A New Scientifically Based Method of Underwriting and a Glimpse Into Breakthroughs in Aging

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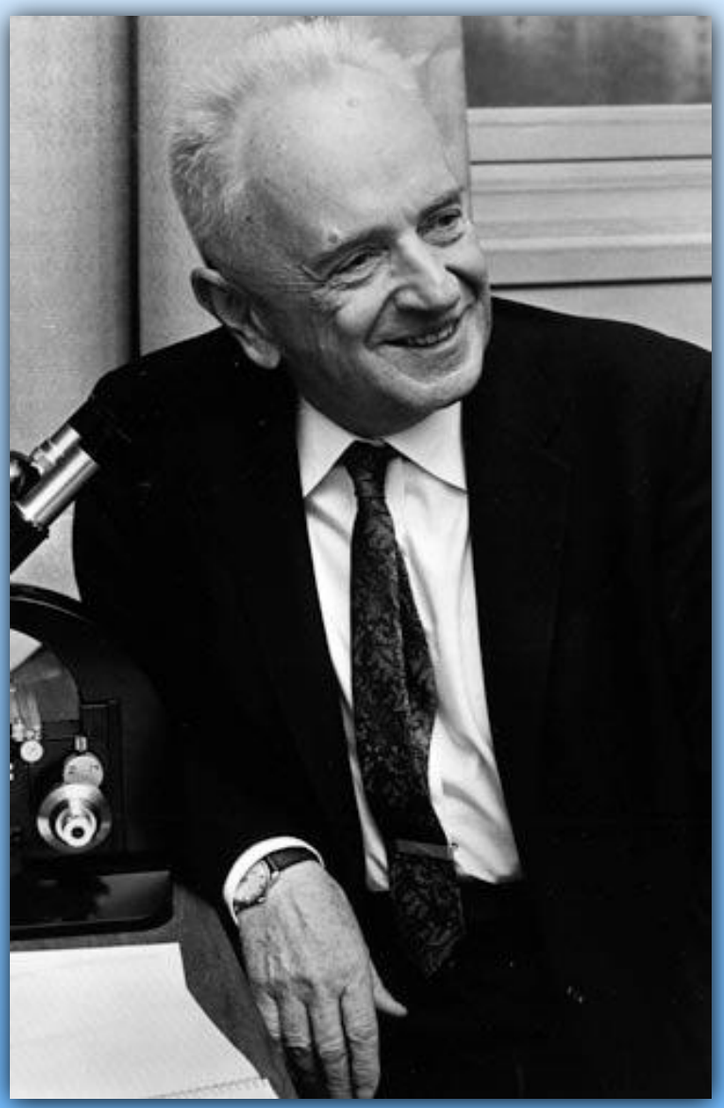
Lapetus Solutions, Inc.
University of Illinois at Chicago

September 8, 2016

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

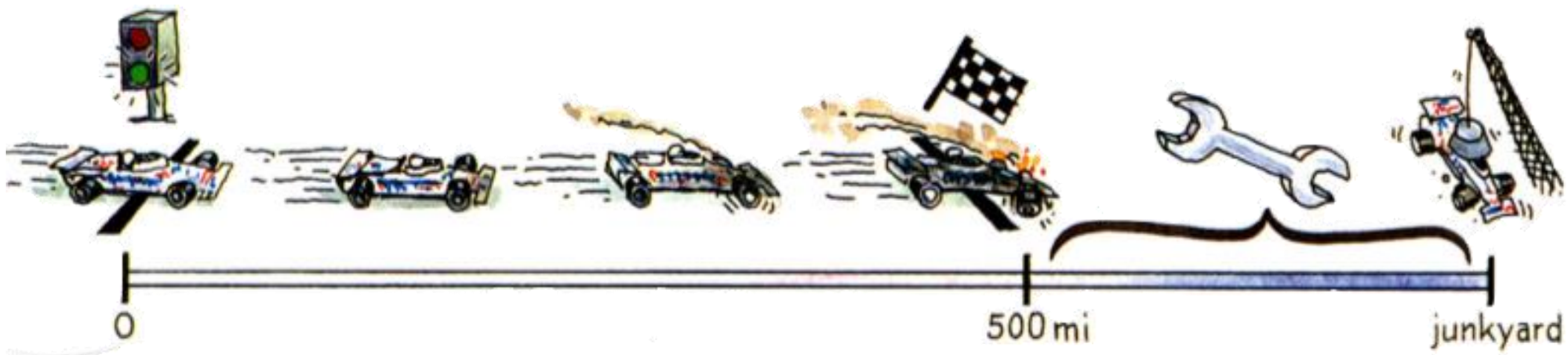
"Nothing in biology makes sense except in the light of evolution"

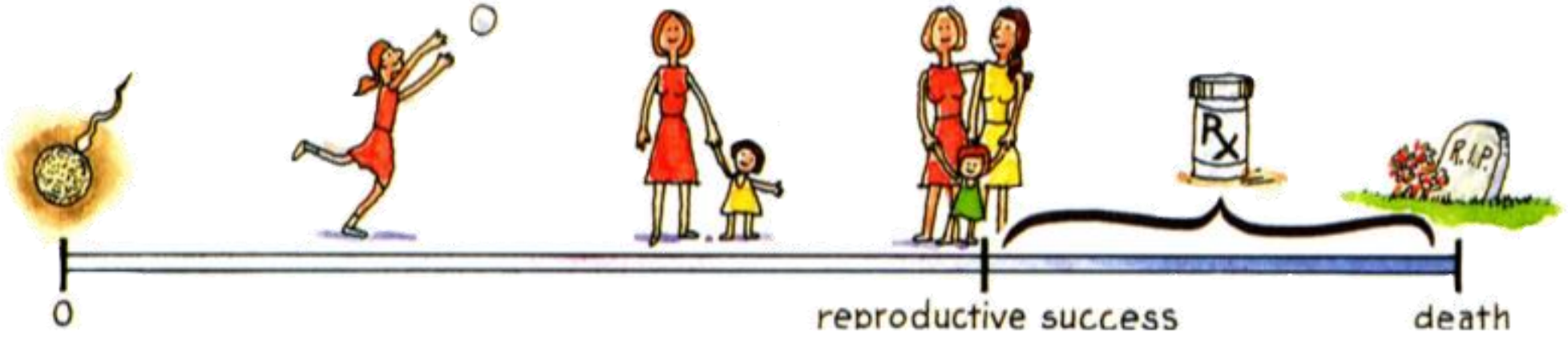


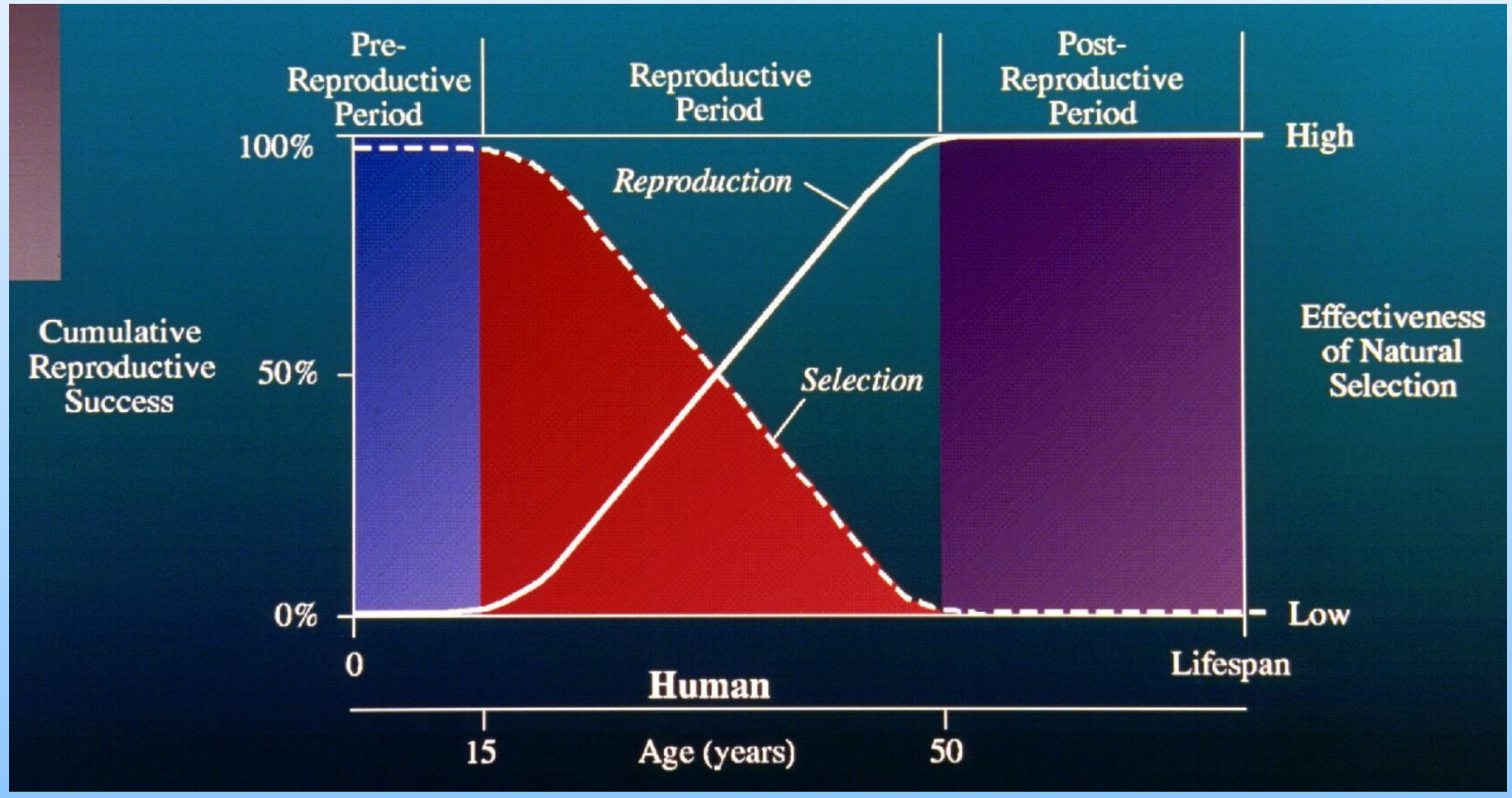
Theodosius Dobzhansky

The American Biology Teacher, March 1973


BENTLEY


0
500 mi
junkyard


Rx
R.I.P.
0
reproductive success
death

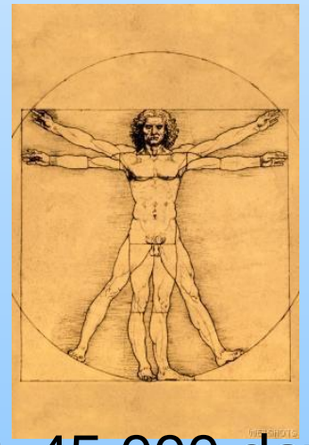


1. There is a remarkable consistency to the timing of death across species.
2. Duration of life is calibrated to the onset and length of a species' reproductive window.
3. There are no aging or death genes.

146,000 days
Greenland shark

77,000 days
bowhead whale

55,000 days
sea turtle



45,000 days
Human (max)
29,000 (avg)

26,000 days
elephant

5,000 days dog

1,000 days
mouse

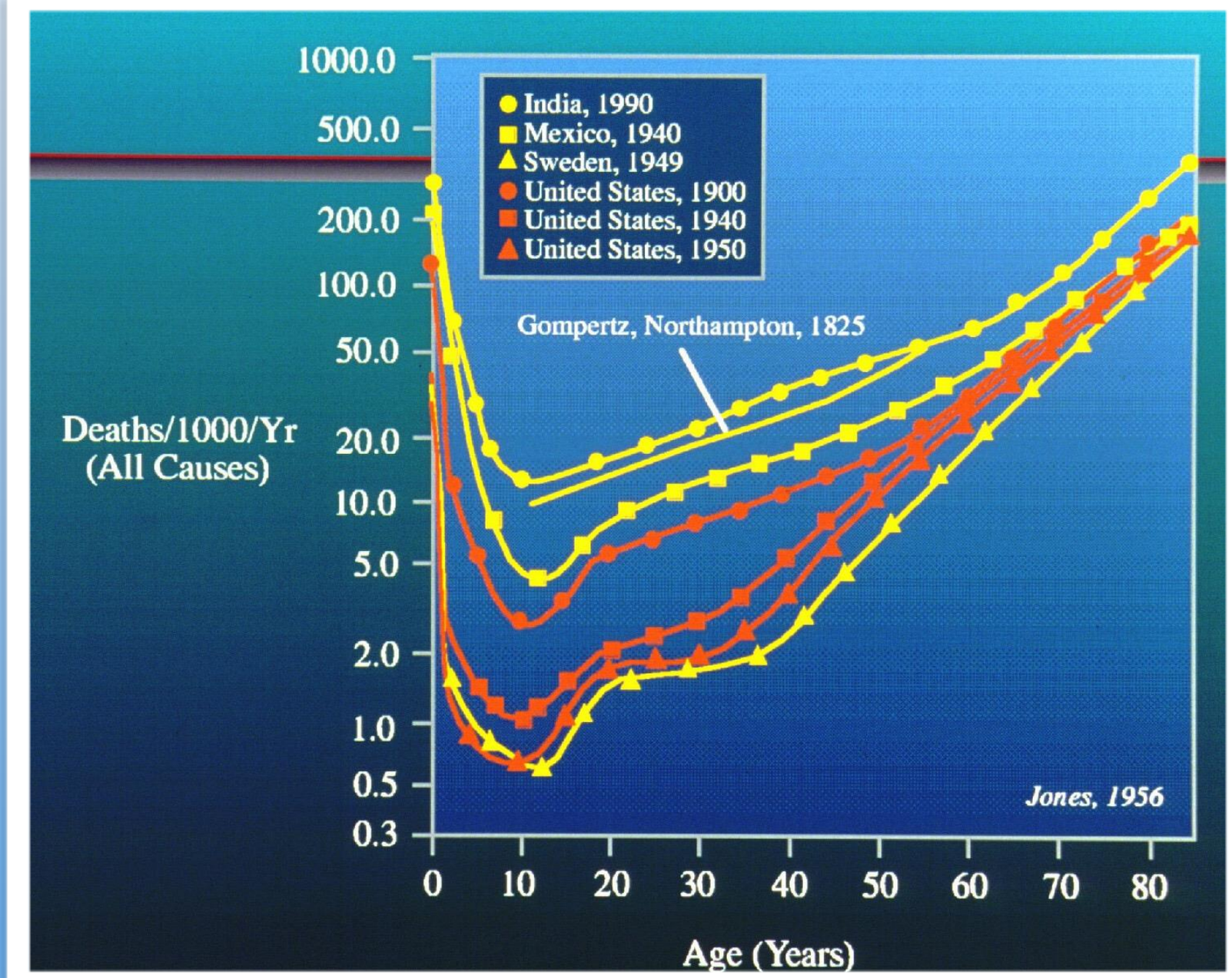
Aging or senescence is an accident of surviving beyond the warranty period for living machines.

