WWTF/City of Vienna: Wien Kultur Summer School 2016

The Demography of Health and Education

Wittgenstein Centre
Summer School 2016

The Demography of Health and Education

Is disability-free life expectancy stagnant or increasing?

Jean-Marie Robine

INSERM – EPHE, Paris and Montpellier, France

The three theories of the 1980s

- The compression of morbidity: According to Fries, life expectancy was close to its maximum in the 1980s. Medical and health behaviors progress can only reduce the number of bad years to a small part of the life expectancy (Fries, 1980).

- The expansion of morbidity: On the opposite side, according to Gruenberg and Kramer, the same medical progress will increase the survival of frail elderly people such as those with dementia (Gruenberg, 1977; Kramer, 1980).

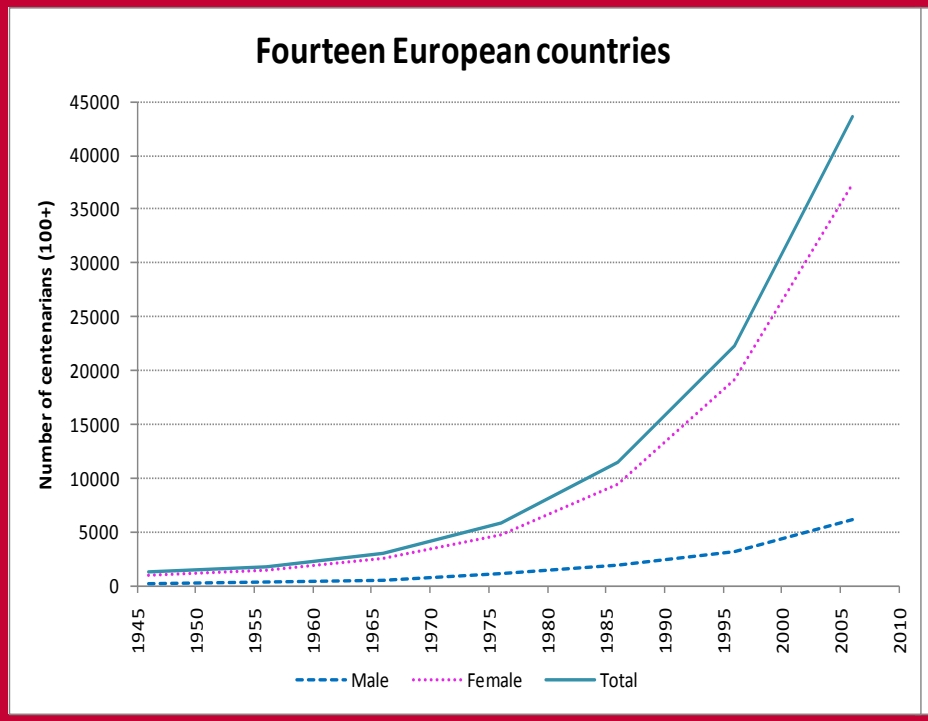
- The dynamic equilibrium: Between these two extreme futures, Manton proposed a dynamic equilibrium in which increased survival is offset by better control of chronic diseases, keeping the proportion of life lived in good health more or less constant (Manton, 1982).

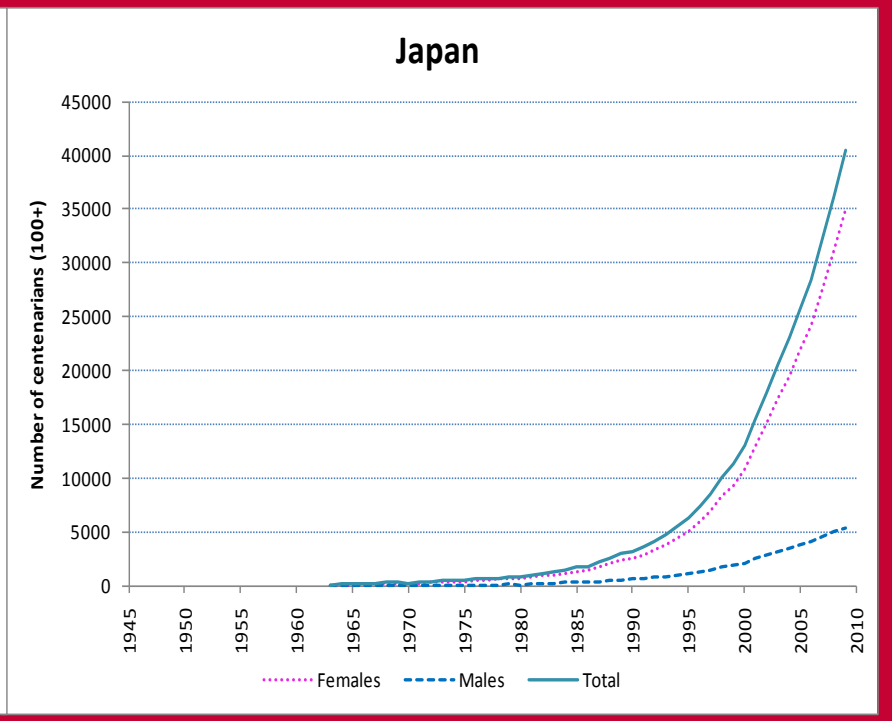
The longevity revolution

- But no theory on health at that time was anticipating the longevity revolution which is currently occurring in most developed countries and which has led to impressive numbers of nonagenarians and centenarians.

