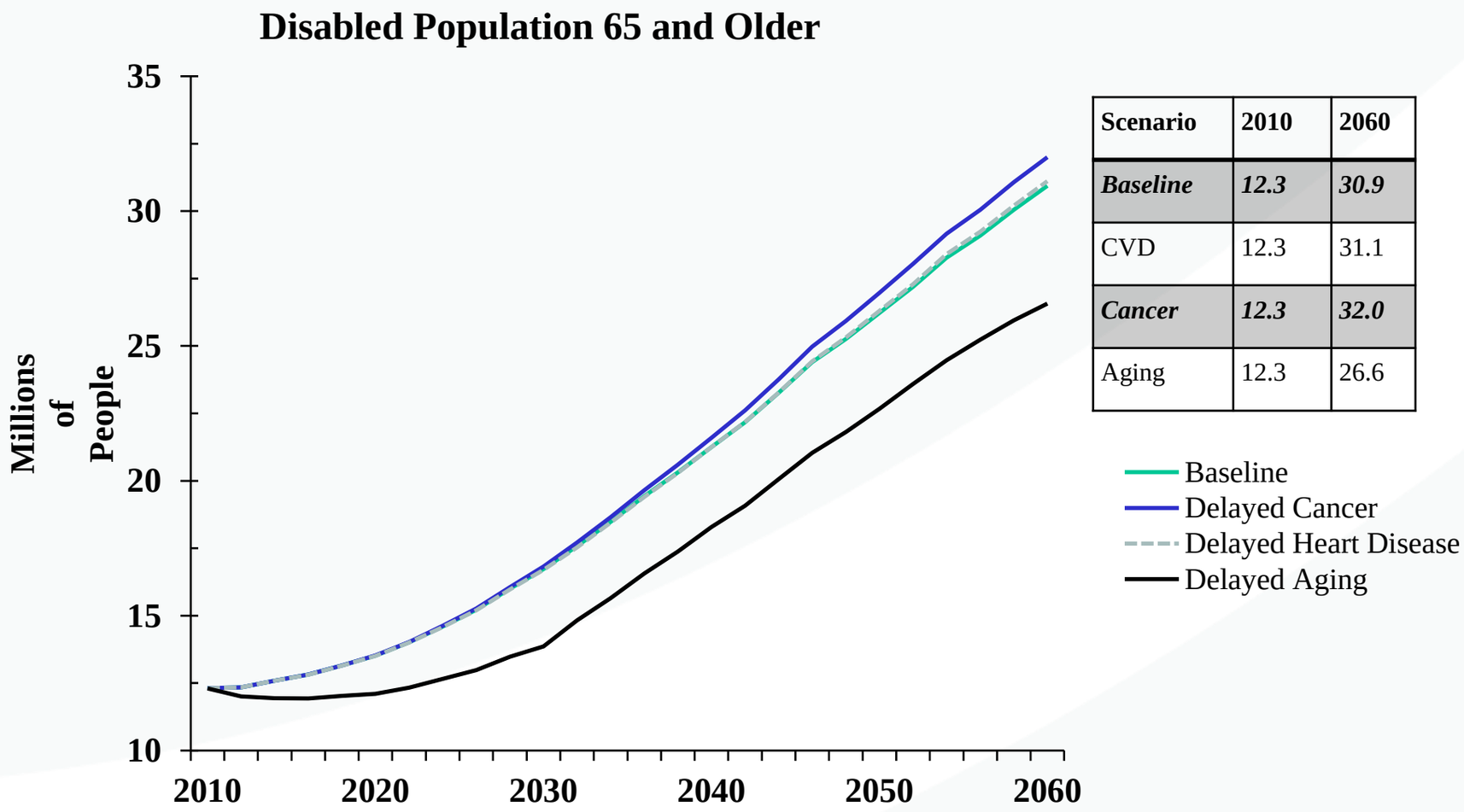



| Scenario | 2010 | 2060 |
|---|---|---|
| ***Baseline*** | ***31.0*** | ***75.5*** |
| CVD | 31.0 | 76.1 |
| ***Cancer*** | ***31.0*** | ***76.5*** |
| Aging | 31.0 | 87.2 |

Baseline
Delayed Cancer
Delayed Heart Disease
Delayed Aging

**Source: Goldman et al., 2013**

# …and it would do so without increasing the number of disabled.

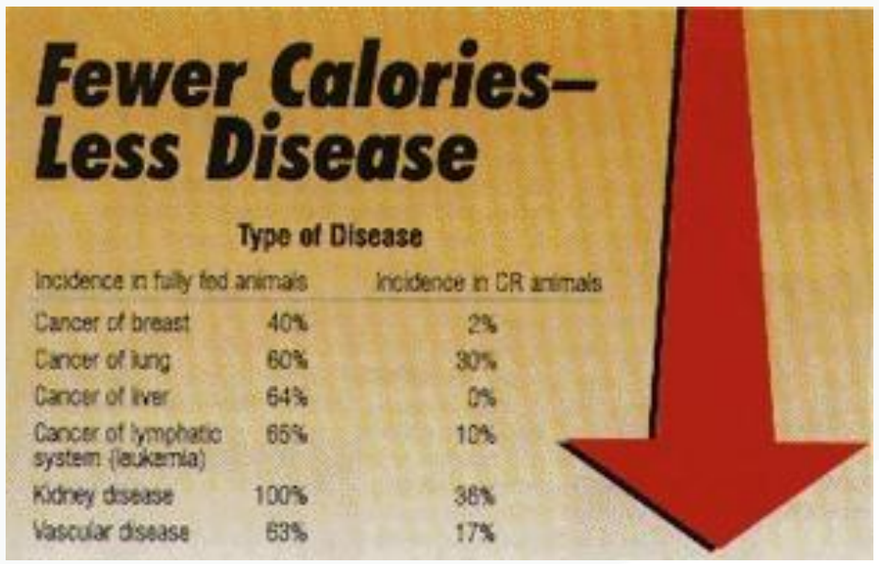



| Scenario | 2010 | 2060 |
|---|---|---|
| ***Baseline*** | ***12.3*** | ***30.9*** |
| CVD | 12.3 | 31.1 |
| ***Cancer*** | ***12.3*** | ***32.0*** |
| Aging | 12.3 | 26.6 |