We Rust

Duration of Life is Limited

Don’t Believe Radical Forecasts of Longevity


of Life


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)

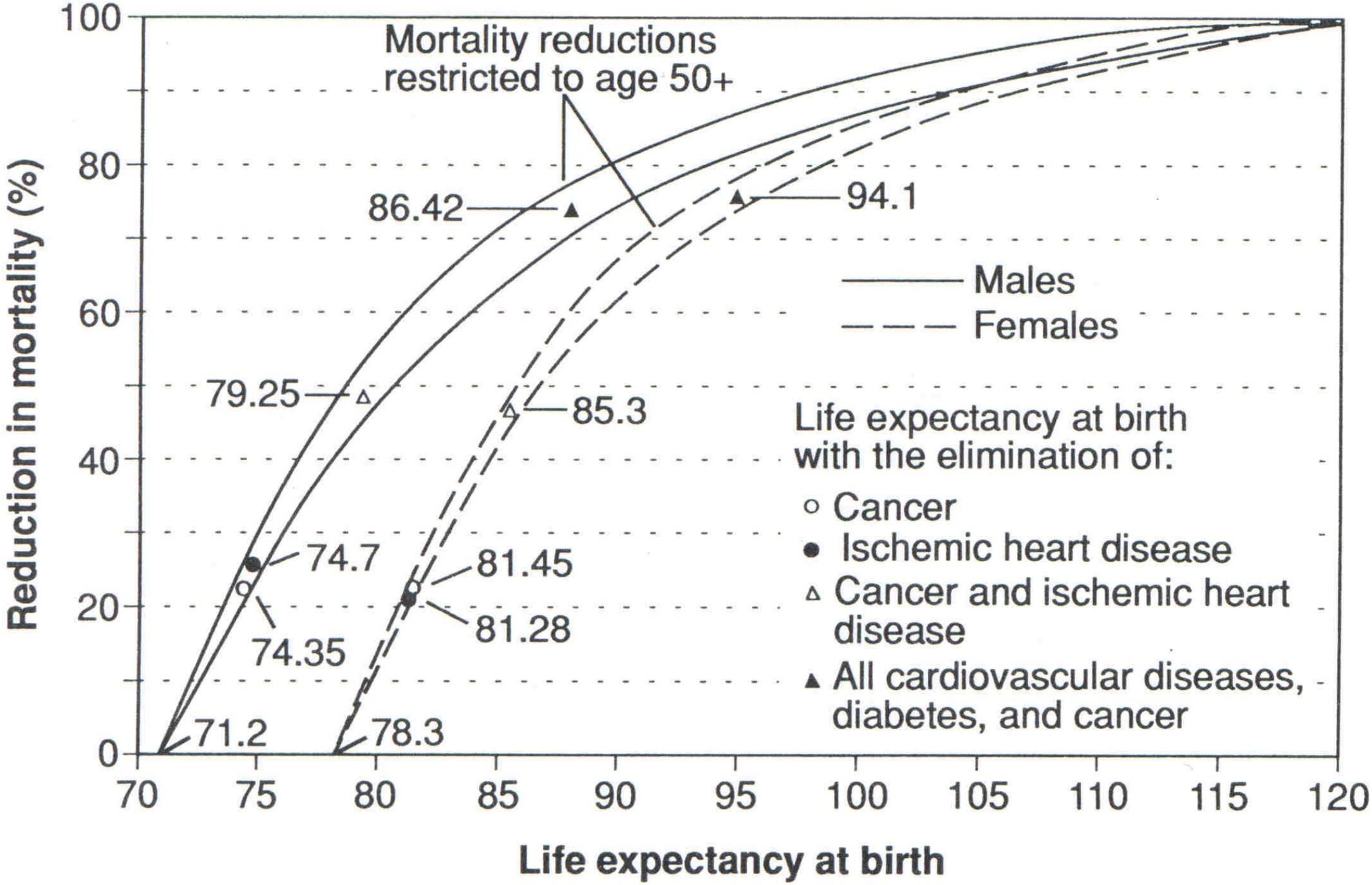
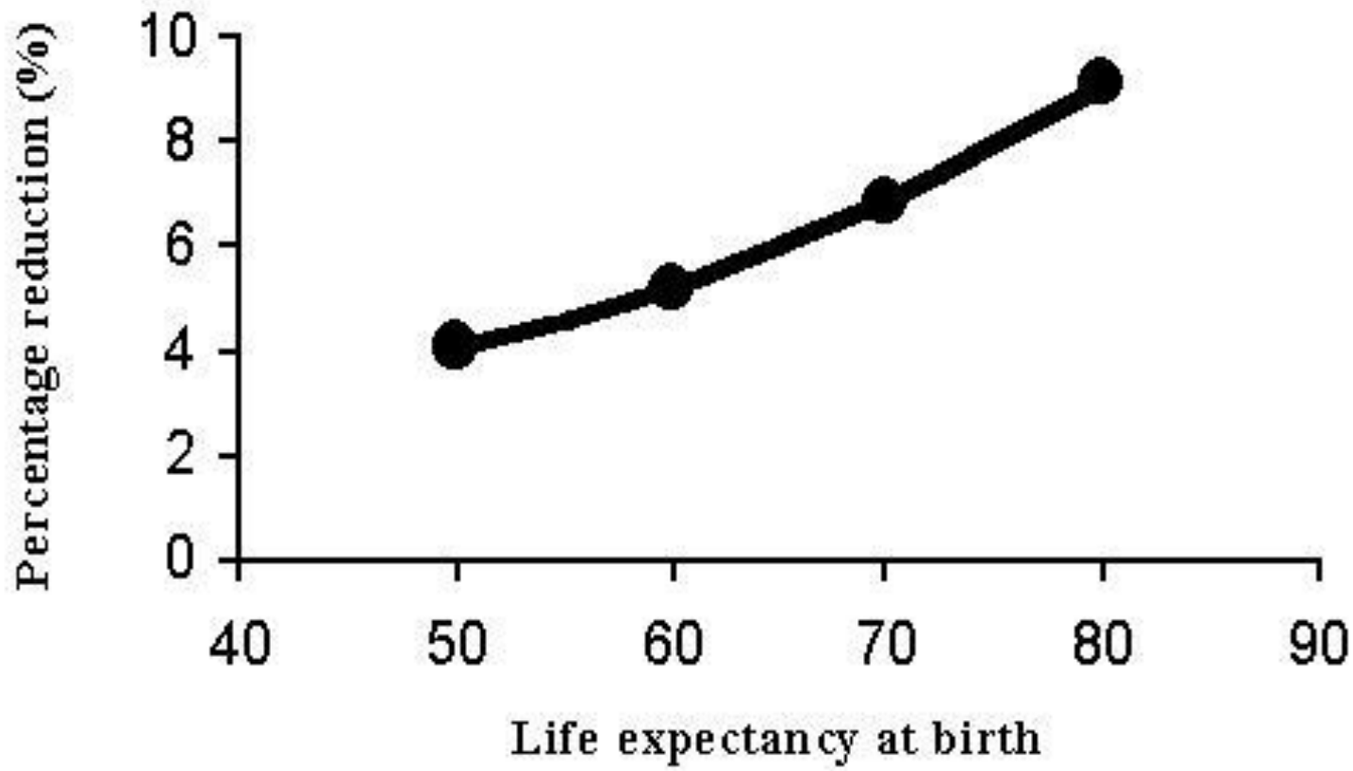


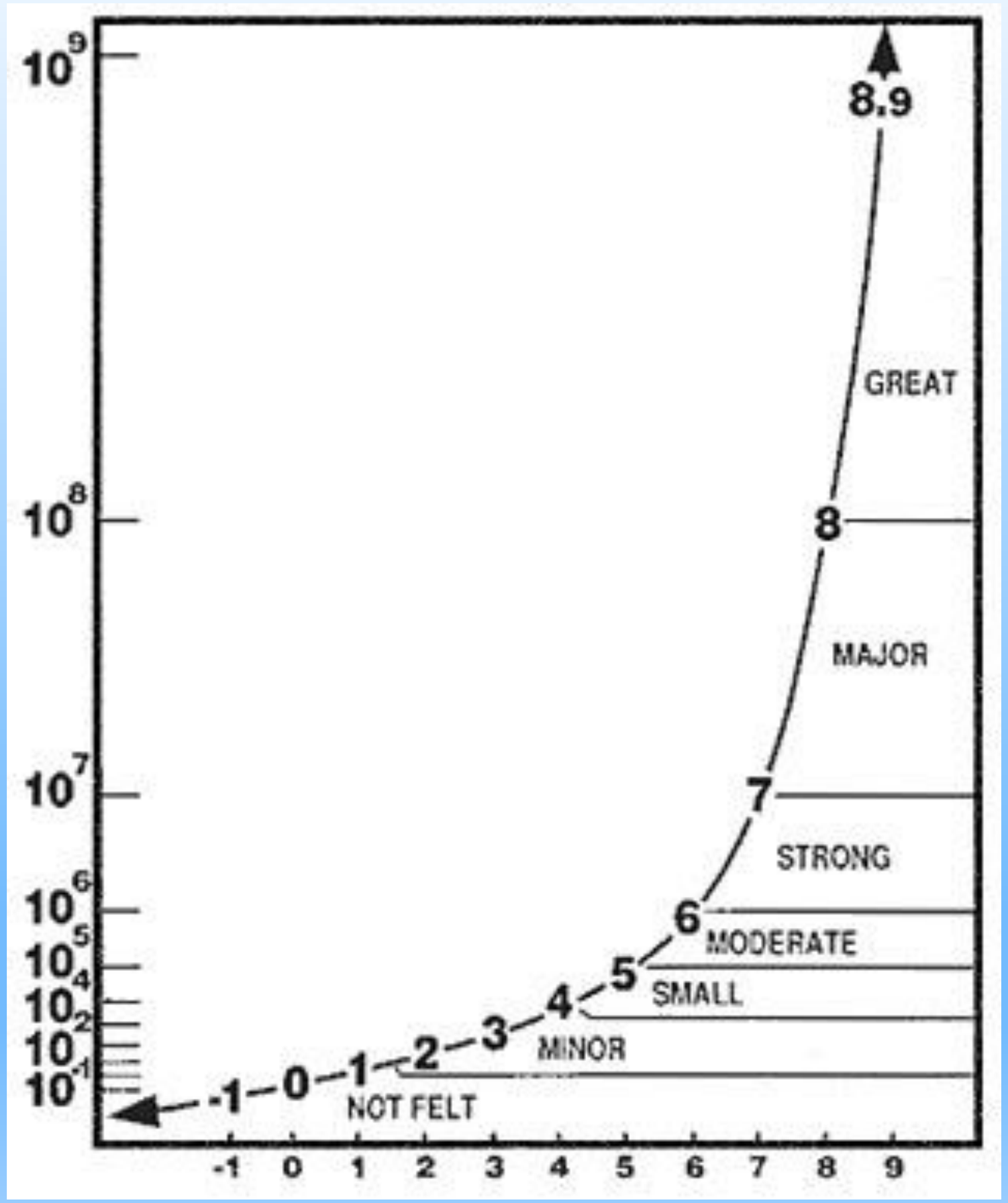
Fig. 2. Percentage of reduction in the conditional probability of death for the United States (from 1985 levels) required to produce a life expectancy at birth from 80 to 120 years.

Source: Olshansky, Carnes and Cassel, 1990. *Science*.

Percentage reduction in death rates at all ages required to raise life expectancy at birth by one year



SOURCE: Olshansky, Carnes and Désesquelles, 2001. Prospects for Human Longevity. *Science*.



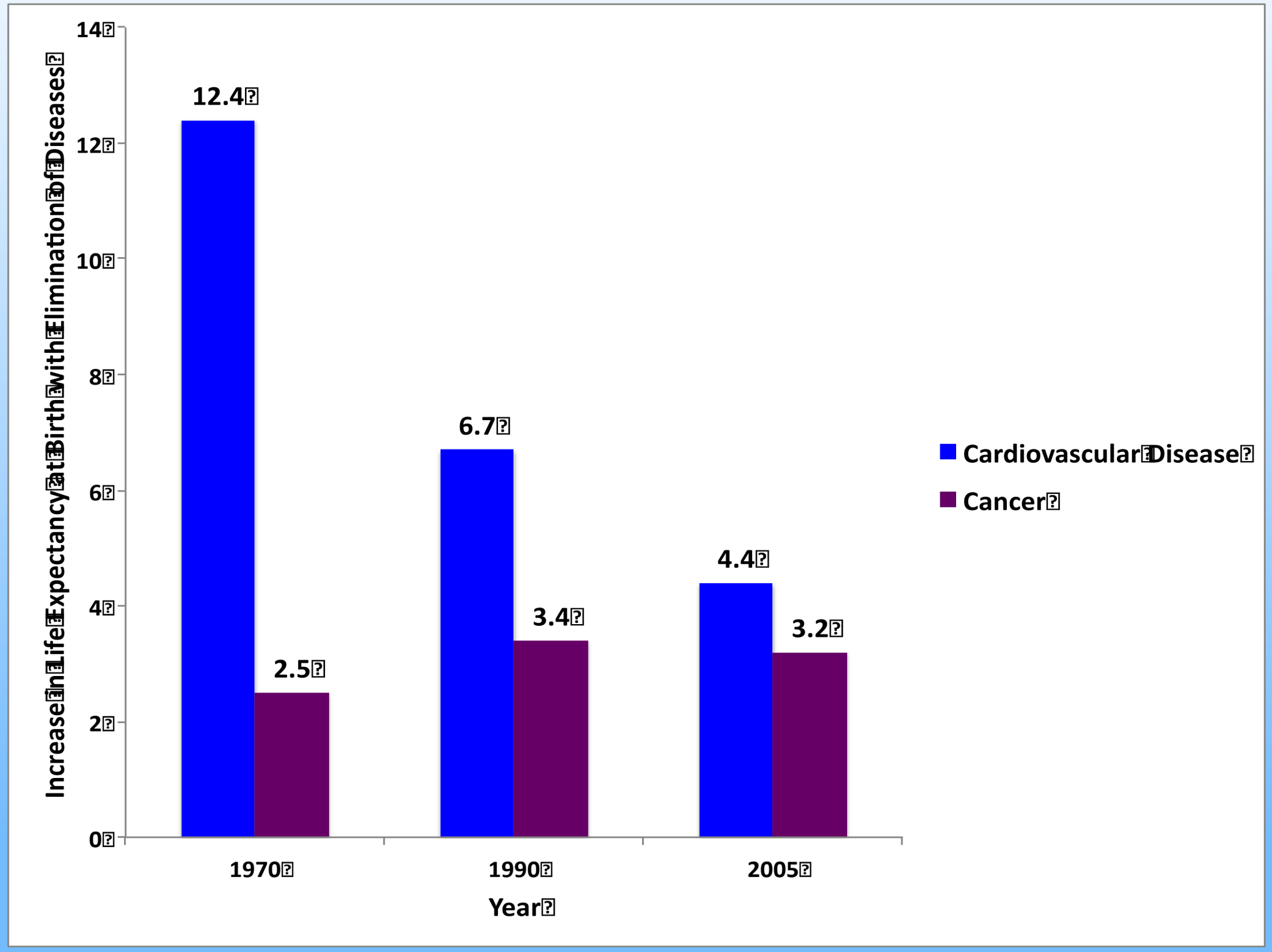
Seismic energy yield

7.0 – 7.1 = 200 kilotons

8.0 – 8.1 = 6 megatons

9.0 – 91 = 300 megatons

Richter Scale used to measure energy released during an earthquake



Sources: Tsai et al, 1978, AJPH 68(10):966-71; NCHS, 1999. U.S. Decennial Life Tables for 1989-91 1(4):PHS-99-1150-4; Sanchez et al. 2008. Demographic Research 19:1323.

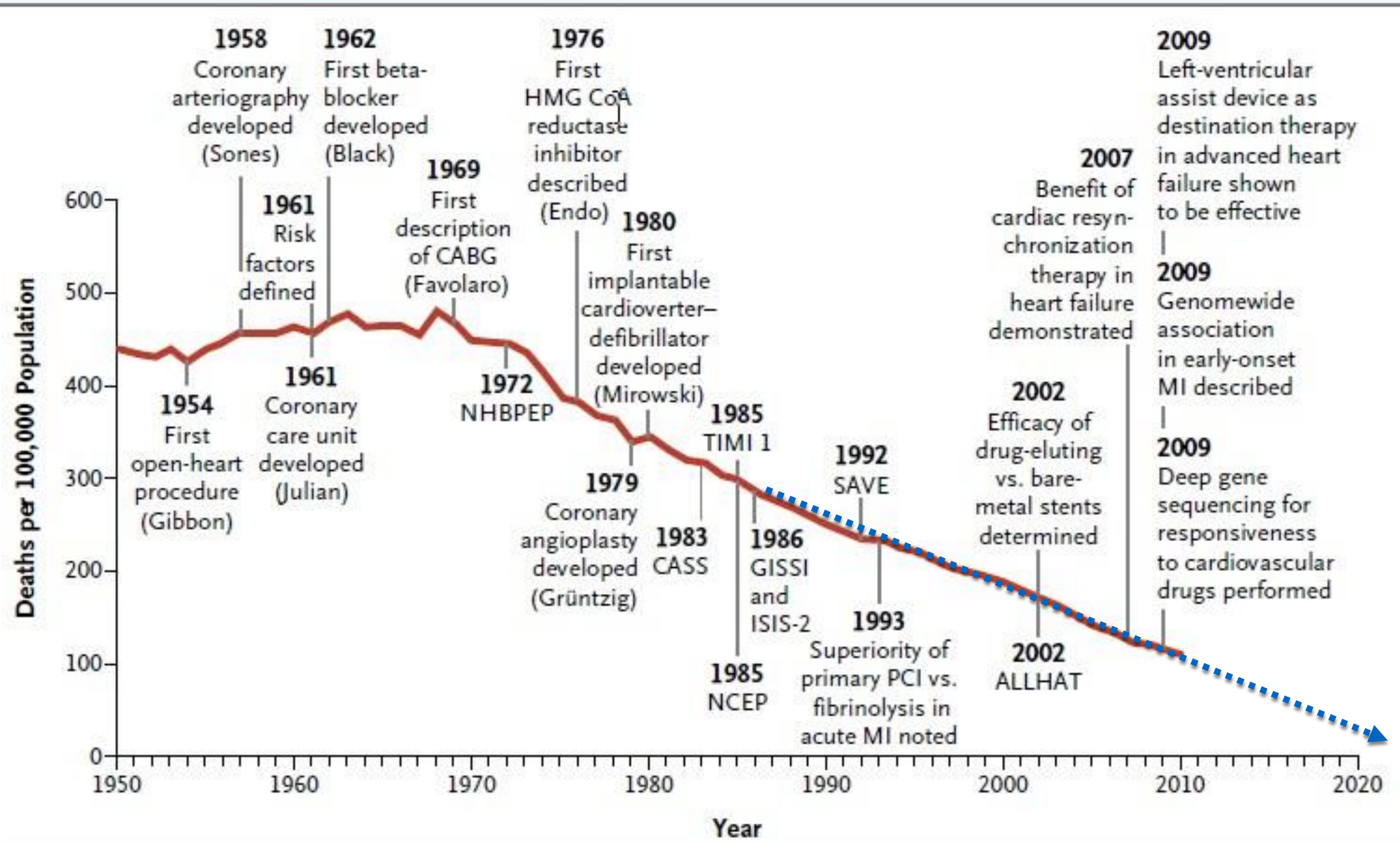
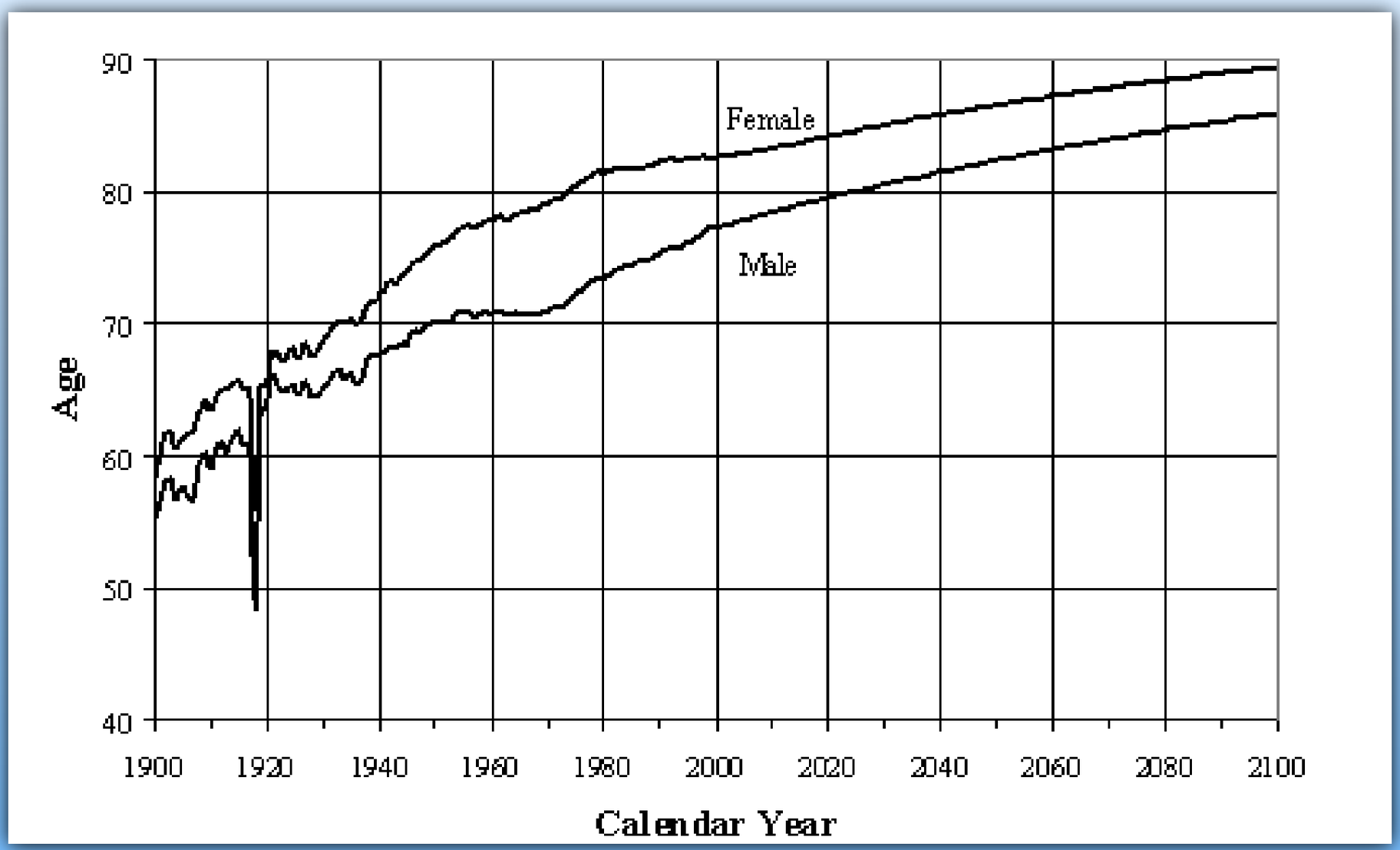