The longevity revolution

Change in the number of centenarians in Europe vs. Japan





Europe vs. Japan

INSEE PREMIERE

N° 1319 - OCTOBRE 2010

15 000 centenaires en 2010 en France, 200 000 en 2060 ?

Nathalie Blanpain, division Enquêtes et études démographiques, Insee

Au 1er janvier 2010, 15 000 centenaires vivent en France métropolitaine : c'est treize fois plus qu'en 1970. Neuf centenaires sur dix sont des femmes et parmi les personnes de 110 ans et plus, qu'on appelle les « supercentenaires », il n'y a quasiment que des femmes. Un centenaire sur deux vit à domicile, qu'il soit seul, en couple, ou avec une autre personne que son conjoint. La part des centenaires qui vivent en solo ou en couple s'accroît. Les hommes sont plus fréquemment à leur domicile que les femmes.

Dans cinquante ans, la France pourrait compter 200 000 centenaires, soit treize fois plus qu'aujourd'hui. Si les conditions d'espérance de vie sont meilleures que prévu, ils pourraient être 380 000 en 2060, contre 120 000 dans le cas contraire.

doyenne a 114 ans et aucun homme n'a plus de 110 ans.

Treize fois plus de centenaires que dans les années 1970

En 2010, 15 000 centenaires vivent en France métropolitaine (*encadré 1*). Selon le point de vue adopté, on peut considérer que ce chiffre est élevé ou non. C'est beaucoup, car c'est treize fois plus que dans les années 1960-1970. Entre 1960 et 1975, leur nombre était stable, on en comptait 1 150 chaque année. Depuis 1975, leur effectif augmente continûment au rythme de 8 % par an. Au total, ils ne représentent que 0,02 % de la population, ou encore un centenaire pour deux ou trois communes en moyenne, sur les 37 000 que compte la France.

Les « supercentenaires » : quasiment tous des femmes

Selon les travaux de recherches disponibles

Number of Future Centenarians

December 2010

DWP Department for Work and Pensions

Table 2: Number of centenarians in the United

Year	100+	110+
1980	2,300	-
1985	3,400	-
1990	4,400	-
1995	5,700	-
2000	6,800	-
2005	8,900	-
2010	11,800	-
2015	15,000	-
2020	21,900	-
2025	37,600	-
2030	58,800	100
2035	97,300	100
2040	148,900	400
2045	202,100	1,000
2050	276,600	2,100
2055	306,200	3,500
2060	378,200	5,600
2065	487,400	7,200
2066	507,000	7,700
2070	563,500	10,700
2075	587,000	16,200
2080	626,900	21,000

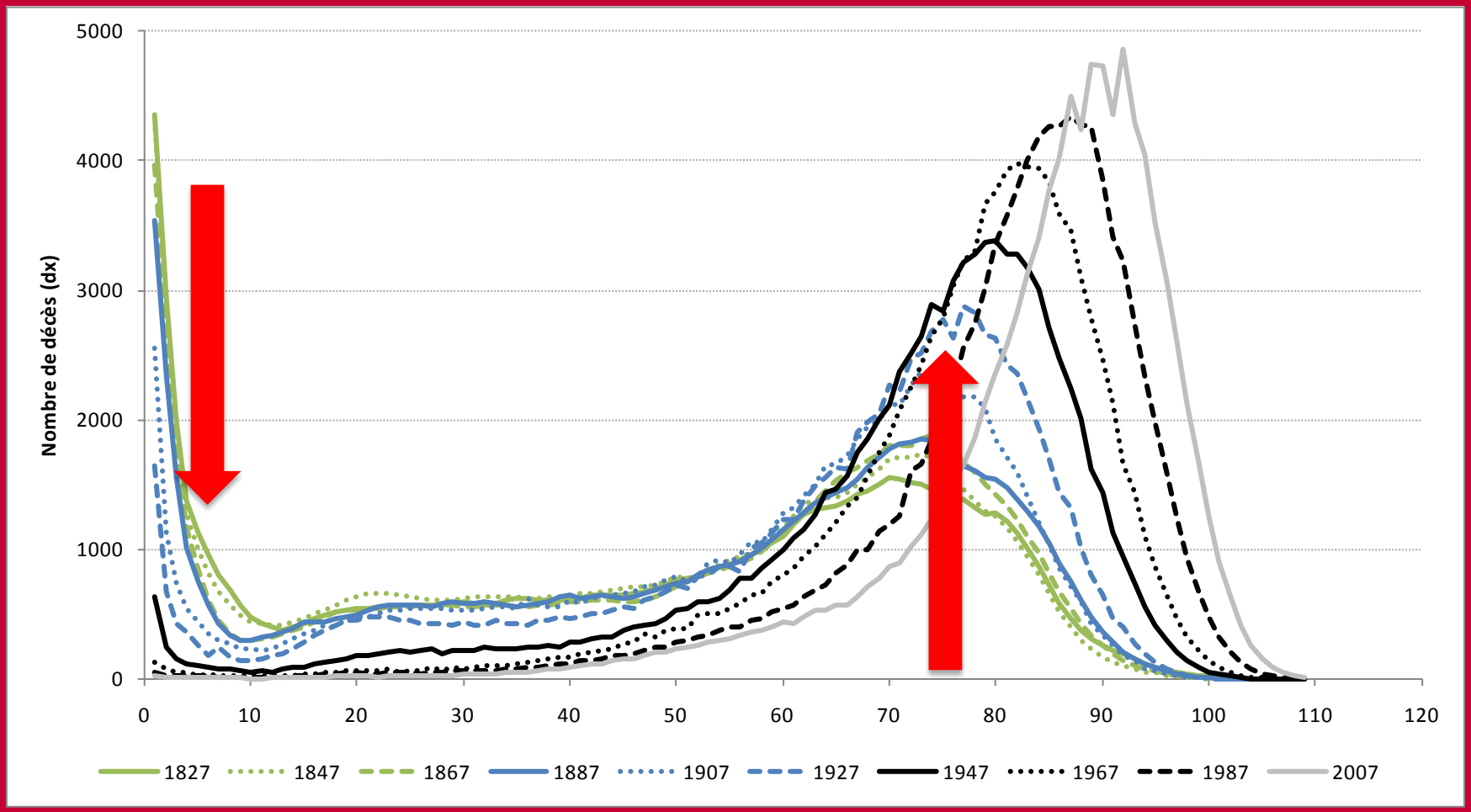
Numbers rounded to nearest 100. Population estimates have b
2009, and 2008-based population projections from 2010