**Source: Goldman et al., 2013**

# Do We Need to Know in Advance Which Scientific Pathways to the Longevity Dividend Will Work?

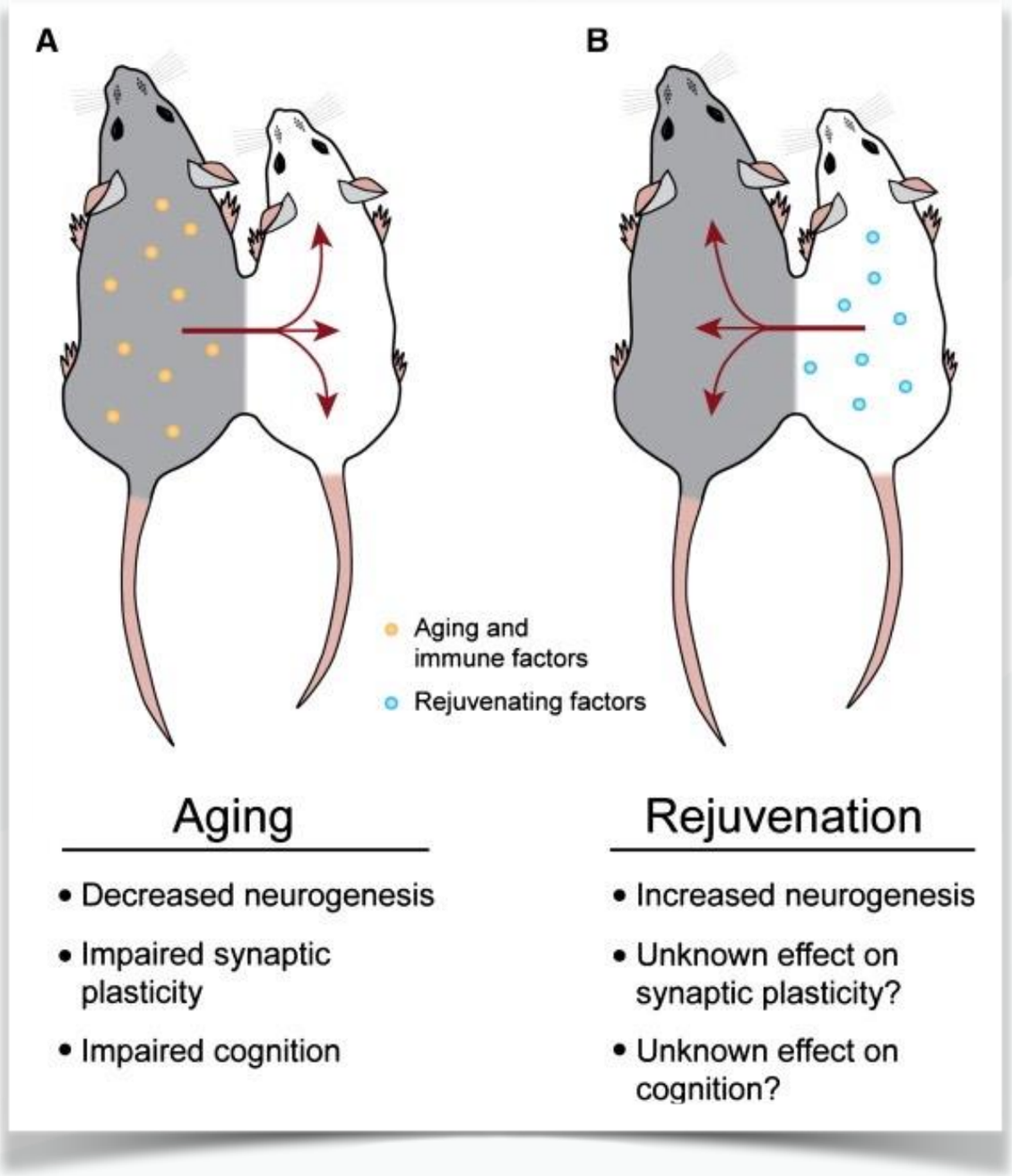
Genetics of long-lived people




Caloric restriction

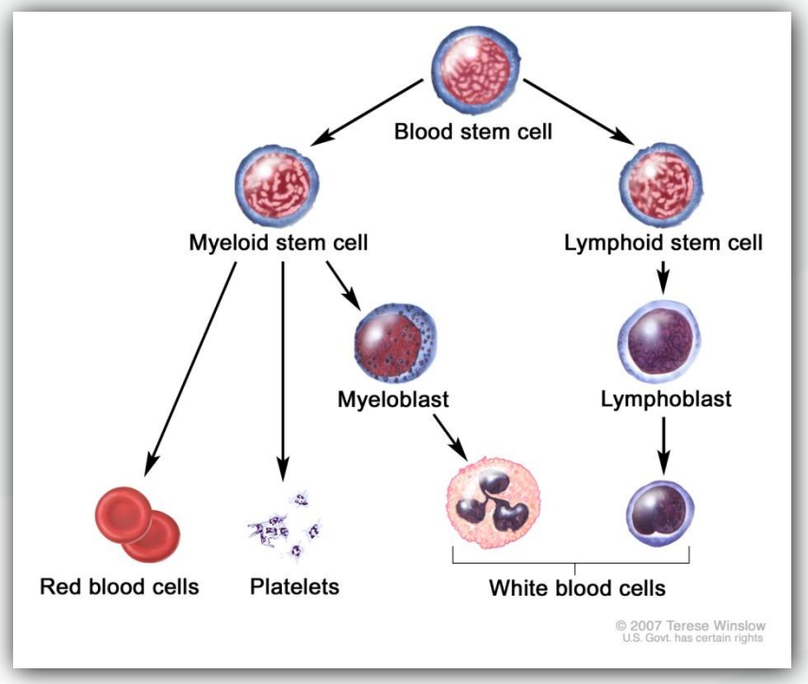
Compounds with properties that appear to slow aging