Figure 1. Decline in Deaths from Cardiovascular Disease in Relation to Scientific Advances.

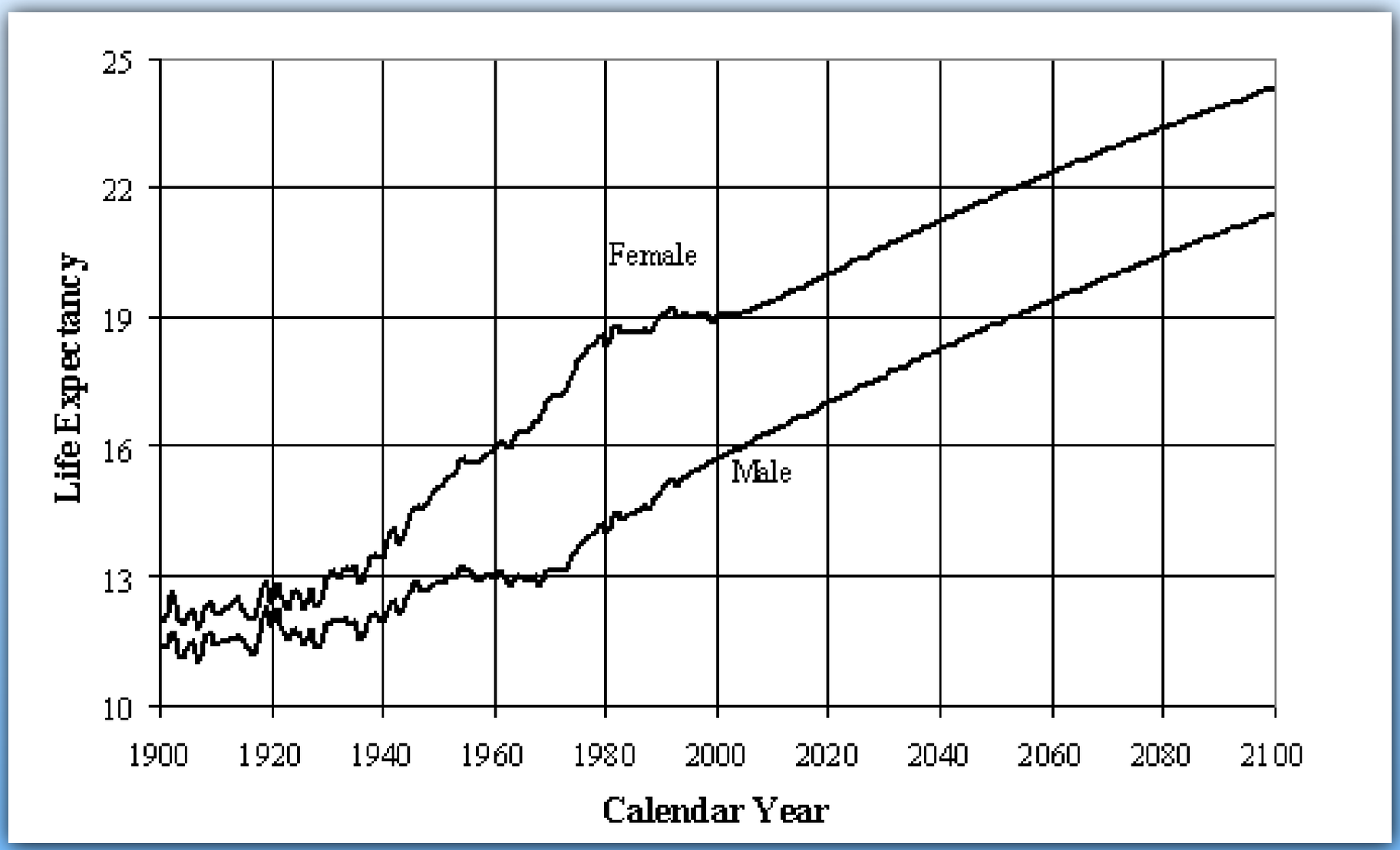
The timeline shows the steady decline in cardiovascular deaths over the late 20th and early 21st centuries, along with major advances in cardiovascular science and medicine. ALLHAT denotes Antihypertensive and Lipid-Lowering Treatment to Prevent Heart Attack Trial, CASS Coronary Artery Surgery Study, GISSI Italian Group for the Study of Streptokinase in Myocardial Infarction, HMG-CoA 1-hydroxy-3-methylglutaryl coenzyme A, ISIS-2 Second International Study of Infarct Survival, MI myocardial infarction, NCEP National Cholesterol Education Program, NHBPEP National High Blood Pressure Education Program, PCI percutaneous coronary intervention, SAVE Survival and Ventricular Enlargement, and TIMI 1 Thrombolysis in Myocardial Infarction 1.

Life Expectancy at Birth



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

Life Expectancy at Age 65

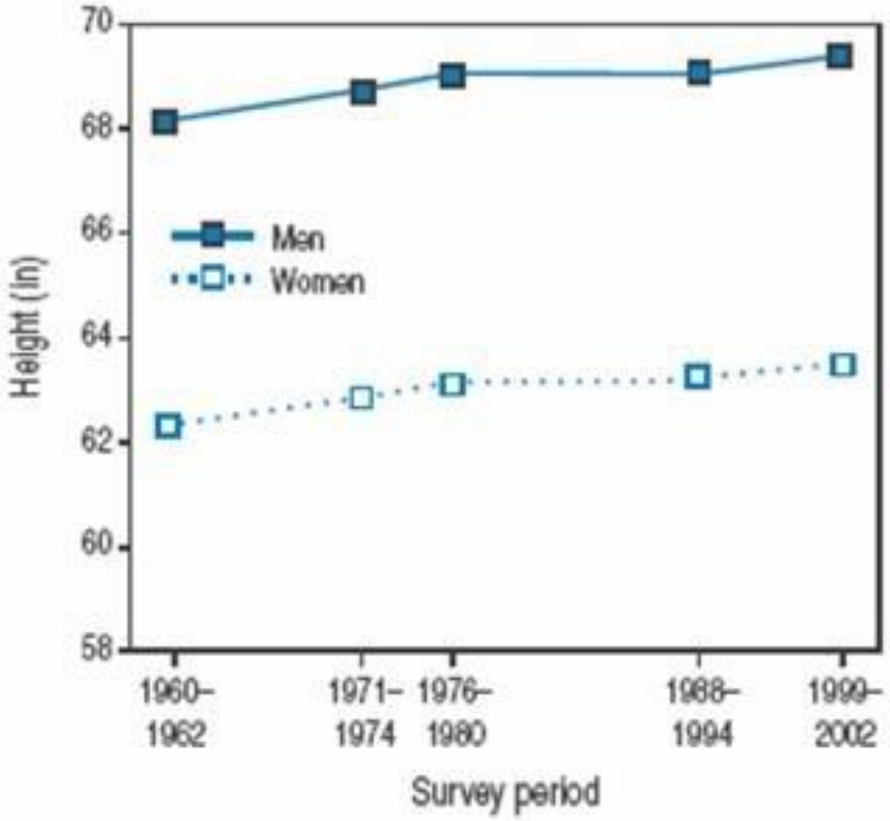


Social Security Administration. Actuarial Study No. 116. 2002.

6’ 4.5”

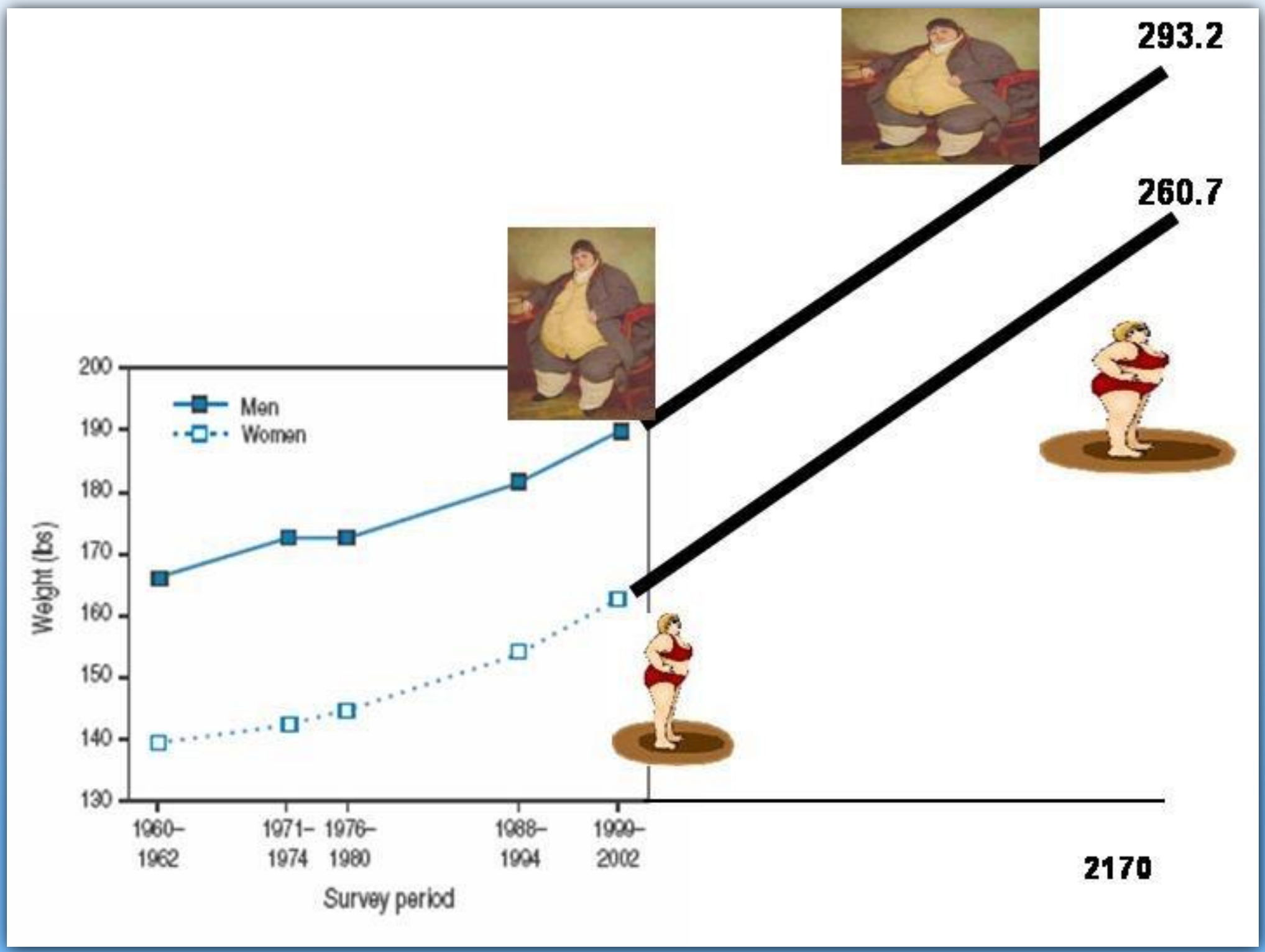
5’ 8”

5’ 9.5”

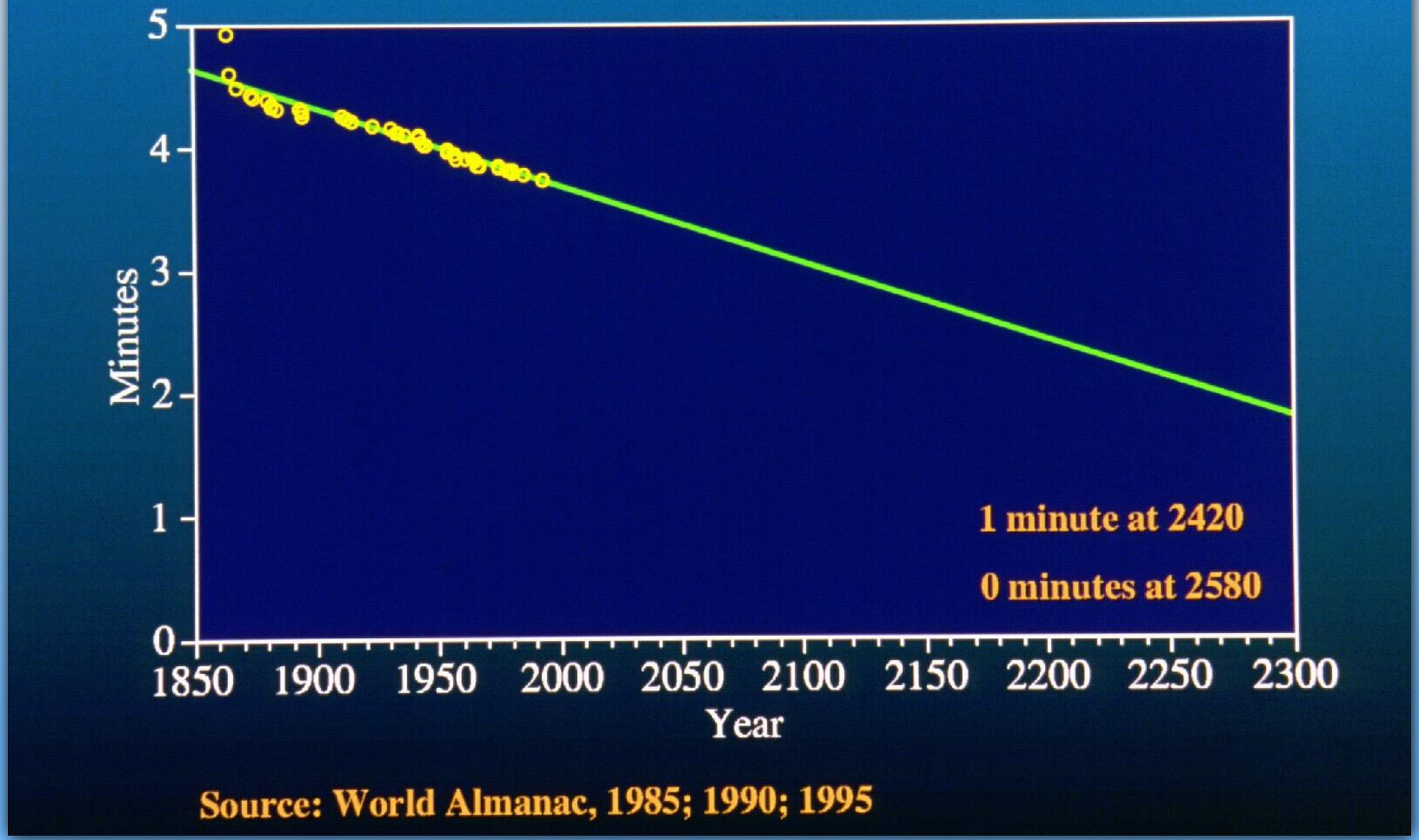


5’ 4”