Source: Office for National Statistics, 2008-based Population P

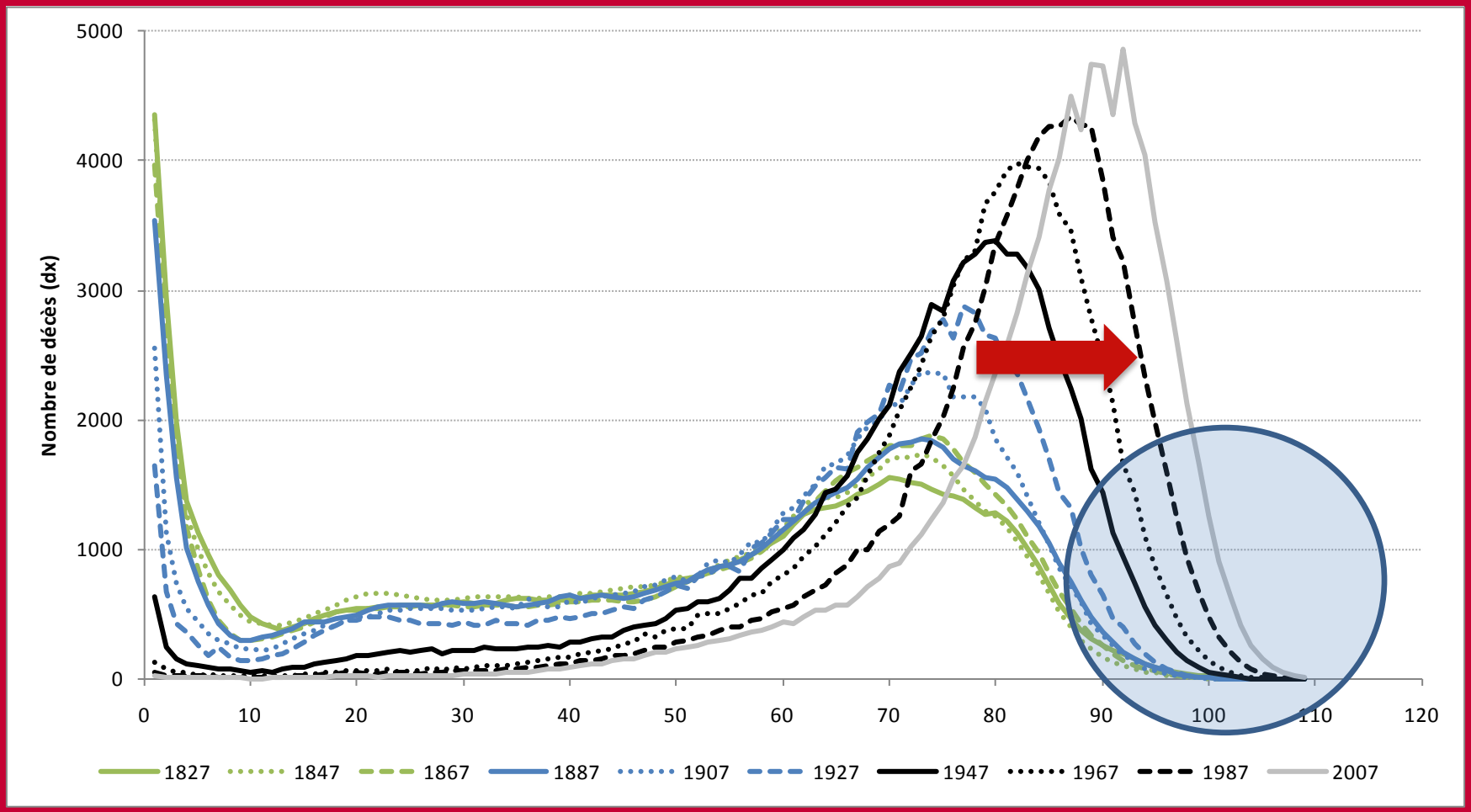
Estimates of the very elderly:
www.statistics.gov.uk/statbase/Product.asp?vlnk=15003

Mechanisms

Change over time in the distribution of the ages at death in France since 1827, female - for 100.000 newborn