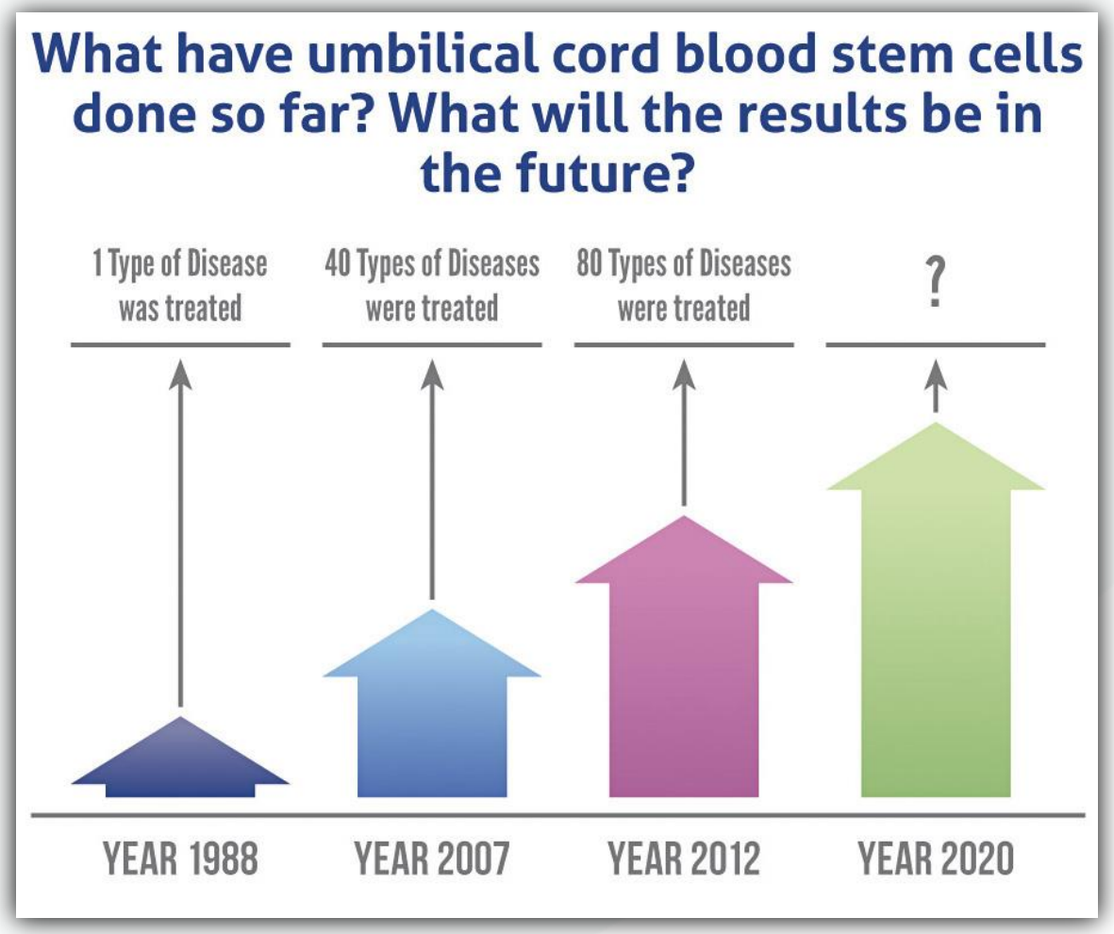

# Parabiosis


A
B
Aging and immune factors
Rejuvenating factors
Aging
• Decreased neurogenesis
• Impaired synaptic plasticity
• Impaired cognition
Rejuvenation
• Increased neurogenesis
• Unknown effect on synaptic plasticity?
• Unknown effect on cognition?