2170

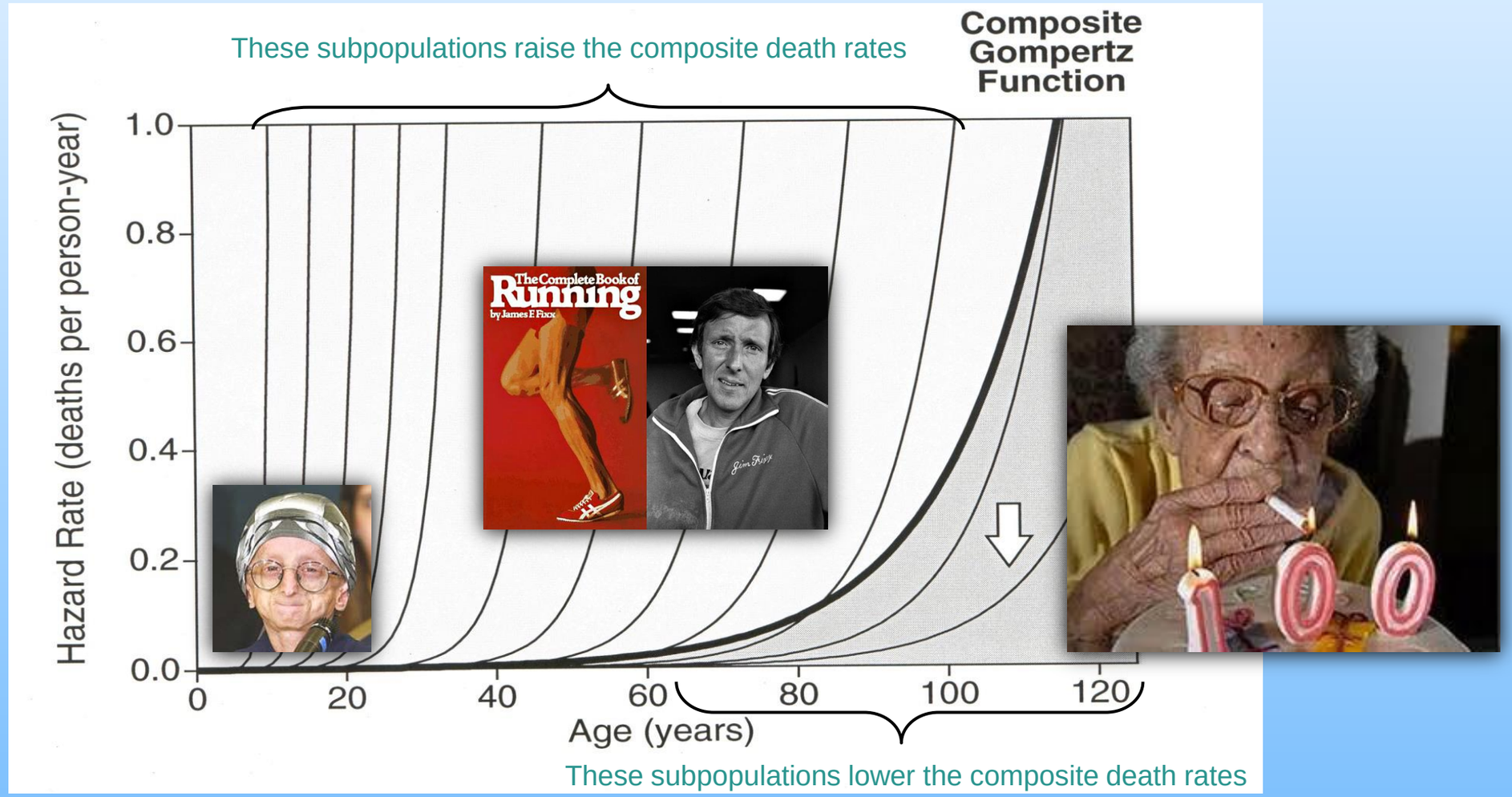

293.2
260.7
200
190
180
170
160
150
140
130
Men
Women
Weight (lbs)
1960–1962
1971–1974
1976–1980
1988–1994
1999–2002
Survey period
2170

World Record for the 1-Mile Run (Males)



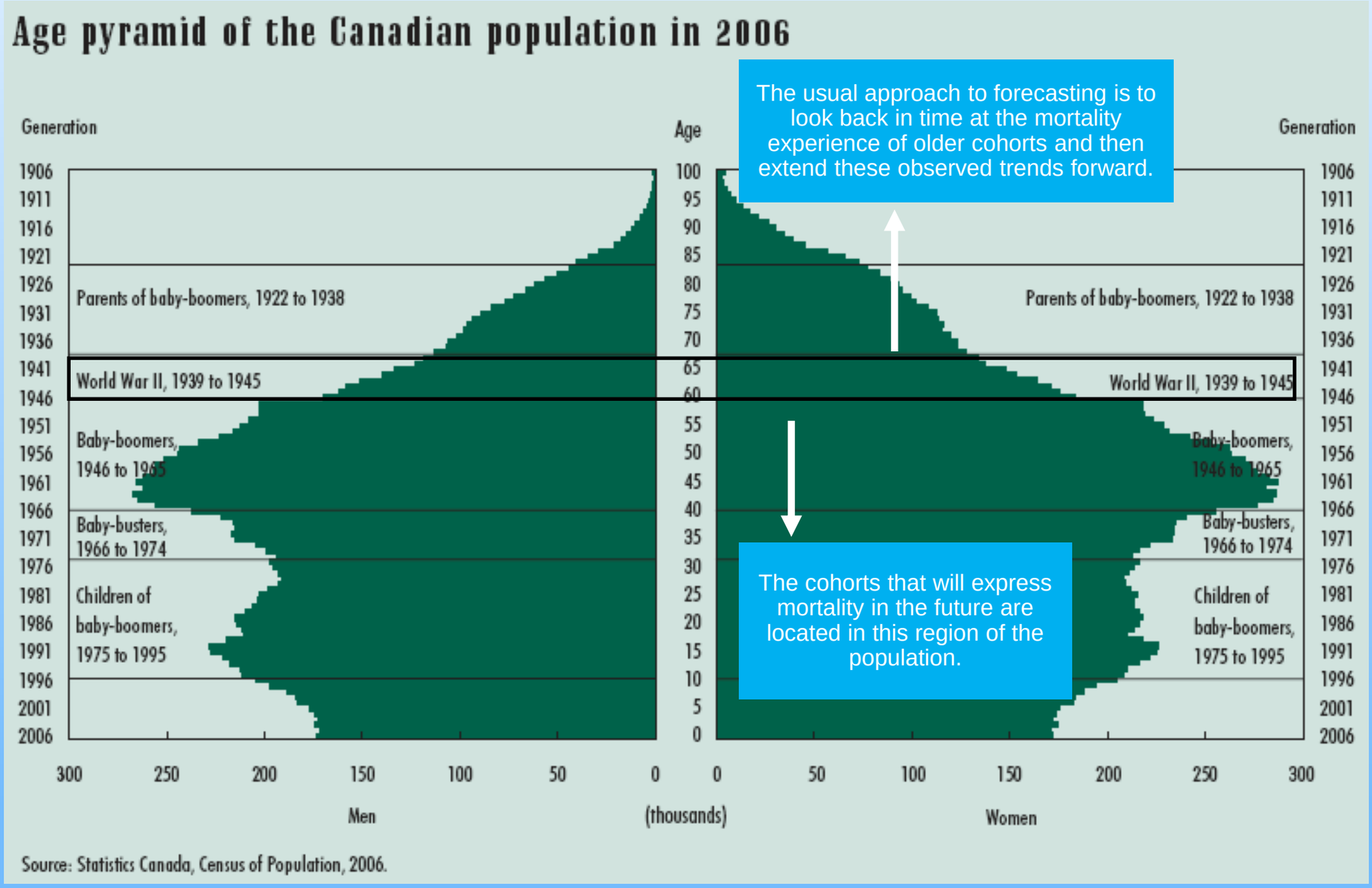
Source: World Almanac, 1985; 1990; 1995

Populations Are Heterogeneous Mixtures

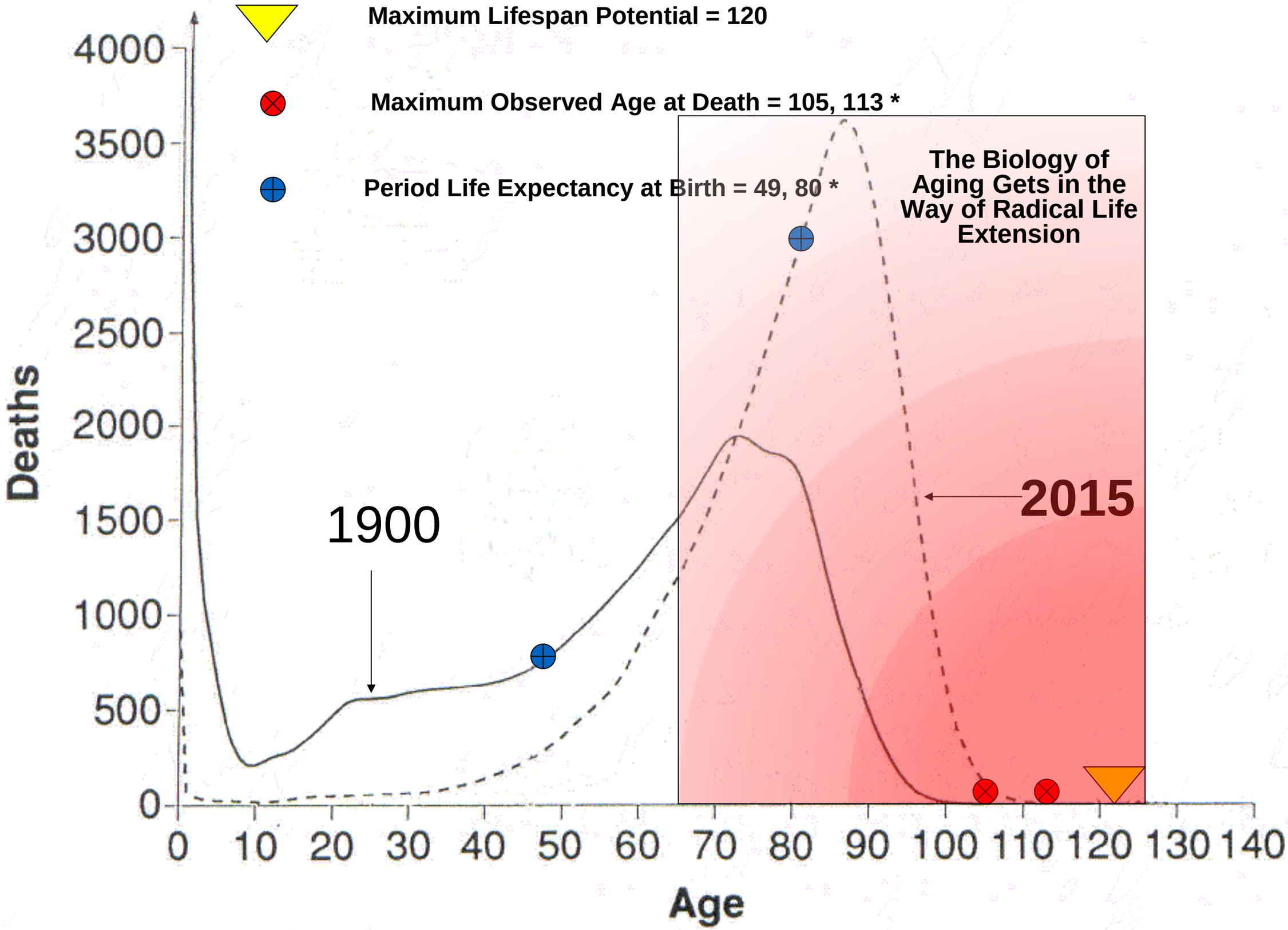


The usual approach to mortality is to see and measure only the dark black line, which represents the risk of death for an entire population or an insured cohort. We know that national and insured populations are heterogeneous, with varying mortality risks.

Populations Are Influenced by Life Events



U.S. Females


Maximum Lifespan Potential = 120
Maximum Observed Age at Death = 105, 113 *
Period Life Expectancy at Birth = 49, 80 *
The Biology of Aging Gets in the Way of Radical Life Extension
2015
1900
Deaths
4000
3500
3000
2500
2000
1500
1000
500
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Age

The Next Revolution in Aging Science

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

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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

LDI Leading Organizations / Research Advisory Committee

afar american federation for aging research

THE GERONTOLOGICAL SOCIETY OF AMERICA

Alliance FOR AGING RESEARCH

GLENN FOUNDATION FOR MEDICAL RESEARCH

NATIONAL INSTITUTE ON AGING
National Institutes of Health

AGE American Aging Association

Affiliated Research Institutions and Universities

the BUCK INSTITUTE FOR RESEARCH ON AGING

MAYO CLINIC

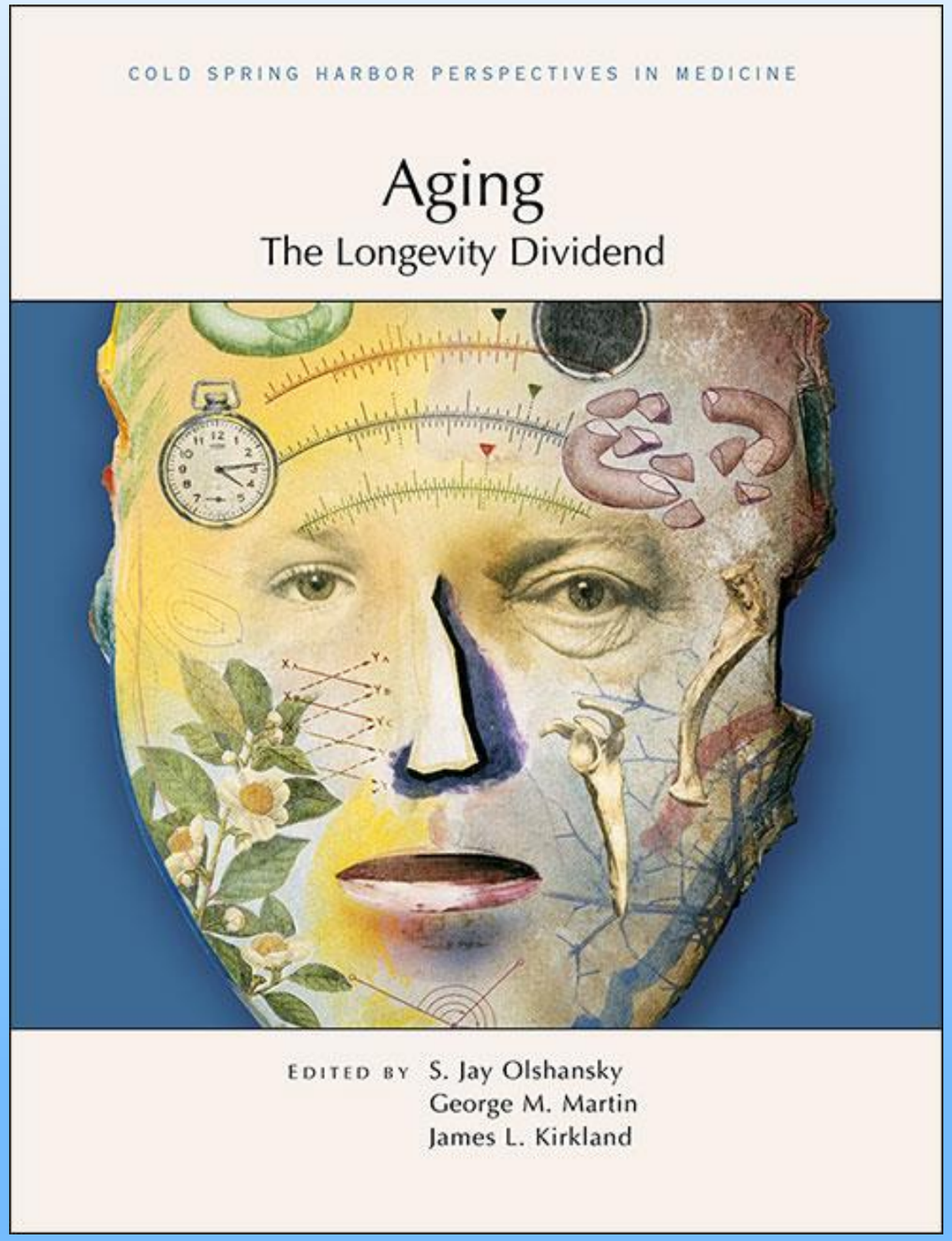
UIC University of Illinois at Chicago

EINSTEIN Albert Einstein College of Medicine OF YESHIVA UNIVERSITY

UNIVERSITY OF WASHINGTON 1861

UNIVERSITY OF SOUTHERN CALIFORNIA 1880

VE RI TAS HARVARD

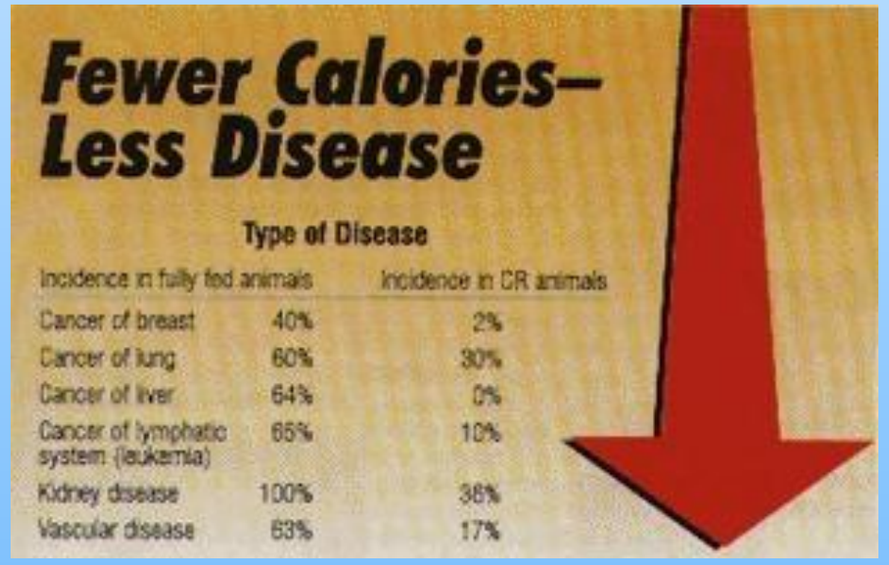

COLD SPRING HARBOR PERSPECTIVES IN MEDICINE
Aging
The Longevity Dividend
EDITED BY S. Jay Olshansky
George M. Martin
James L. Kirkland