The longevity revolution



Compression vs. shifting mortality

Bongaarts, 2005, 2009

Population Studies, Vol. 63, No. 3, 2009, pp. 203–213

Routledge
Taylor & Francis Group

Trends in senescent life expectancy

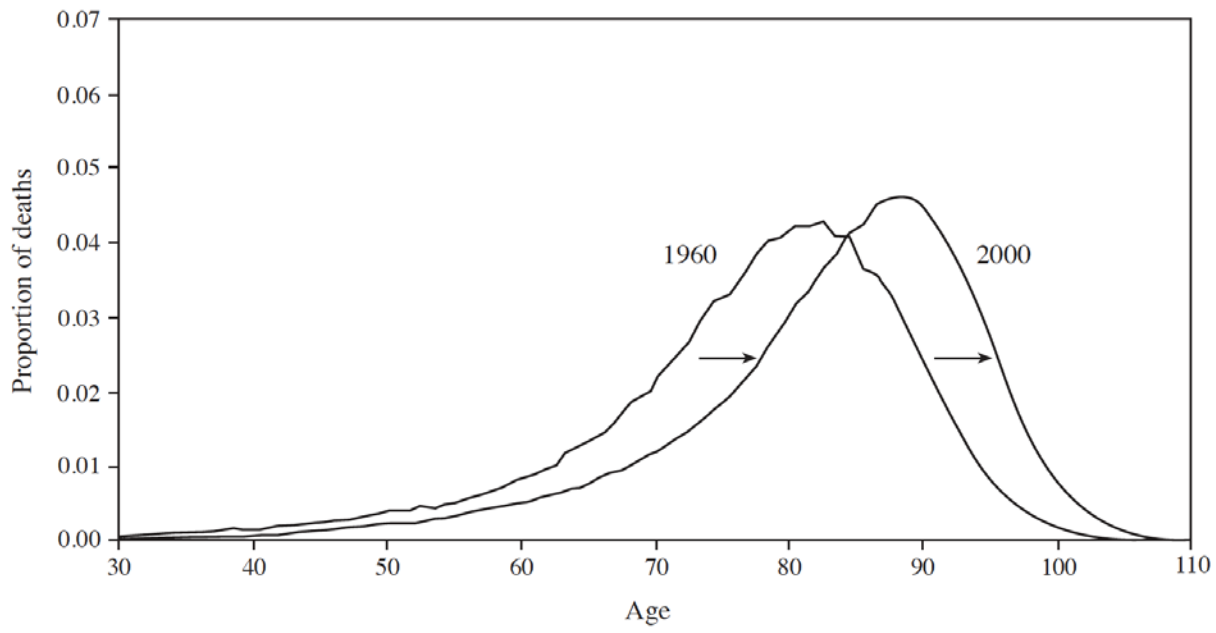


Figure 6 Distribution of senescent deaths by age, Swedish females, 1960 and 2000
Source: As for Figure 4

describing
se mortality
estimating
death rates
expectancy
indicators
expectancy
untries. The
distribution

n method

Fries, 1980

blood pressure are examples of such variables. Exercise, weight control, and diet are some of the common modifying factors.

The modifiability, or "plasticity," of aging has been demonstrated in studies in which performance can be bettered despite age, within surprisingly broad limits. This important phenomenon has been largely unnoticed partly because of an emphasis on average rather than individual performance and partly because disparate disciplines are involved. Average declines in variables in aging can hide remarkable individual variation. The marathon runner is an example (Fig. 4). A runner in middle life who completes a marathon in 3½ hours is in the 99th percentile for this endeavor; yet not until age 73 would that time set an age-group record. These marathon data are important in that they show the maximum rather than the average performance, but here too there is a linear decline in performance between age 30 and 70. Still, the age-related decrement in maximal performance is only 1 per cent per year. Variation between healthy persons of the same age is far greater than the variation due to age; age is a relatively unimportant variable, and training in marathon running is clearly more important than age.