The Collection Process:
placenta
tubing
needle
umbilical cord
collection bag

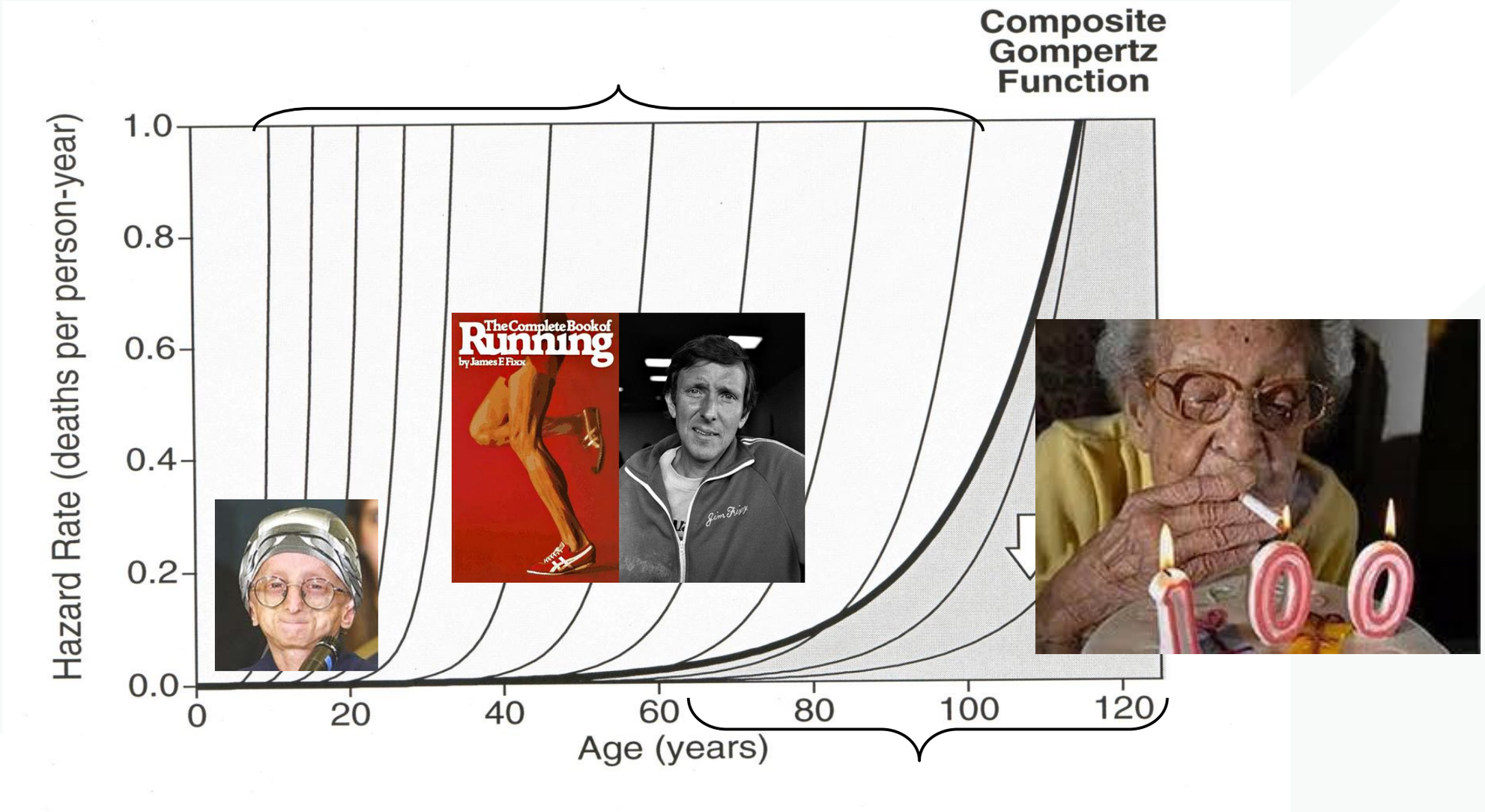

Umbilical cord blood is often stored after birth.
CORD BLOOD
COLD STORAGE


Blood stem cell
Myeloid stem cell
Lymphoid stem cell
Myeloblast
Lymphoblast
Red blood cells
Platelets
White blood cells
© 2007 Terese Winslow
U.S. Govt. has certain rights

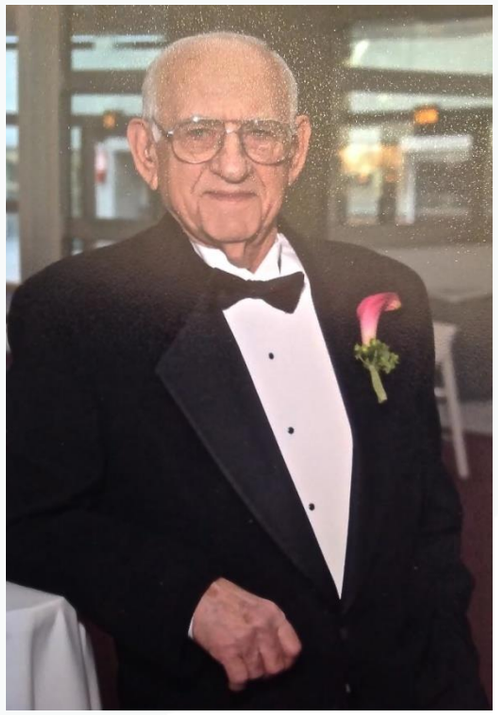

What have umbilical cord blood stem cells done so far? What will the results be in the future?
1 Type of Disease was treated
40 Types of Diseases were treated
80 Types of Diseases were treated
?
YEAR 1988
YEAR 2007
YEAR 2012
YEAR 2020

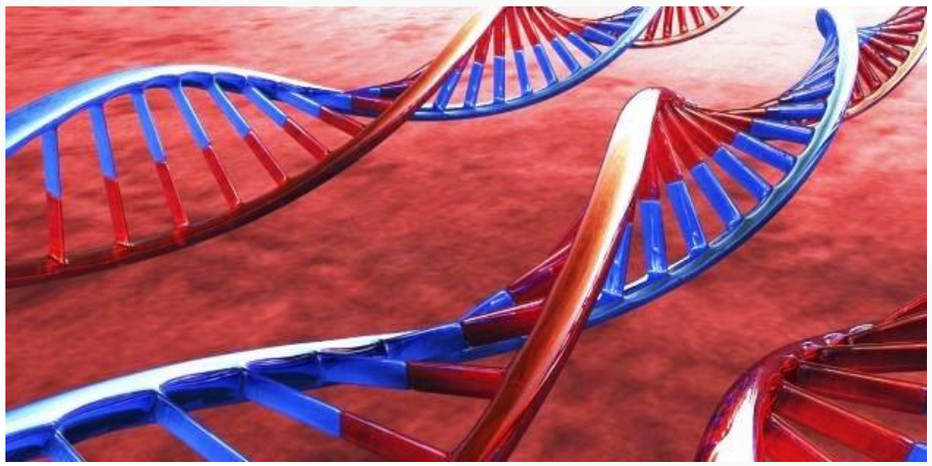

Cord Blood Benefits Siblings
100%
Match for self
25%
Chance perfect match
50%
Chance of partial match