A GLOBAL SERIES EVENT
BREAKTHROUGH
DEVELOPED BY
PREMIERES FALL 2015


Executive Summary
Unprecedented increases in longevity are presenting equally unprecedented challenges but are also unlocking stores of human capital that can transform societies
Examples of this so-called longevity dividend include better public balance sheets, healthier, more productive employees and increased income and investment
Individuals, for their part, would do well to rethink retirement investing, finding out how much annual income their money can produce in retirement rather than focusing on the often misleading "nest egg" figure
BLACKROCK®
UNLOCKING THE LONGEVITY DIVIDEND:
HOW LONGER LIVES ARE CHANGING RETIREMENT, INVESTING AND THE ECONOMY
JUNE 2015

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

The Next Revolution in Underwriting: The Future is Here

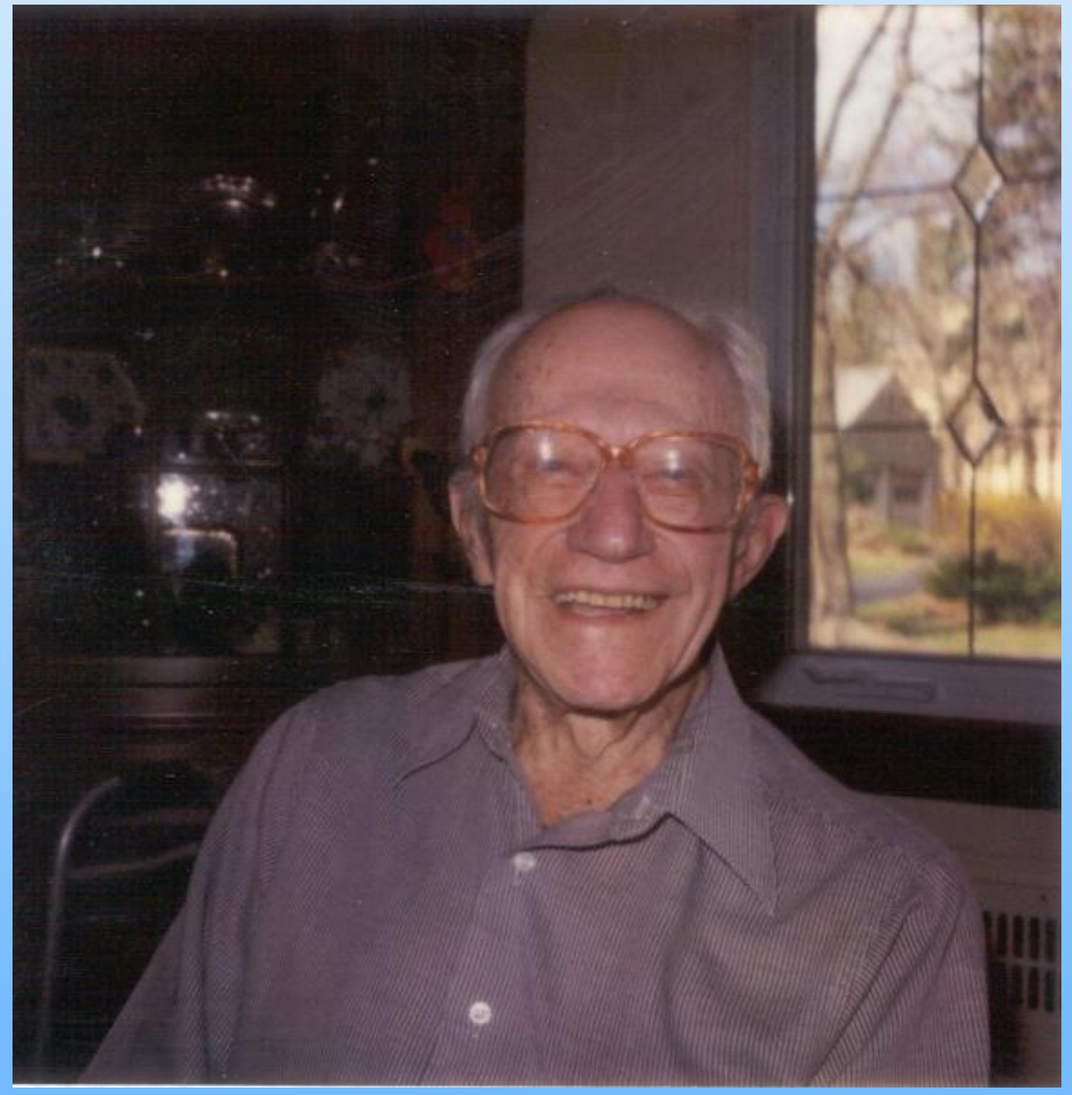
The Marriage of Biodemography and Facial Analytics is a New Disruptive Technology for Life Insurance Underwriting

Our goal is straightforward…..

Transform complex science into a friendly consumer experience.


NYS
AMD
CNBC EXCLUSIVE
ROBERT BENMOSCHE
AIG PRESIDENT & CEO
NASDAQ
-35.55 -1.16%
3,024.30
ss Worldwide. First in Business Worldwide. First in Business World
First in Business Worldwide. First in Business Worldwide. First in
CNBC

100 year old proband



70 year old son

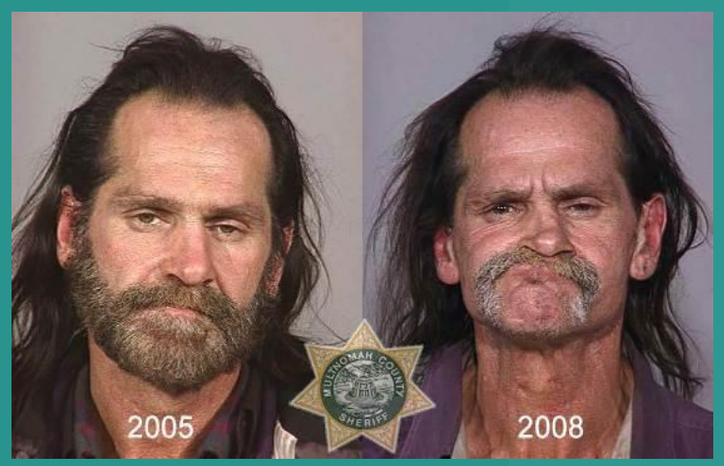
Photos from Dr. Nir Barzilai

The Faces of Risk

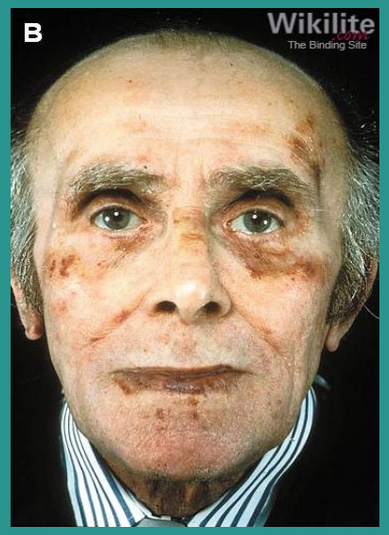
BMI

Drug use

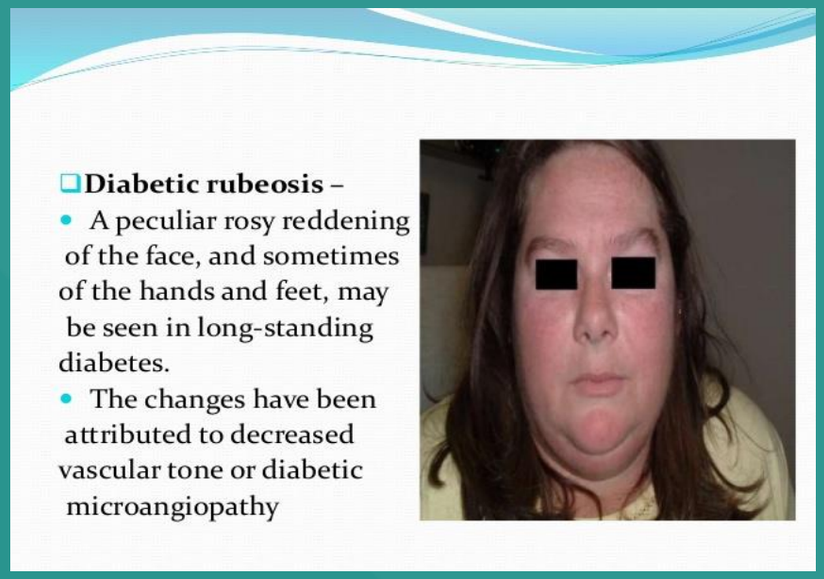
smoking



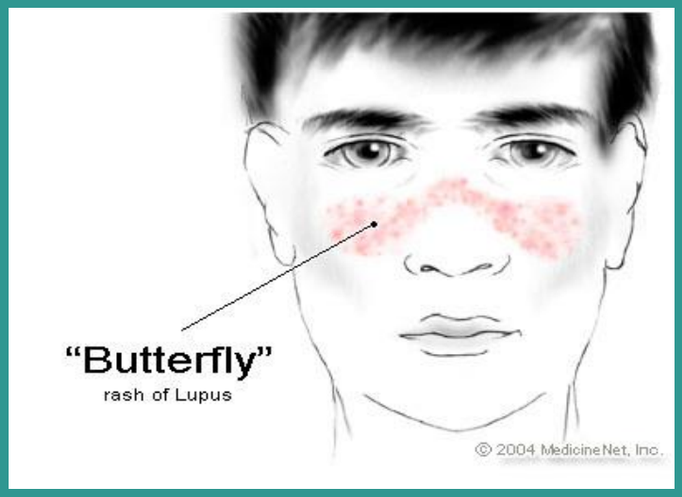
The Faces of Disease



Amyloidosis
[linked to kidney and heart disease]

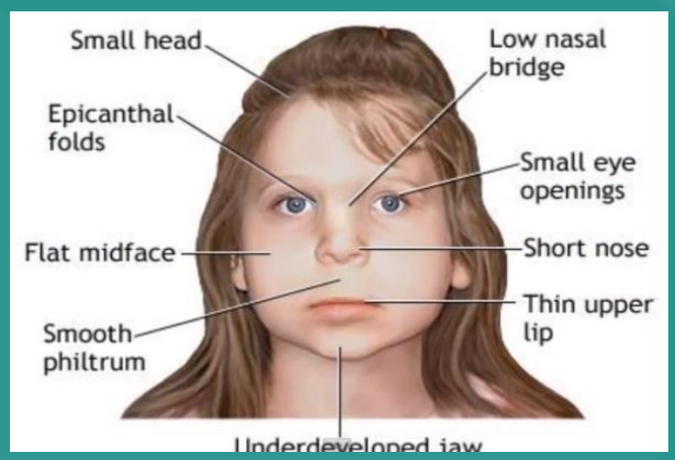


Diabetes



Lupus

HIV-associated Lipohypertrophy



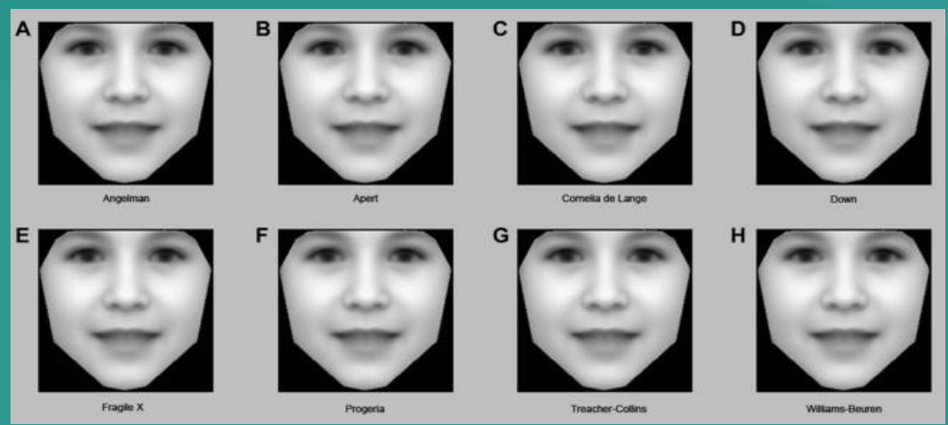
Fetal Alcohol Syndrome

Rare genetic disorders diagnosed by computer analysis of photos

Written by Marie Ellis

Published: Tuesday 24 June 2014

More and more, the medical world is being merged with technology to improve diagnosis, prevention and treatment of health conditions. Now, researchers from Oxford University in the UK have developed a computer algorithm that can analyze photographs and diagnose which children have a rare genetic disorder.



In an emerging era of Big Data, once all covariates are analyzed for their predictive power, we quickly learn that Less is More

Research on the predictive value of covariates must be an ongoing exercise

Independent Validation of Assumptions

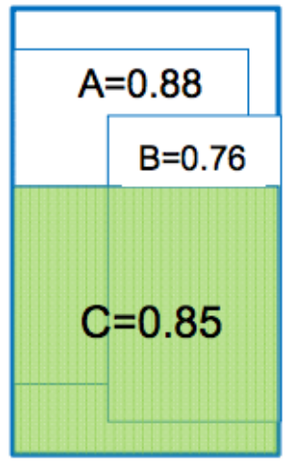
The Era of Smart Analytics
Predictive Modeling and Big Data For Evaluating Predictive Values

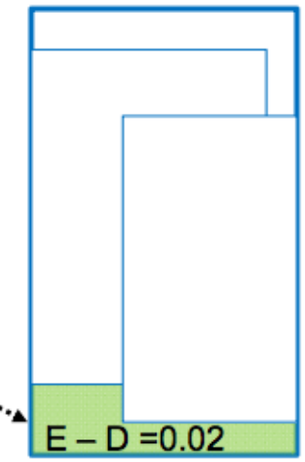
Presented by Dr. Zhiwei Zhu
Scor Global Life Americas
SOA 2014 Annual Meeting

Predictive Values of Lab Data for NHANES

(Numbers May Vary for Your Businesses)

ROC Association Statistics				
	Mann-Whitney			
ROC Model	ROC Area	Standard Error	95% Wald Confidence Limits	
A. Demographics	0.877	0.0033	0.870	0.883
B. Biometrics only	0.755	0.0048	0.745	0.764
C. Lab tests only	0.851	0.0038	0.843	0.858
D. All but lab	**0.889**	0.0031	0.883	0.895
E. Full Model	**0.910**	0.003	0.90	0.915
E - D	**0.021**	0.002	0.018	0.024

