

MAX-PLANCK-INSTITUT MAX PLAN FÜR DEMOGRAFISCHE FOR DEMOG FORSCHUNG RESEARCH

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The Biodemography of Human Longevity:

by James W. Vaupel

The Future of Science IX: Secrets of Longevity, Venice, 21 September 2013





View 1: The Fixed Frontier of Survival Limited lifespans Aristotle 350 BC, James Fries NEJM 1980

View 2: Breaking through the Frontier of Survival Secrets of longevity

Luigi Cornaro The Art of Living Long 1558

View 3: The Advancing Frontier of Survival:

Unrecognized progress

Vaupel, Manton, Stallard Demography 1979

Discovery of Postponement of Senescence

Vaupel and Lundstroem 1994





The decline in chances of death in Japan at ages 80, 85, 90 and 95



The explosion of centenarians







The major discovery— The advancing frontier of survival.

Supplemental discoveries

1. The frontier of survival is advancing because senescence (the increase of mortality with age) is being postponed.

The Postponement of Senescence: Evidence from Sweden



Data Source: Calculations based on Human Mortality Database by Elisabetta Barbi and Giancarlo Camarda (unpublished)





The major discovery— The advancing frontier of survival.

Supplemental discoveries

- 1. The frontier of survival is advancing because senescence is being postponed.
- 2. The advancing frontier of survival is part of the larger, long-term Life Expectancy Revolution.





The Linear Rise of Best-Practice Life Expectancy



The rise in remaining life expectancy at age 65



Age-Specific Contributions to the Increase of Life Expectancy among Women 1850 to 2007

Age group	1850- 1900	1900- 1925	1925- 1950	1950- 1975	1975- 1990	1990- 2007
0-14	62	55	31	30	11	6
15-49	29	32	38	18	6	5
50-64	5	9	19	16	24	11
65-79	3	4	13	28	41	37
80+	0	0	0	8	18	42
Total	100%	100%	100%	100%	100%	100%



Life Expectancy and Life Disparity

Vaupel, Zhang, van Raalte BMJ Open 2011

Couptry -	Life Expectancy		Life Disparity		Probability before a (in perc	Probability of death before age 65 (in percent)	
Country	Female	Male	Female	Male	Female	Male	
Switzerland	84.1	79.3	9.1	10.2	7	13	
Italy	83.7	78.2	9.0	10.3	7	14	
Germany	82.2	77.0	9.1	10.7	9	17	
Eng&Wales	81.7	77.5	9.9	10.9	10	14	
USA	80.4	75.2	11.3	12.7	13	21	
Hungary	77.2	68.7	10.8	12.9	16	36	
Russia	73.2	60.4	12.2	15.4	23	55	

Life Expectancy vs. Life Disparity



Determinants of Longevity

- Average lifespan in a population
 - Biomedical knowledge, health care system, standard of living, education, healthy behavior, environment
- Variation in lifespans among individuals
 - Healthy behavior: listen to your mother
 - 25% genetics, 10% childhood, 65% adult life
 McGue, Vaupel, Holm & Harvald, J. Gerontology A 1993

The Life Expectancy Revolution: Why?







Medicine?







It's never too late

Vaupel, Carey, Christensen, Science 2003







Life expectancy without and with long-term disability at age 75 in Denmark



with long-term c	lisability	without long-term disability
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Life expectancy without and with long-term disability at age 75 in Denmark







How many of us work? How much do we work?

Vaupel & Loichinger, Science 2006

Country	R, nonworkers per worker			H, hours worked per week per capita		
	2009	2025	Change	2009	2025	Change
Germany	1.13	1.47	30%	12.55	11.16	-11%
Denmark	1.01	1.12	11%	14.96	14.13	-6%
France	1.40	1.69	21%	12.45	11.35	-9%
Italy	1.60	1.86	16%	13.14	12.05	-8%
Netherlands	0.91	1.20	32%	13.84	11.97	-14%
UK	1.11	1.19	7%	14.97	14.67	-2%
USA	1.17	0.99	-15 %	15.64	16.36	5%



- Rely on extrapolation using time-series
 methods
- Be very cautious about using expert judgments about the future



The Sorry Saga of Looming Limits to Life Expectancy

Oeppen and Vaupel Science 2002



Directly Forecasting Record Life Expectancy



Forecasting female record life expectancy (up to 2100)

using a random walk with drift

The Future Will Be Different from the Past

- In next decade or two, progress against cancer and dementia and in developing genotype-specific therapies
- Then progress in regenerating and eventually rejuvenating tissues and organs
- Accompanied by progress in replacing deleterious genes
- Aided by nanotechnologies (nanobots)
- Perhaps in a decade or two, probably later, progress in slowing the rate of aging (as opposed to further postponing aging).

Oldest Age at which at least 50% of a Birth Cohort is Still Alive

Christensen, Doblhammer, Rau & Vaupel Lancet 2009, Updated by Rau 2013

Year of Birth:	2000	2005	2010
France	101	103	104
Germany	99	100	102
Great Britain	101	102	104
Japan	104	106	107
Italy	101	103	104
USA	100	101	103

Data are ages in years. Baseline data were obtained from the Human Mortality Database and refer to the total population of the respective countries.



- Live longer and longer
- Live healthier at any specific age
- Postpone disability to later ages
- Geriatic medicine
- Work more years but fewer hours per year



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