# Populations Are Heterogeneous Mixtures

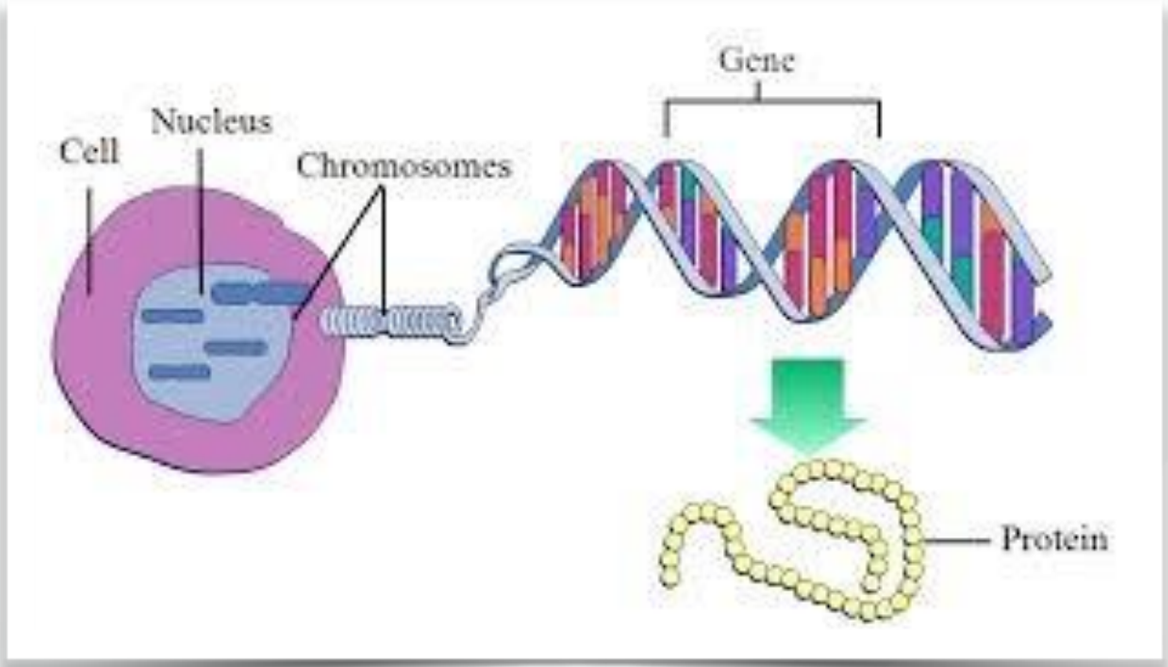


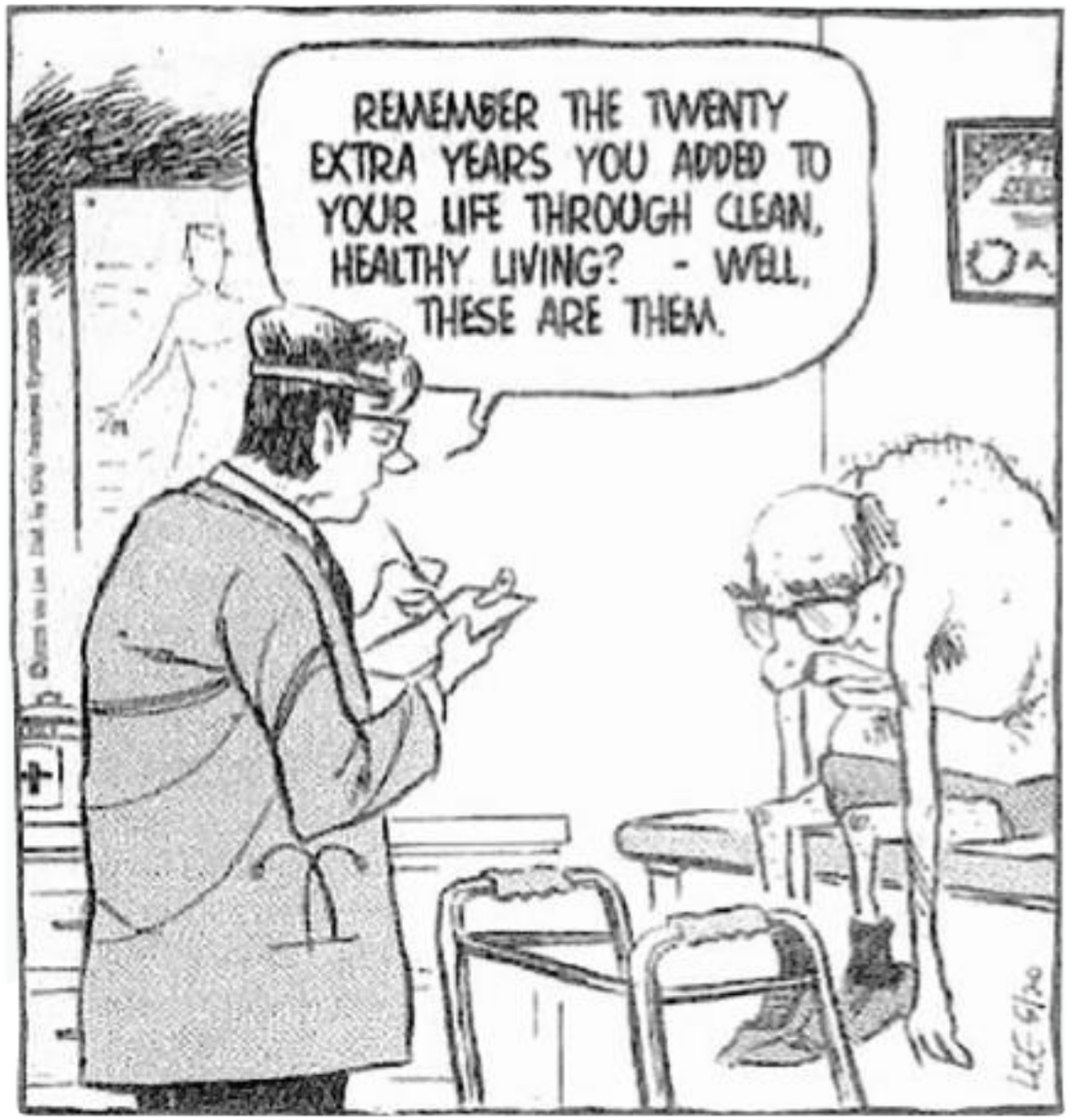
# The secret to Primary Prevention is already here…