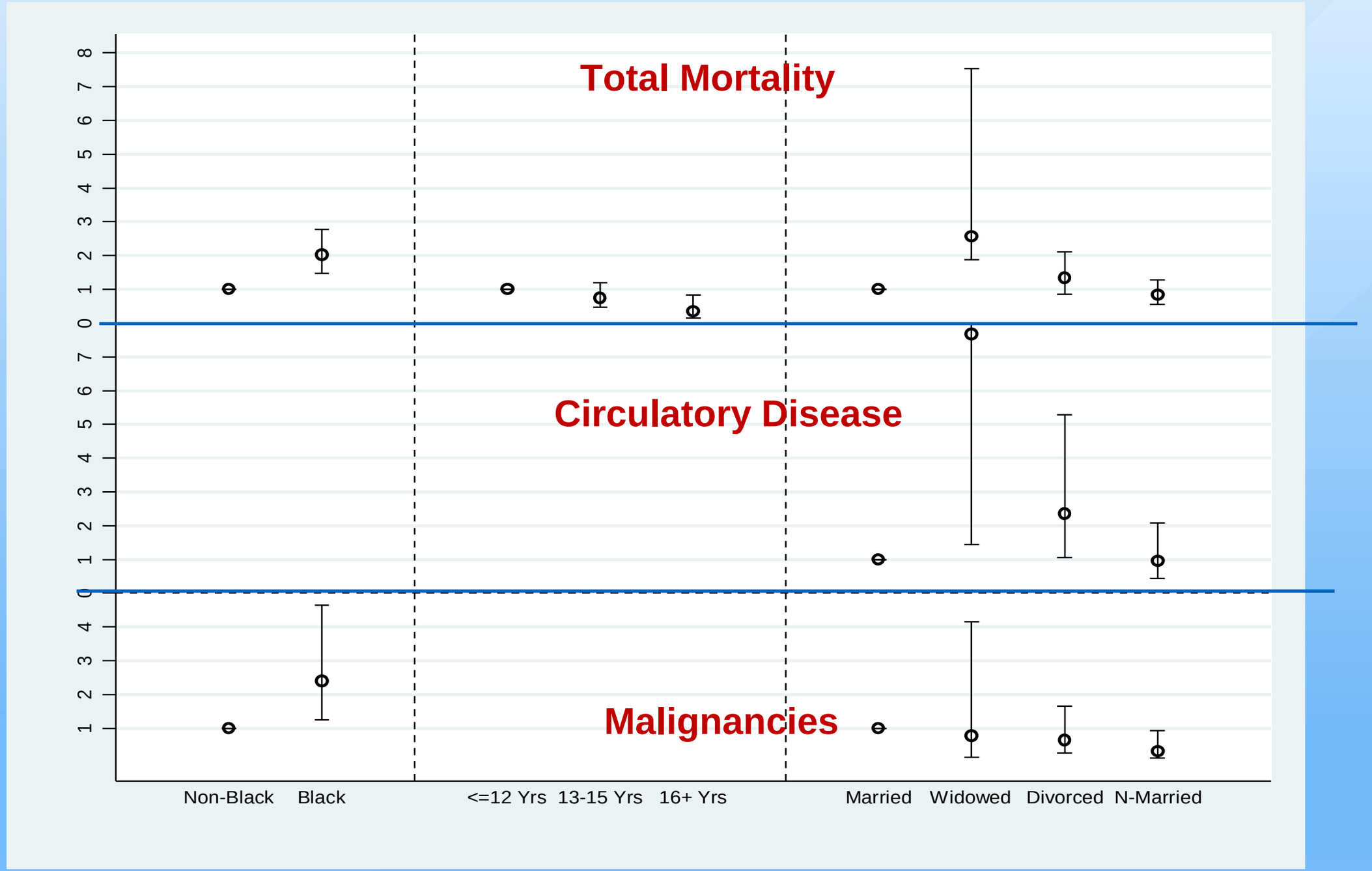




- Demographics, Biometrics, and Lab tests all have high individual predictive values
- They also have high information redundancy, implies opportunities for optimization

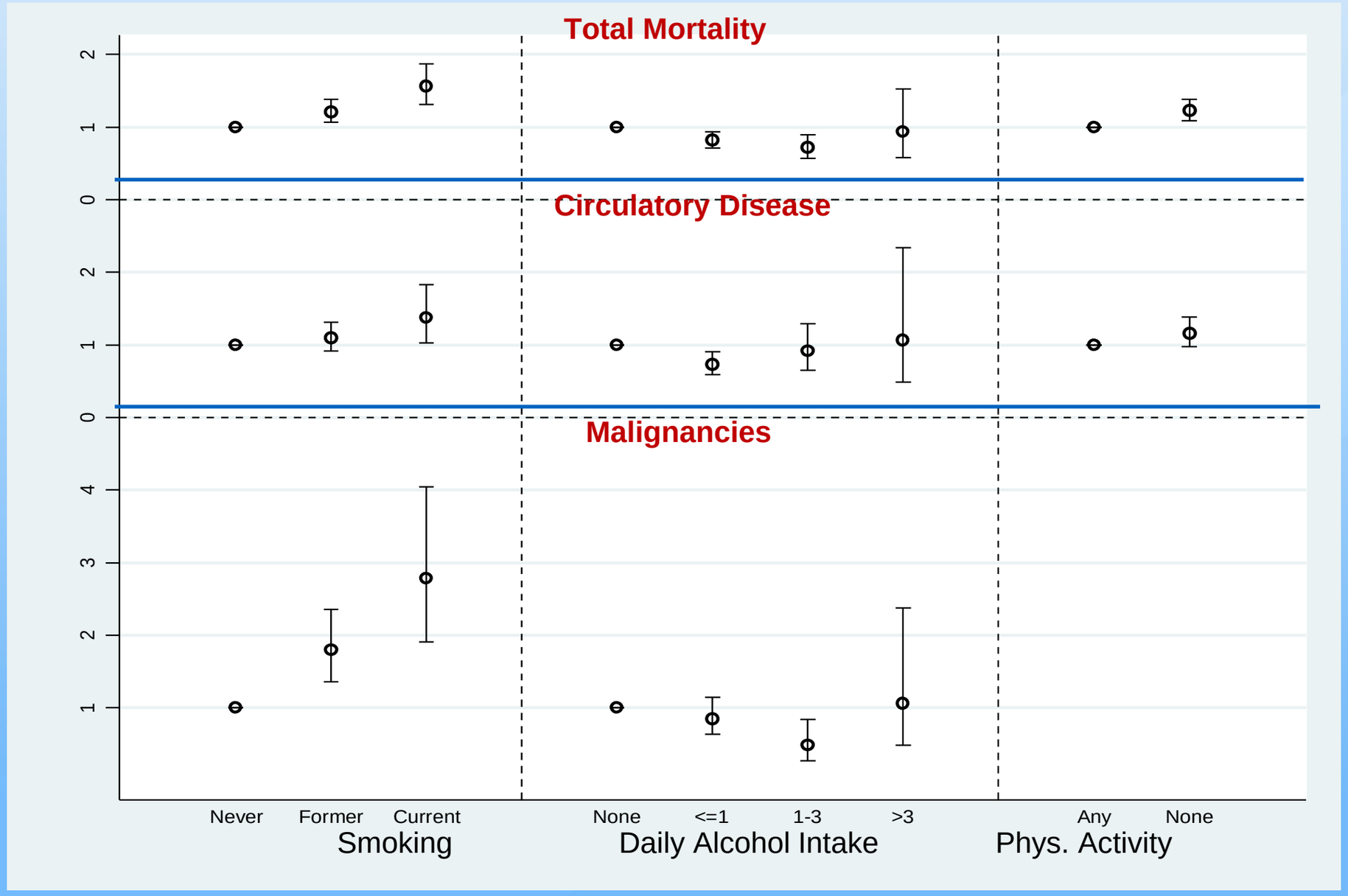
SCOR Global Life

Adjusted Hazard Ratios for Demographics and Social Factors by Major Causes (Ages 17-44)



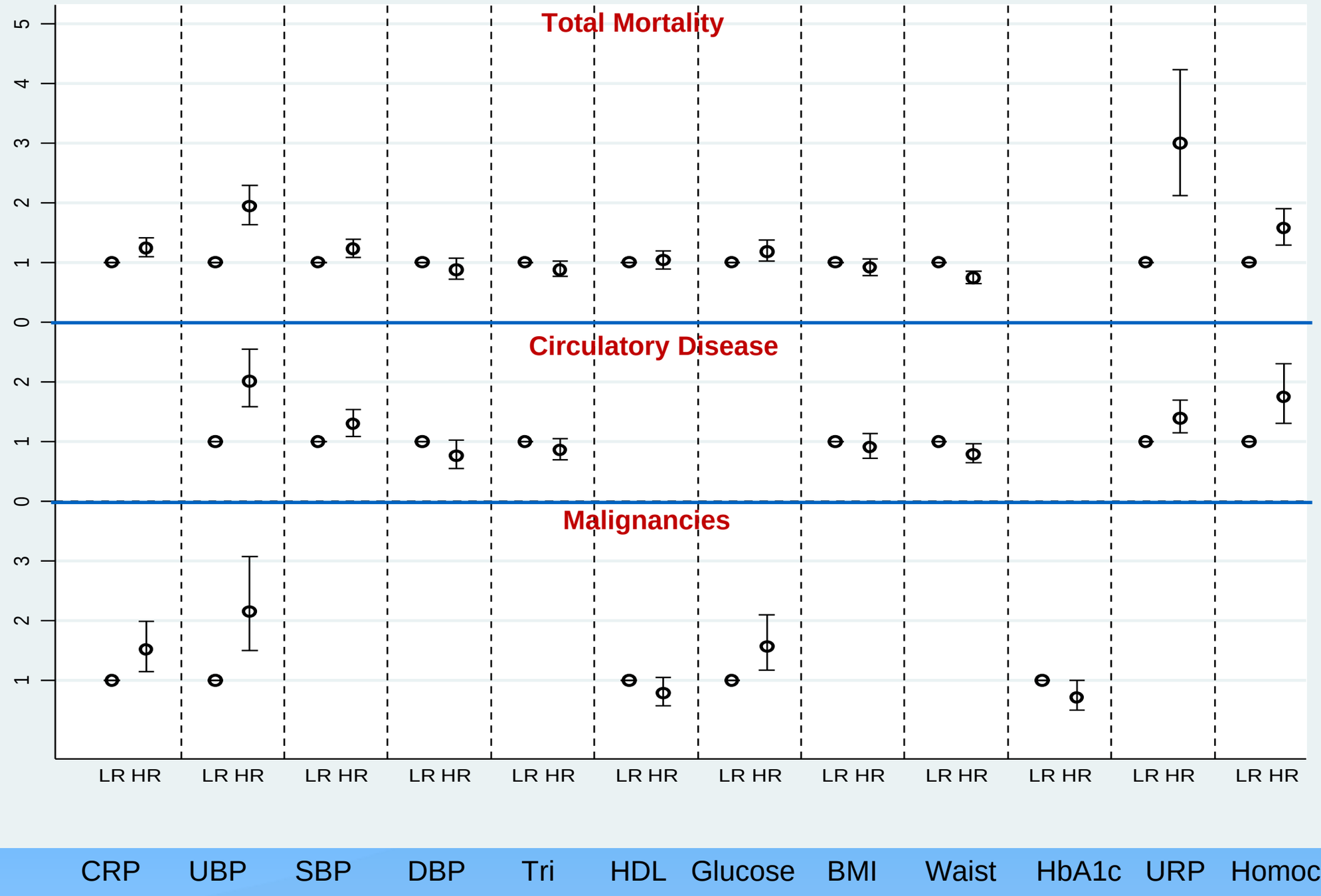
Race Education Marital Status

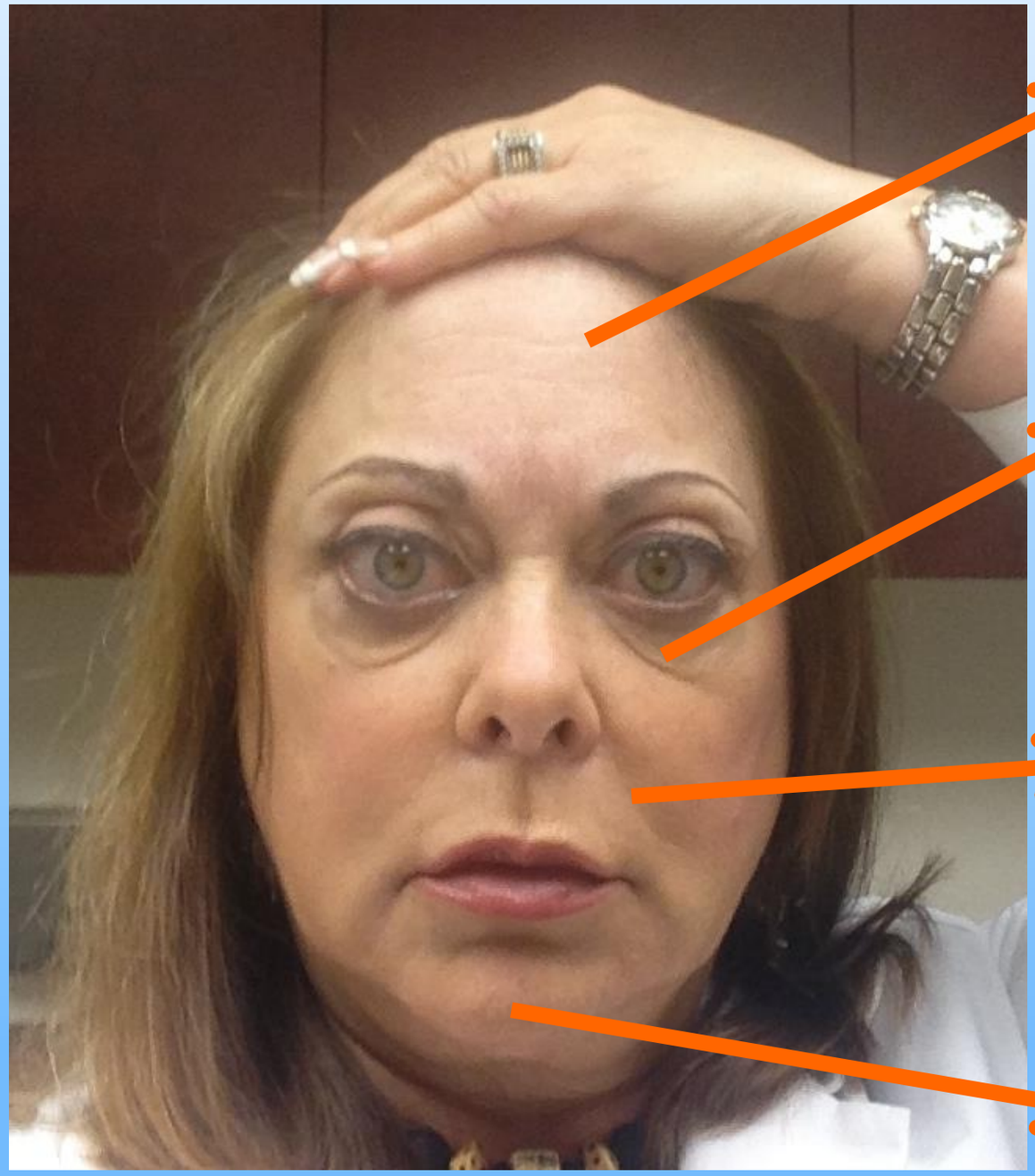
Adjusted Hazard Ratios for Health Behaviors by Major Causes



Smoking Daily Alcohol Intake Phys. Activity

Adjusted Hazard Ratios for Biomarkers by Major Causes (Ages 65+)



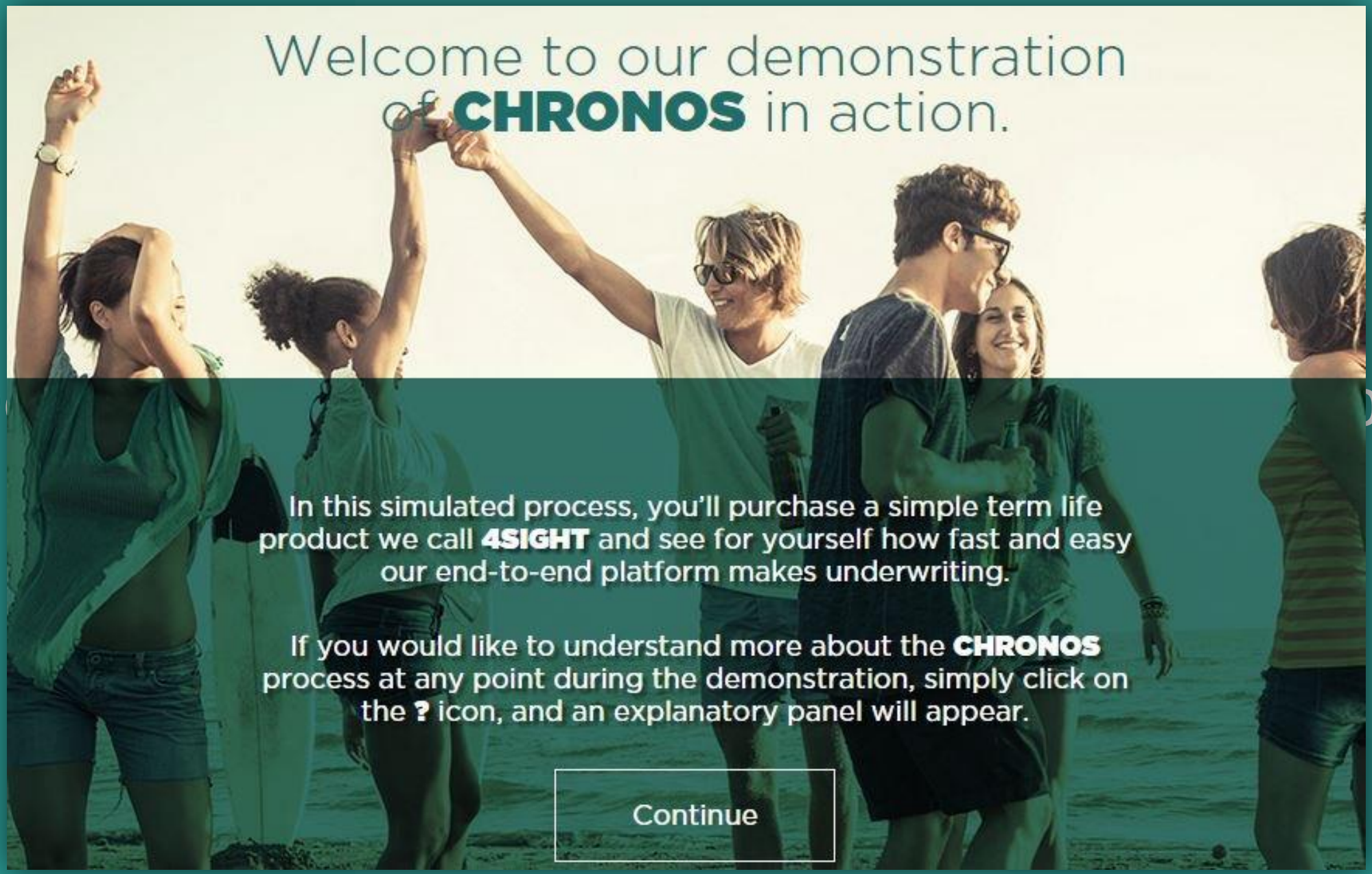


Chronological age: 3-yea r range of erro

Gender: near 100% accurac y

Smoking: 85% accurate

BMI: 79% accurate


Welcome to our demonstration of CHRONOS in action.
In this simulated process, you'll purchase a simple term life product we call 4SIGHT and see for yourself how fast and easy our end-to-end platform makes underwriting.
If you would like to understand more about the CHRONOS process at any point during the demonstration, simply click on the ? icon, and an explanatory panel will appear.
Continue

Welcome to **4SIGHT**.
Life insurance made easier.