Similar observations on increased variation be-

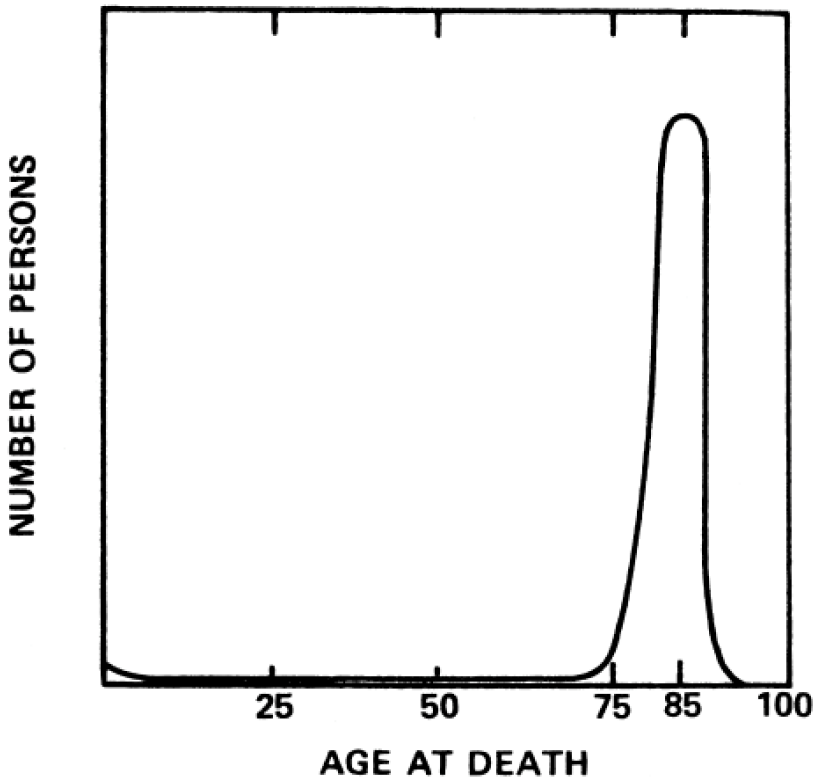
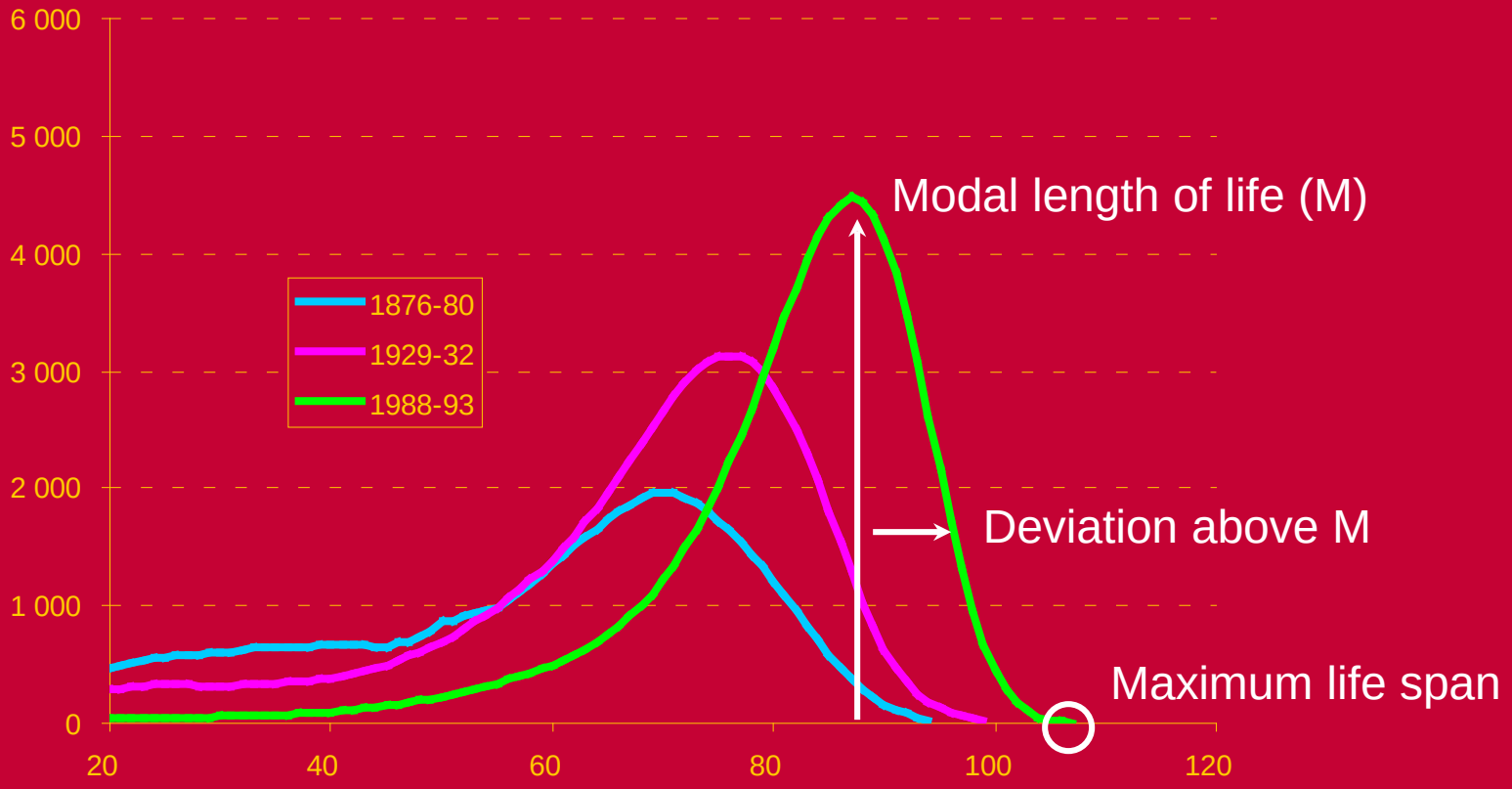


Figure 5. Mortality According to Age, in the Absence of Premature Death.

The morbidity curve is made rectangular, and the period of morbidity compressed between the point of the end of adult vigor and the point of natural death.