*Centenarians and their offspring possess genes that protect them from fatal diseases that kill the rest of us at younger ages*


Gene
Nucleus
Cell
Chromosomes
Protein


REMEMBER THE TWENTY EXTRA YEARS YOU ADDED TO YOUR LIFE THROUGH CLEAN, HEALTHY LIVING? - WELL, THESE ARE THEM.

# Tip # 5

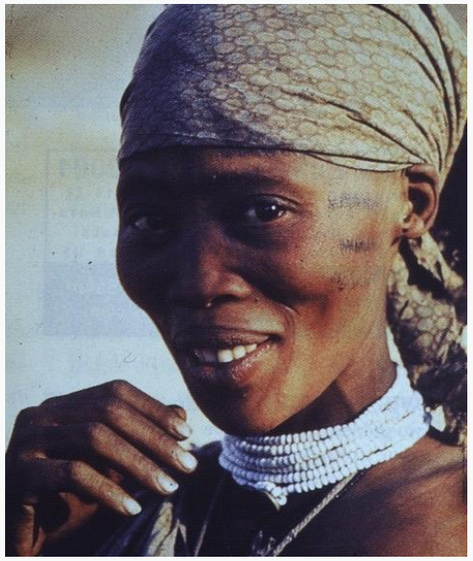
A breakthrough in aging science is within view. It will lead to the extension of healthy life, and a small increase in longevity.