In **less than 10 minutes**, get the best, most affordable life insurance plan for your needs.

With **4SIGHT**, you're in Control:

- No invasive medical exams
- No sales pressure and no need to talk to anyone
- You decide which policy and premium is right for you
- Immediate enrollment and coverage

Get Started

Let's get started.
0% Completed.

First, we need your **full name**, **email address** and a **photo**.

Don't worry, we won't share your information with any third party and you can always choose not to receive emails from us in the future.

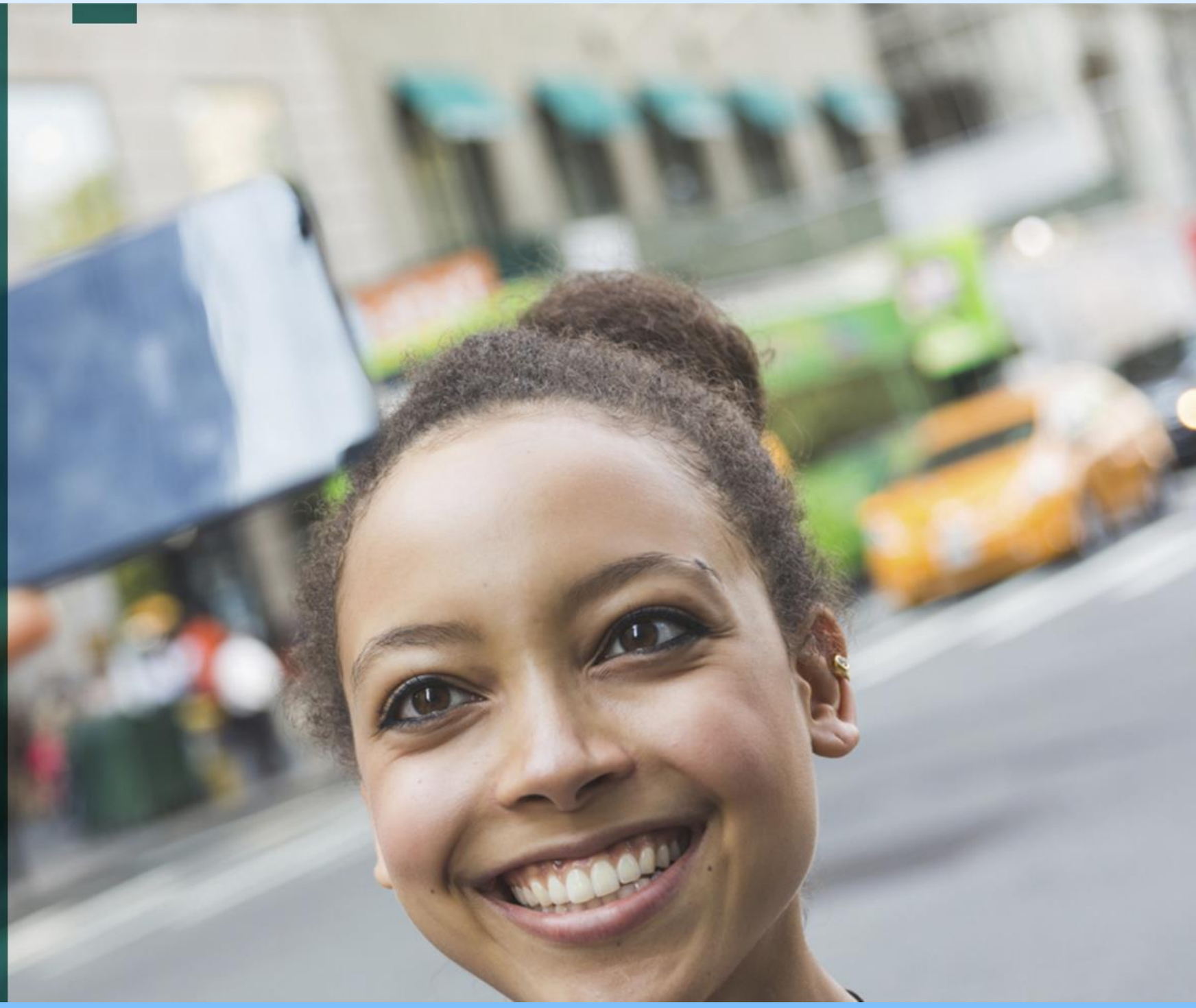
Full Name Jay Olshansky

E-mail jay@lapetussolutions.com

We need a recent photo to help us calculate the best price and plan for you based on your estimated lifespan.

We use patented facial analytics to examine your face for signs of longevity. Then we'll estimate your lifespan and share the results with you in just a few minutes.

Upload a photo



Thanks
25% Completed

Now,

while we analyze your photo, please answer a few questions about yourself.

Date of Birth: 02 / 22 / 1954

Gender: Male Female

What is your current height? 5 ft 6 in

What is your current weight? 170 lbs

Years of Education completed by age 25: 18

Continue

?

Thanks.
50% Completed.

We're still examining your photo, so please answer these last four questions.

Smoking History
Non-smoker

What is your current level of daily physical activity?
Moderate/Vigorous

Self reported current health
Excellent

How many biological parents, grandparents, aunts, uncles, and siblings do you have that are aged 85 and older? (include deceased relatives).
6

Continue

Thanks
55% Completed

Do you use an activity sensor or your cell phone to monitor physical activity?

Register your sensor with us and receive a discount on your premiums.

Our state-of-the-art algorithms will show the impact of this activity on your lifespan and healthy life expectancy.

Skip >

Register Device

Thanks
60% Completed

Please choose a device from the following:

- ✓ Please Choose...
- adidis miCoach
- Apple Watch
- AsthmaMD
- Biomedtrics
- BodyTrace BPM
- BodyTrace Scale
- Daily Mile
- Edamam
- Epson
- FatSecret
- Fitbit
- Fitbug
- Garmin Connect
- Higi
- iHealth
- InRFood
- Jawbone UP
- Life Fitness
- Lumo
- MapMyFitness
- MapMyHike
- MapMyRide
- MapMyRun
- MapMyWalk
- Microsoft
- Mio GO
- Misfit Wearables
- Moov Now
- Movable
- Moves App
- MyFitness Pal
- Omron Fitness
- Pivotal Living
- PredictBGL
- Qardio
- Runkeeper
- RxCheck
- Sony Lifelog
- Strava
- Suunto
- Telcare
- TomTom MySports
- Under Armour Record
- VitaDock

Thanks
60% Completed

Please choose a device from the following: MapMyWalk

Your MapMyWalk will be connected to our Chronos Platform.

```
Looking up your account, please wait...

Retrieving data from the last 30 days...

Data retrieved, analyzing...
```

Congratulations, your level of physical activity is "vigorous" -- the most favorable rating possible. If you maintain this level of physical activity, you can expect your healthy life expectancy to increase!

Continue

Thanks.
65% Completed.

JAY,
you can expect to live to be
84.7 years

Chance of living to 65: **95%**
Chance of living to 85: **42%**

Now you can concentrate on what's important in life, like protecting your loved ones if the unexpected happens.

Continue to Plan Options

Thanks.
85% Completed.

4SIGHT ADVANTAGE TERM LIFE for Jay Olshansky

- Low monthly premiums from **$33.78**
- Premiums **never increase** once you enroll
- Coverage is **effective immediately** upon purchase
- Pay by credit card, debit card or directly from your bank account

With **4SIGHT ADVANTAGE**, you decide:

How much coverage you need:

○ **$150,000** ● **$500,000** ● **$1,000,000**

The amount of time you need it for:

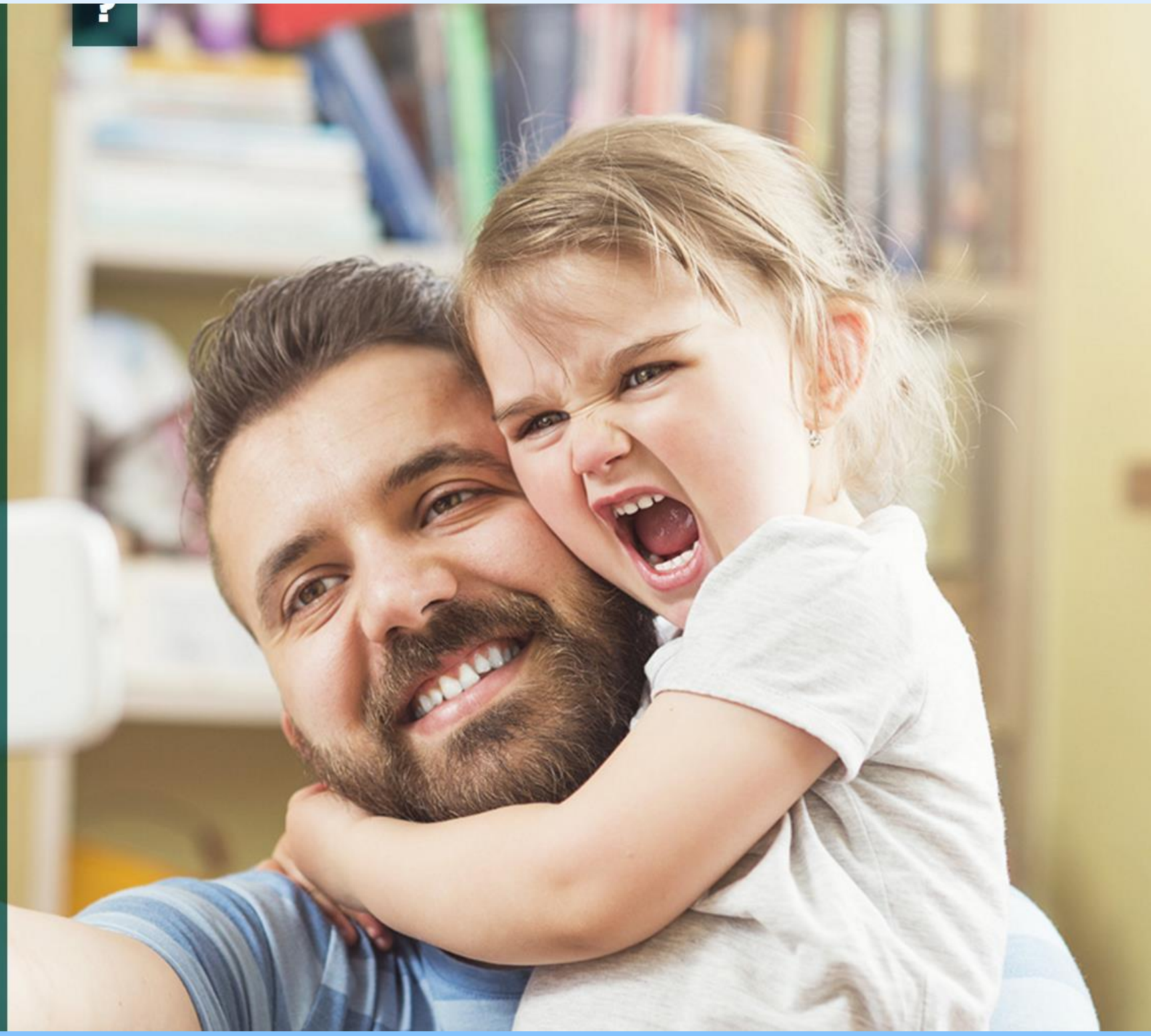
○ **10 Years** ● **20 Years** ● **30 Years**

Congratulations! Your premiums reflect a **10% discount** for an active lifestyle!

Your Monthly Premium: **$33.78**

Annually: **$364.86**

Continue to Purchase



Thanks.
90% Completed.

4SIGHT Term Life policy summary for **JAY OLSHANSKY**

Coverage Amount:	$150,000
Term Length:	10 years
Monthly Premium Amount:	$33.78

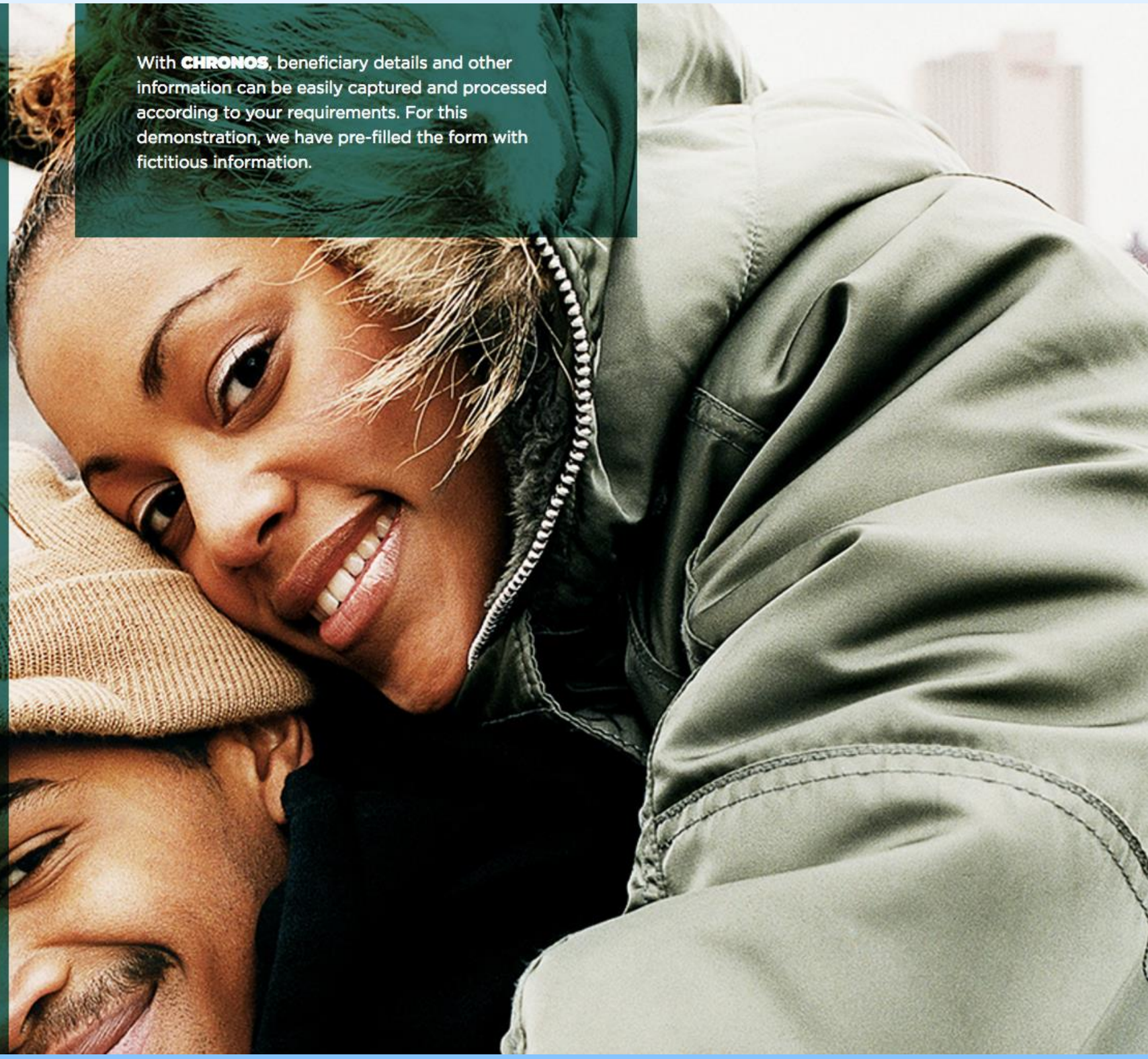
Who would you like to receive the benefits of your policy?