How long are adult life durations

d(x) series



Distribution of the ages at death in Switzerland
1876-1880, 1929-1932, 1988-1993

Europe vs. Japan

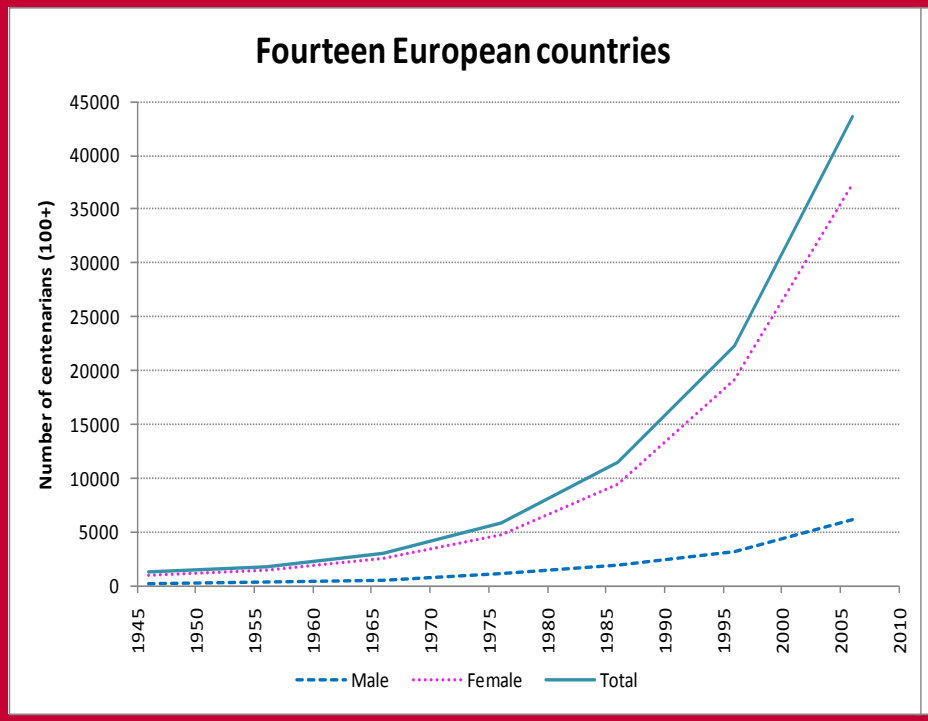
Table 4: Europe compared with Japan: Number of centenarians in 2006 and various centenarian indicators, by sex

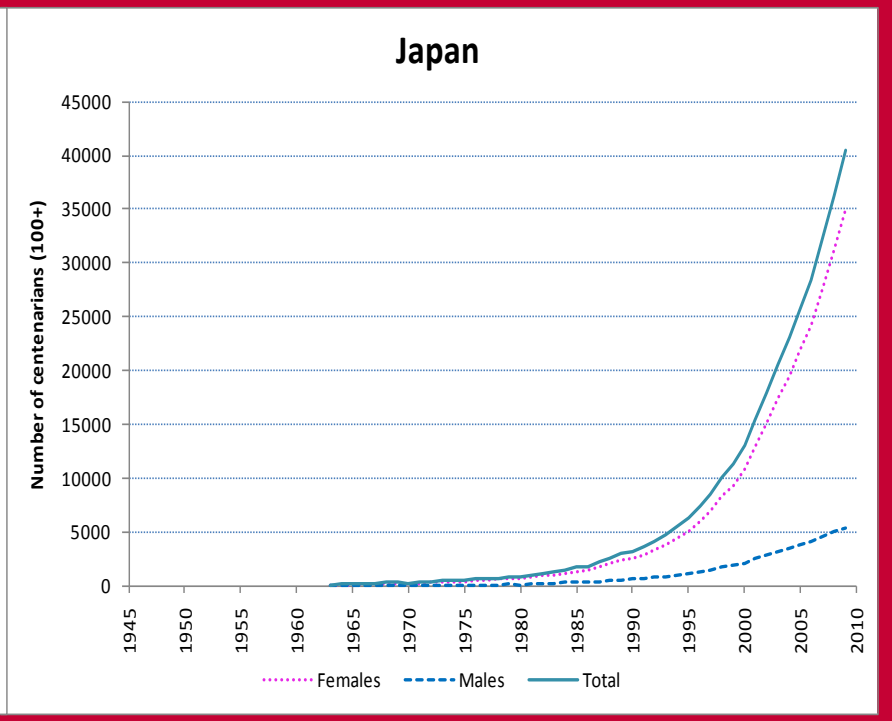
Country	Males	Females	Total	Sex-ratio	Males	Females	Total
	Number of people aged 100 years and more				10-Year increse		
Japan	3906	23236	27142	5,9	3,0	4,5	4,2
European countries	8228	49078	57306	6,0	2,0	2,0	2,0
	Number of people aged 100 years				Centenarian Rate (CR)*		
Japan	1644	9181	10826	5,6	49,3	259,4	157,5
European countries	3823	20675	24499	5,4	18,5	86,5	55,0

Source of data: Human Mortality Database (HMD); *Slovenia excluded

Robine and Saito, 2009

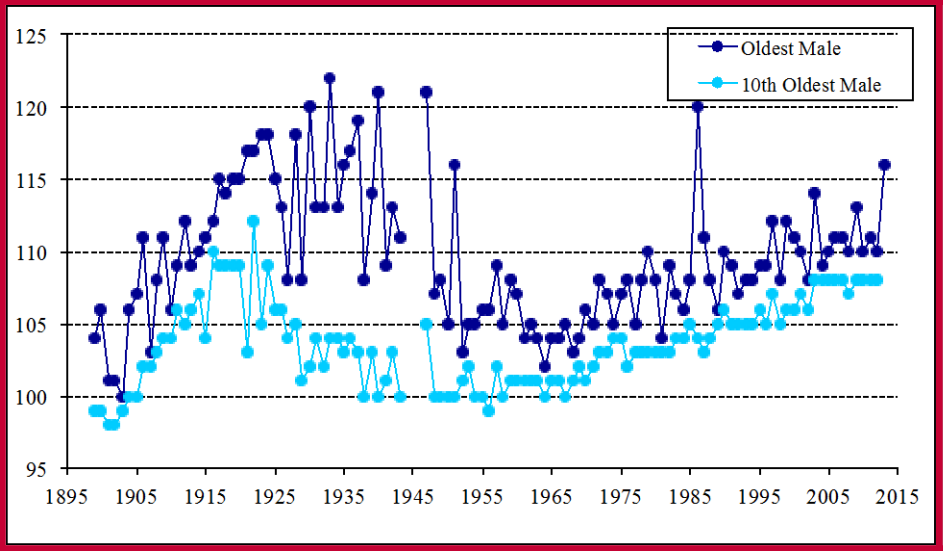
Change in the number of centenarians in Europe vs. Japan