# A Revolution Has Occurred in Life Underwriting

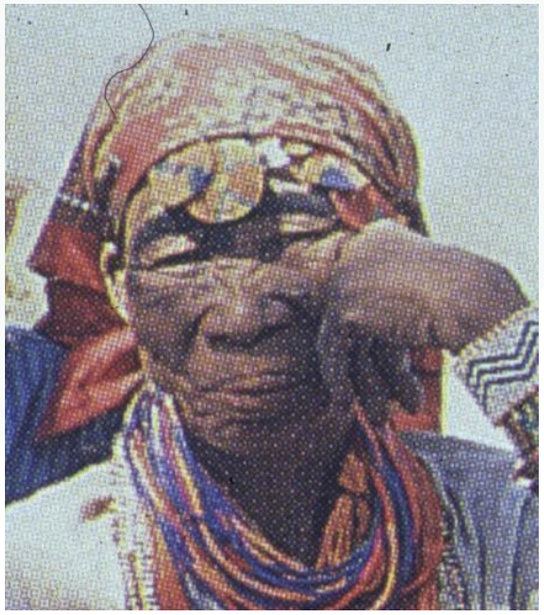
# Chronos Video

40

51

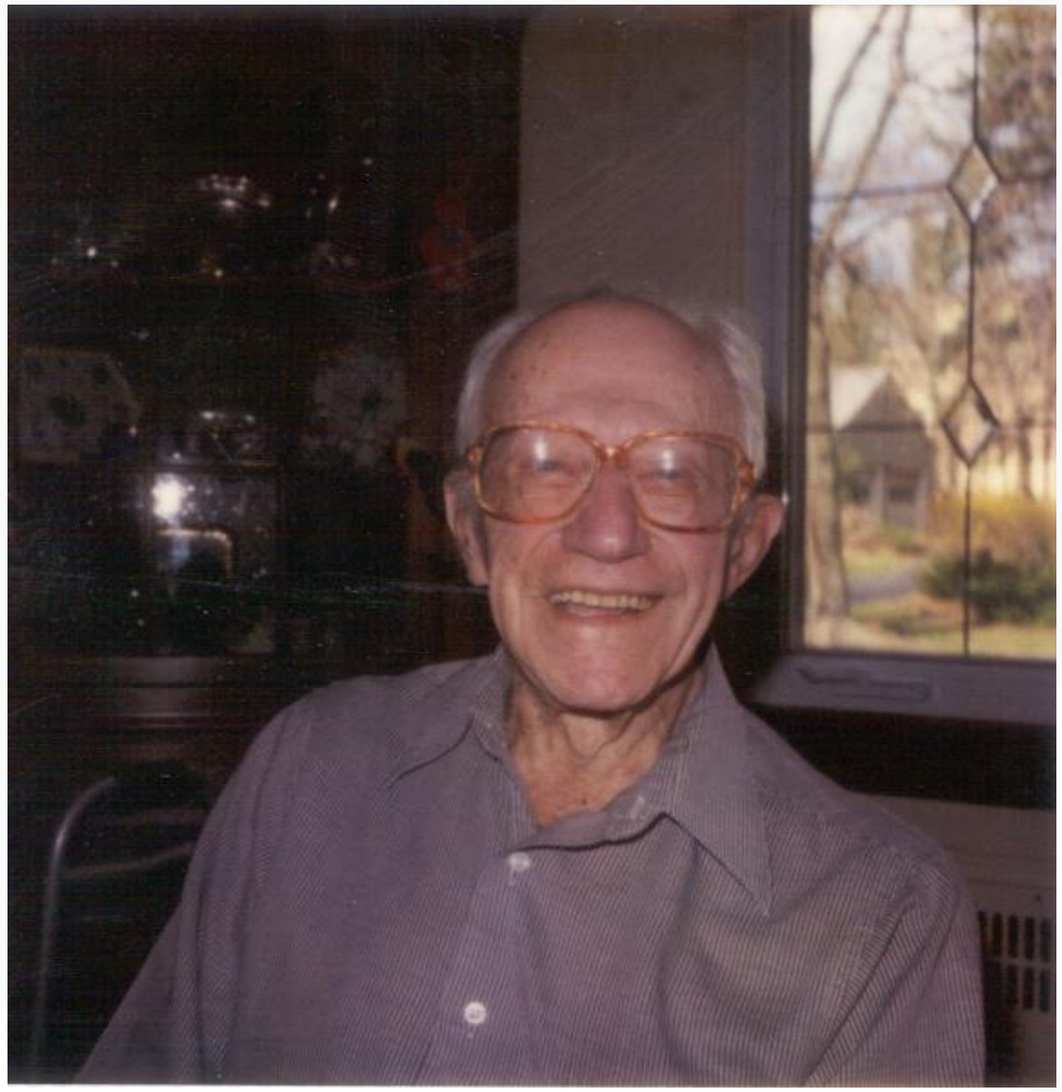


66



68

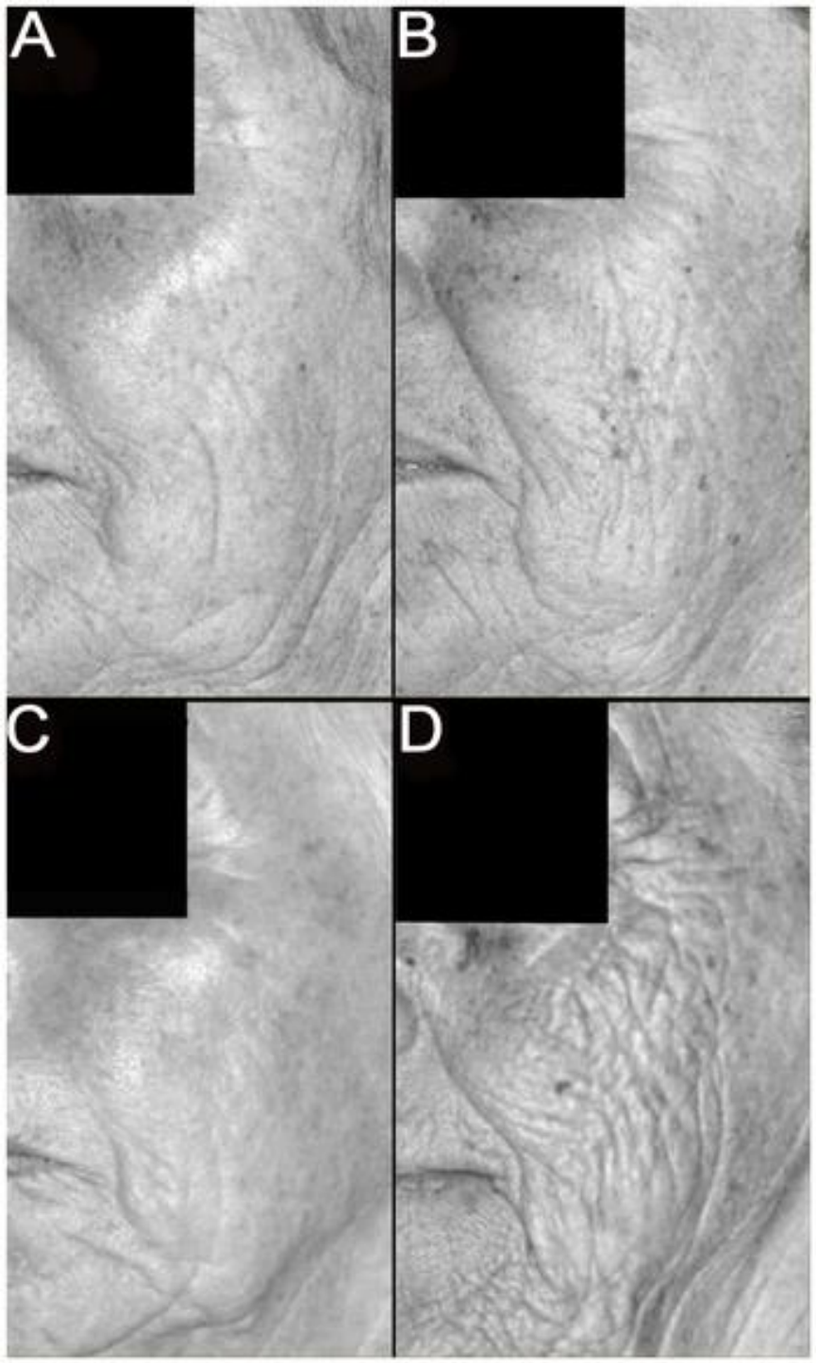
## 100 year old proband



## 70 year old son

*Photos from Dr. Nir Barzilai*

**Figure 3. Example of the most discordant monozygotic twin pair (68 years of age, perceived facial age a 63 years and b 68 years) and dizygotic twin pair (71 years of age, perceived facial age c 71 years and d 82 years) for skin wrinkling grading.**




Gunn DA, Rexbye H, Griffiths CEM, Murray PG, et al. (2009) Why Some Women Look Young for Their Age. PLoS ONE 4(12): e8021. doi:10.1371/journal.pone.0008021
http://www.plosone.org/article/info:doi/10.1371/journal.pone.0008021