Full Name:	Jane
Middle Initial:	A
Last Name:	Smith
Relationship to you:	Spouse
Distribution Percent:	100%

Add Another Beneficiary +

Proceed to Payment Information

With **CHRONOS**, beneficiary details and other information can be easily captured and processed according to your requirements. For this demonstration, we have pre-filled the form with fictitious information.



Thanks.
93% Completed.

4SIGHT Term Life policy summary for **JAY OLSHANSKY**

Coverage Amount:	$150,000
Term Length:	10 years
Monthly Premium Amount:	$33.78

How would you like to pay your monthly premiums?

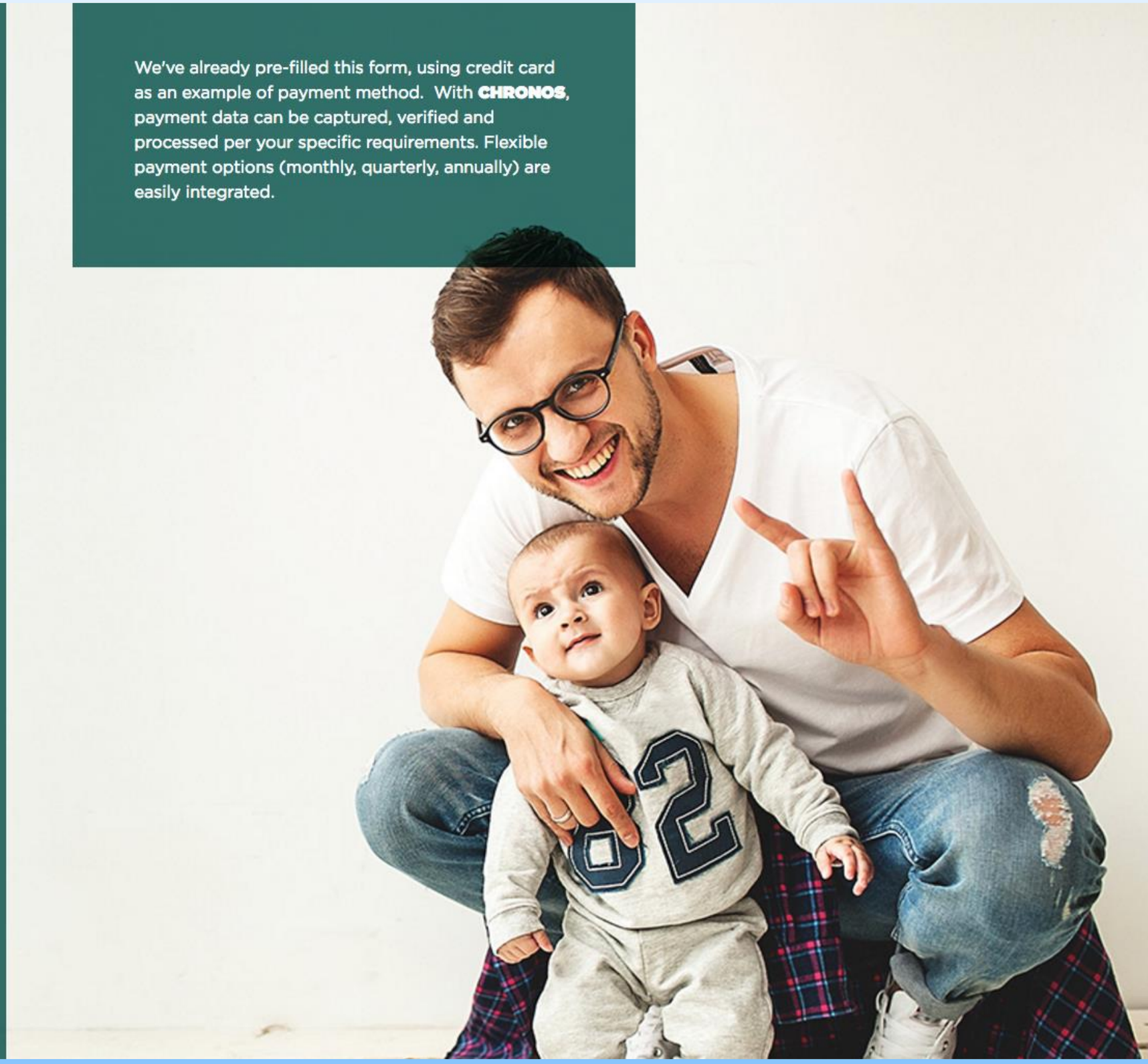
Bank:	●
Check:	●
Credit card:	○
Name on Card:	Richard Smith
Credit Card Number:	XXXX XXXX XXXX XX
Expiration Date:	XX/XX
CVV:	XXX

First Payment Date: **09/02/2016**

You're almost done. We'll finish up with your electronic signature and disclosures.

Proceed with Electronic Signature

We've already pre-filled this form, using credit card as an example of payment method. With **CHRONOS**, payment data can be captured, verified and processed per your specific requirements. Flexible payment options (monthly, quarterly, annually) are easily integrated.



Thanks.
97% Completed.

4SIGHT Term Life policy summary for **JAY OLSHANSKY**

Coverage Amount:	$150,000
Term Length:	10 years
Monthly Premium Amount:	$33.78

Sign your documents.
By checking each box and signing below, you acknowledge that you have read, understand and agree to each of the documents listed.

Fraud Warning √
Consent to Do Business Electronically √
View My Completed Application √

Submit my Application

Electronic signature software can be easily integrated into the **CHRONOS** sales process. In this example, your information has been pre-filled. **CHRONO**S is also very flexible according to your processes and requirements; for example, fully completed applications can be generated for downloading, printing, customer signature and mailing. Where permitted, policies can also be generated and issued on the spot via interaction with your own internal systems. Email confirmations of coverage or acknowledgement of application receipt can also be instantly generated.

That's it.
100% Completed

Thank you for experiencing this demonstration of **CHRONOS** in action.

We trust this has given you a good idea of how fast and flexible insurance underwriting with **CHRONOS** can be.

We do understand that insurers have specific underwriting and policy issuance processes, as well as compliance and regulatory requirements, so we have designed **CHRONOS** to be flexible and customizable according to your individual requirements.

Our IT team will be happy to answer any questions you may have and work with you and your IT department to ensure a fast, smooth integration of **CHRONOS** according to your exact needs and specifications.

More Info

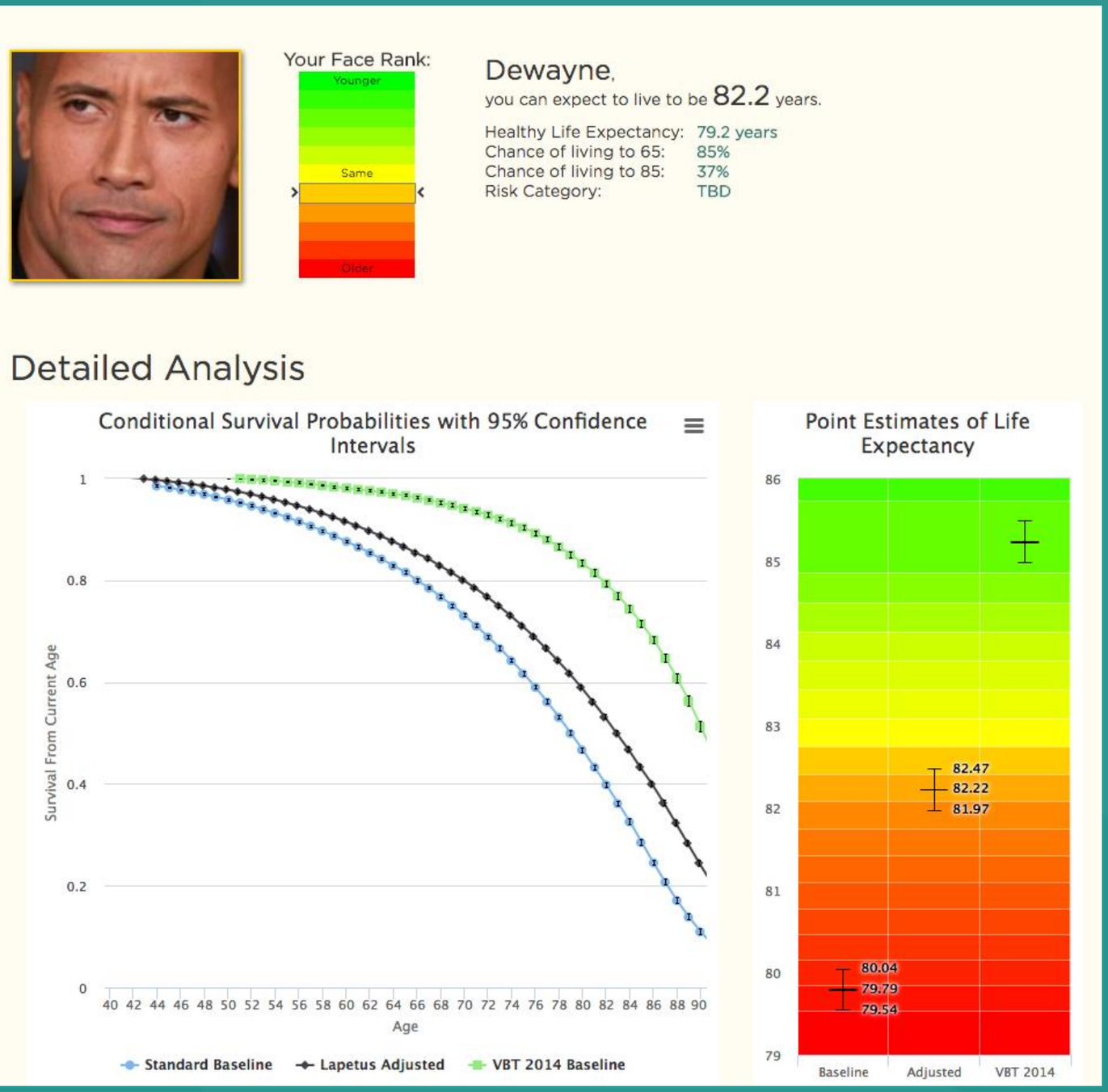
Chronos: Click here
Lapetus Solutions: Click here

Start Over

Face Rank: Measures the rate of aging compared to the population. It's an indicator of left (short lived) and right (long lived) tail individuals.

Survival Probabilities: Lapetus produces a mortality table that extends out to 100 years of age. Lapetus proprietary table can be plotted against any mortality table.

Blue: U.S. SOA
Black: Lapetus
Green: VBT



Primary End Point: Life Expectancy is calculated to the month. LE can be mapped to YOUR risk tables.

Primary End Point: Healthy Life Expectancy (HLE) is calculated to the month and indicates the age for the onset of frailty/disability. Extended care services may be required post HLE age.

LE Point Estimates: LE's can be illustratively compared to any baseline.

Manulife to cut down on insurance application medical tests

JACQUELINE NELSON
The Globe and Mail
Published Monday, May 09, 2016 6:00AM EDT
Last updated Monday, May 09, 2016 9:22AM EDT

Applying for life insurance is about to get a little less invasive at Manulife Financial Corp.

The Toronto-based insurer is doing away with drawing blood, testing urine and collecting other biometric data for term life insurance policies of up to $1-million, purchased by new customers from ages 18 to 40.

It's a change that has been more than one year in the making as Manulife reviewed medical literature, scanned its applicant pools and consulted actuaries as part of a broader push to simplify insurance applications.

"What we decided to do was look at our processes and really test to see whether or not the way we are actually underwriting today still makes sense given the medical improvements we are seeing [and] mortality improvements in the general population," Karen Cutler, Manulife's chief underwriter, said.

The shift comes as more insurance companies are investing in technology to better connect themselves with customers and make it quicker and easier to get insured. It also marks the way that Canadians' expectations are changing when it comes to the coverage they want.

Swiss Re No 6/2015

sigma

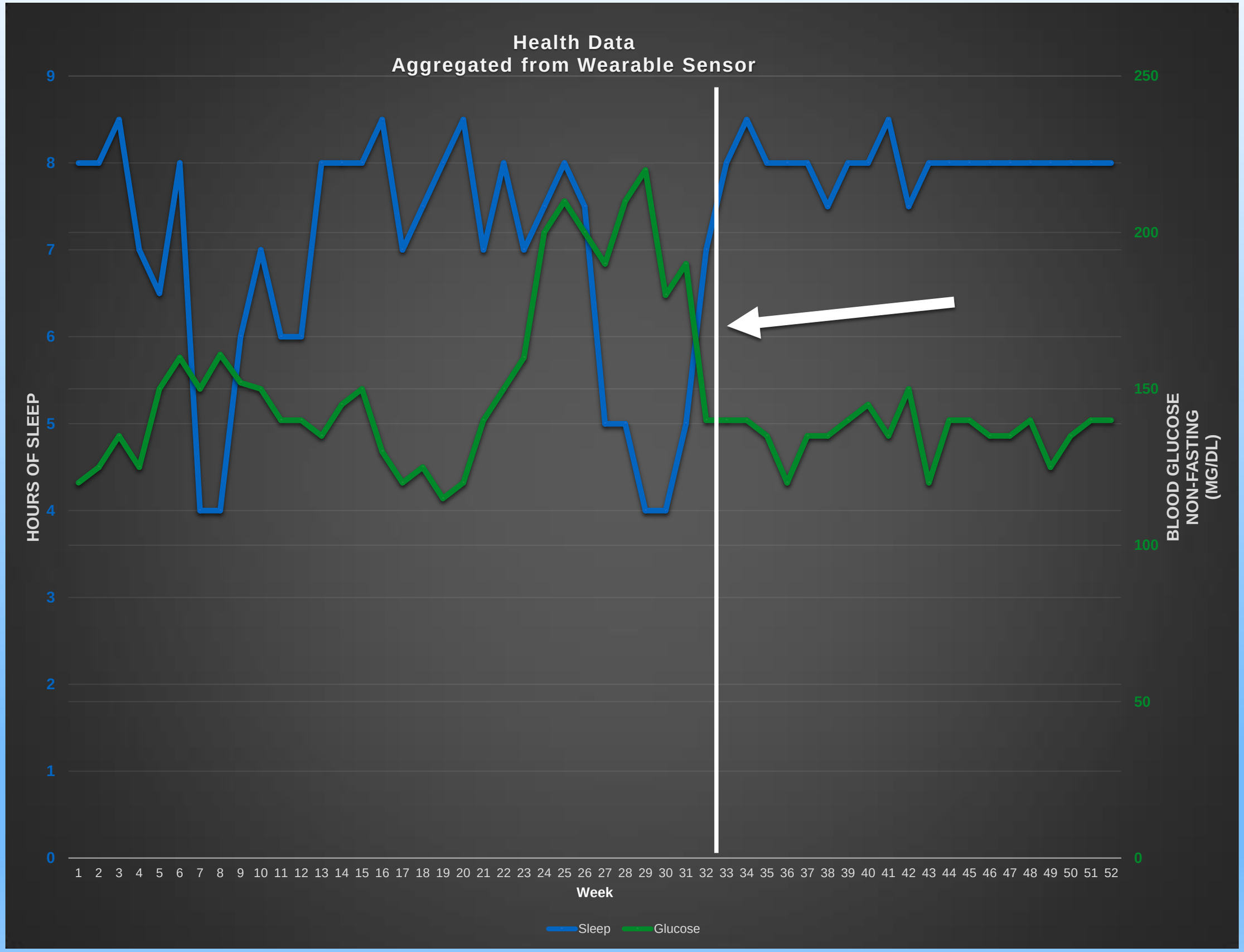
Executive summary

New data and technologies can radically transform the way life insurance is underwritten and sold.

Technological advances have the potential to radically change the way life insurers interact with consumers and also help them better assess and price risks. The rapid spread of internet-enabled wearable devices and ubiquitous connectivity are enabling new ways of communication and information sharing. The amount of digital data generated automatically, inexpensively and non-intrusively is growing exponentially. The number of tools to analyse the data and extract useful insights on consumers is also growing rapidly. Developments in artificial intelligence and cognitive systems also create opportunities for innovation. And advances in medical technology have the potential to improve health outcomes and extend lives, thus changing risk pools.

Life insurance in the digital age: fundamental transformation ahead

New Longitudinal Health Data is Here



Source: Olshansky, S.J., Carnes, B.A., Yang, C., Miller, N., Anderson, J., Beltran-Sanchez, H., Ricanek, K. Designing the Future of Smart Health (forthcoming in Computer).

Table 1: Relative risk of death from total mortality for a 65-year old U.S. male weighing 175 pounds as a function of step count and walking speed.

Level	MPH	Mile Time	Stride Length	Steps/mi	Cal Burn	Cal/Step	RR
Minimal	1	60 min	2.17 ft (26 in)	2433	198	0.0814	1.0
	1.5	40	2.25 ft (27 in)	2347	150	0.0639	1.0
Some	2	30	2.29 ft (27.5 in)	2306	125	0.0542	0.81
	2.5	24	2.33 ft (28 in)	2266	111	0.0490	0.81
Moderate	3	20	2.42 ft (29 in)	2182	105	0.0481	0.73
	3.5	17	2.5 ft (30 in)	2112	105	0.0497	0.73
Vigorous	4	15 min	2.58 ft (31 in)	2046	109	0.0533	0.67

Source: Olshansky, S.J., Carnes, B.A., Yang, C., Miller, N., Anderson, J., Beltran-Sanchez, H., Ricanek, K. Designing the Future of Smart Health (under review).

Simple is Good