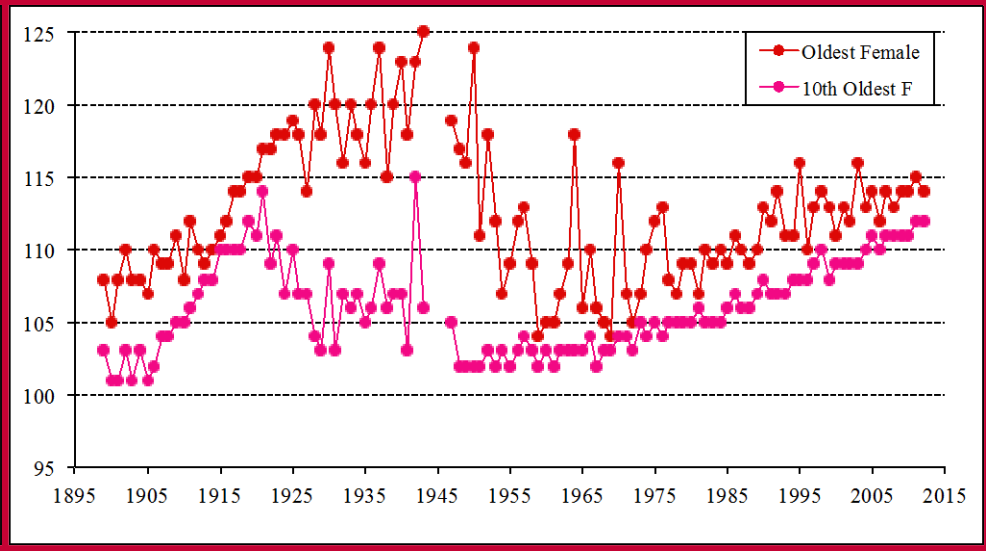


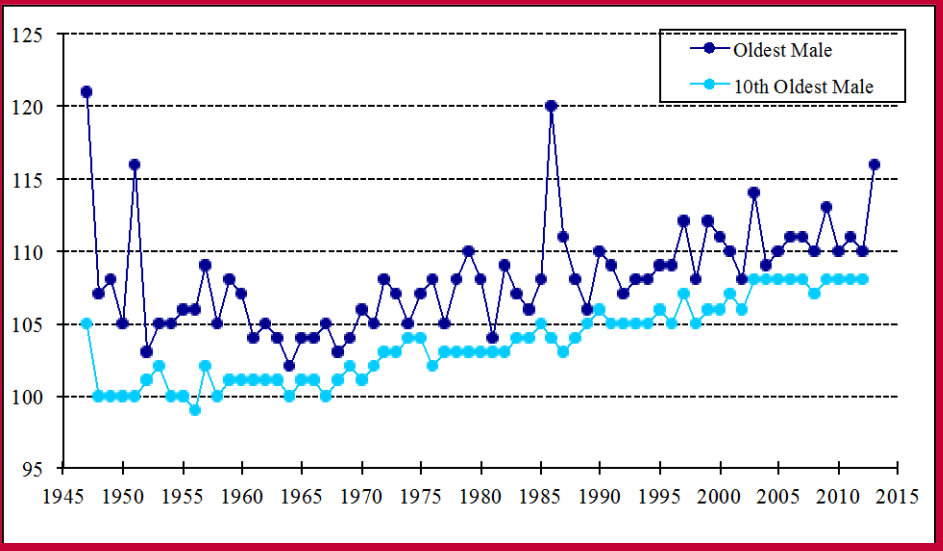


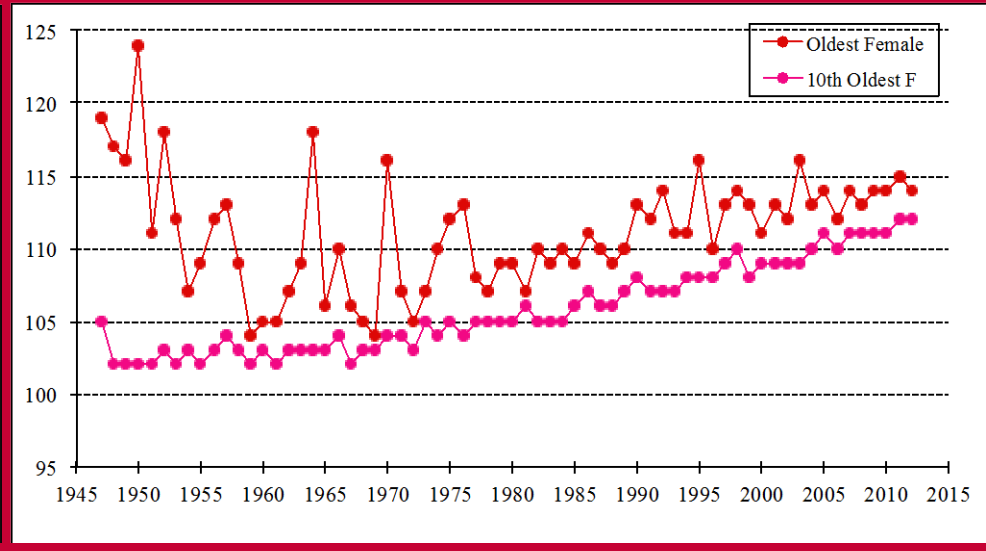
Europe vs. Japan

Maximum life span in Japan (empirical observations)