# Bin Placement for 3 Males 60 Years of Age

Risk Profile 1
75.7 expected lifespan
54% die before, 46 % die after
3.8% die at predicted age
**96 % error rate**

Risk Profile 3
81.7 expected lifespan
51.4% die before, 49.6% die after
3.8% die at predicted age
**96 % error rate**

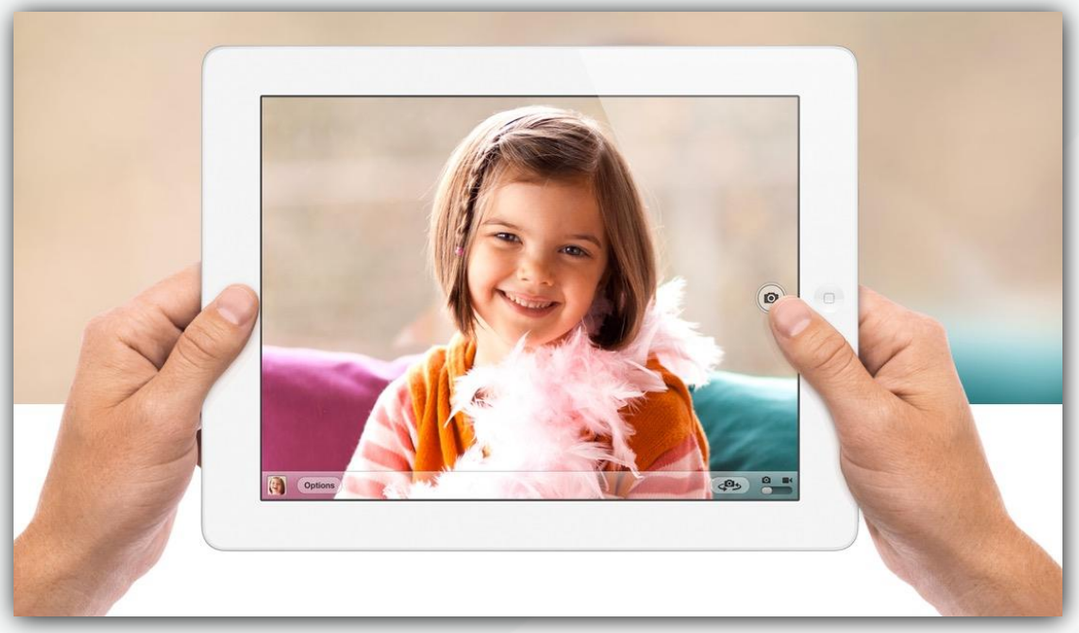
Risk Profile 4
83.7 expected lifespan
49.6% die before; 50.4% die after
4% die at predicted age
**96 % error rate**

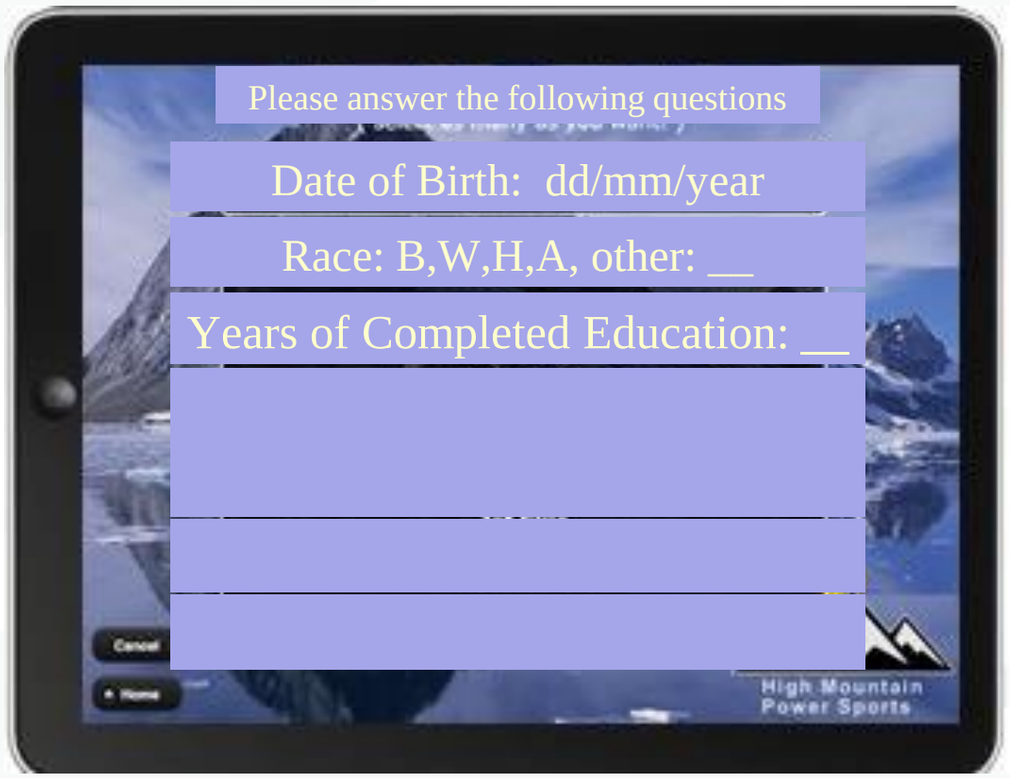
Percent Distribution of Death

5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00

Age

60 65 70 75 80 85 90 95 100 105 110




Please answer the following questions
Date of Birth: dd/mm/year
Race: B,W,H,A, other: __
Years of Completed Education: __
Cancel
Home
High Mountain
Power Sports

# Lapetus Video

# Tip # 6

The future of underwriting is here!

# Live Demonstration

LAPETUS
LIFE EVENT SOLUTIONS

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