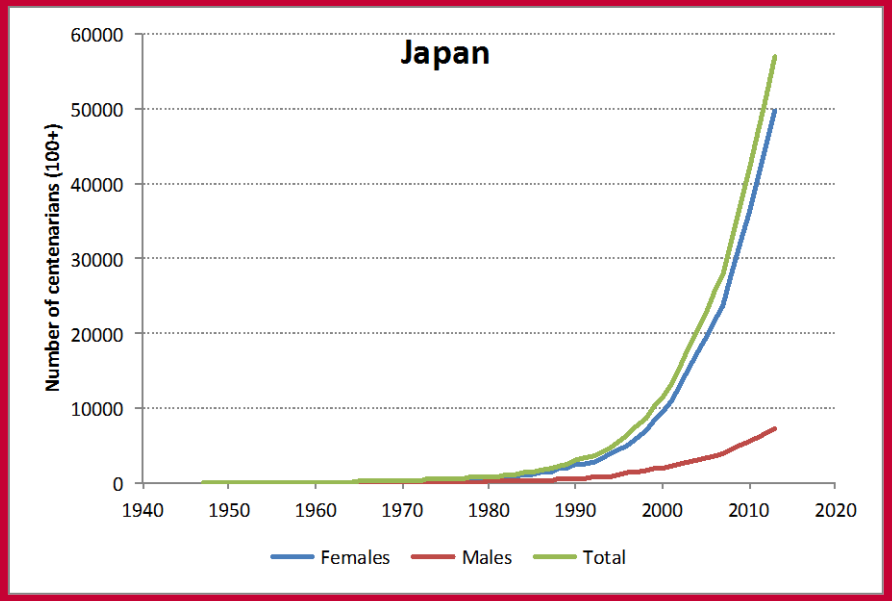


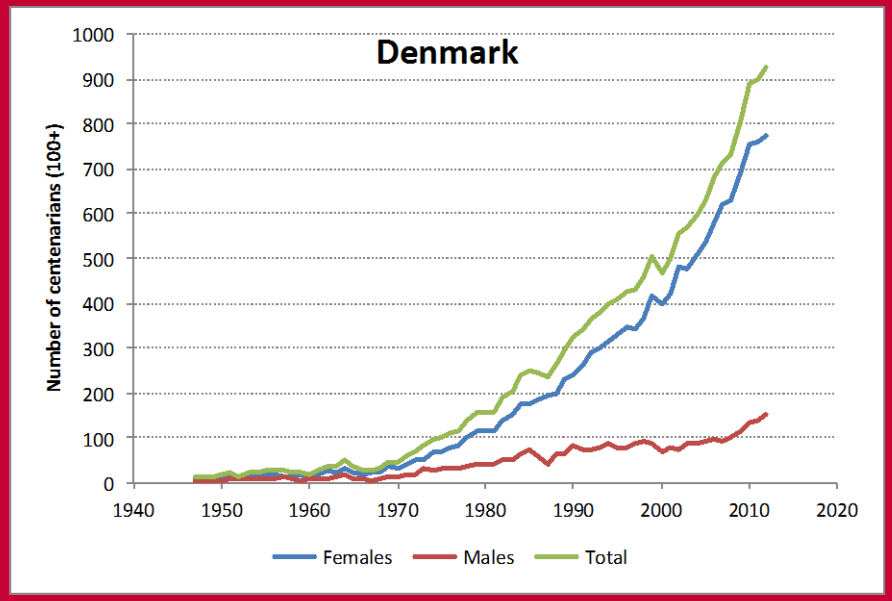
Are centenarians healthy people

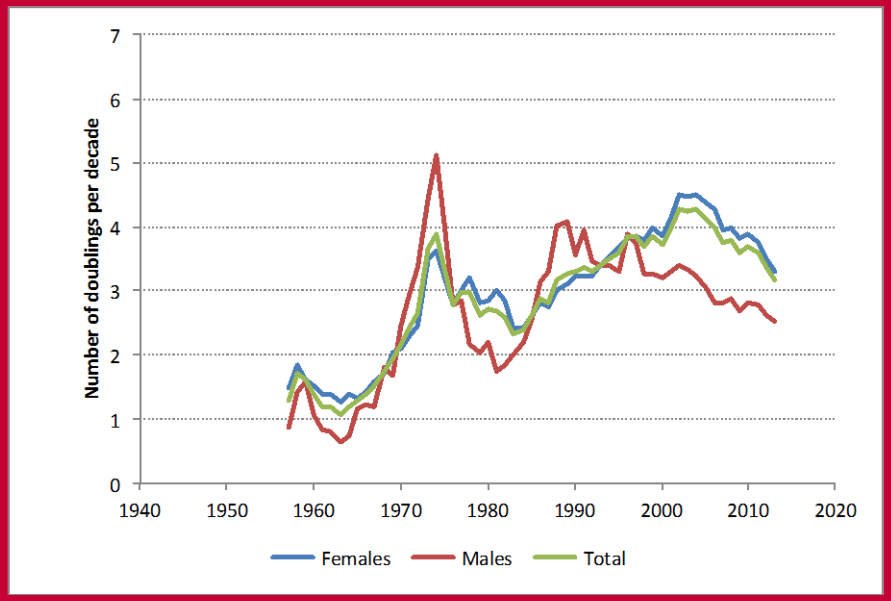
Are centenarian people healthy people?

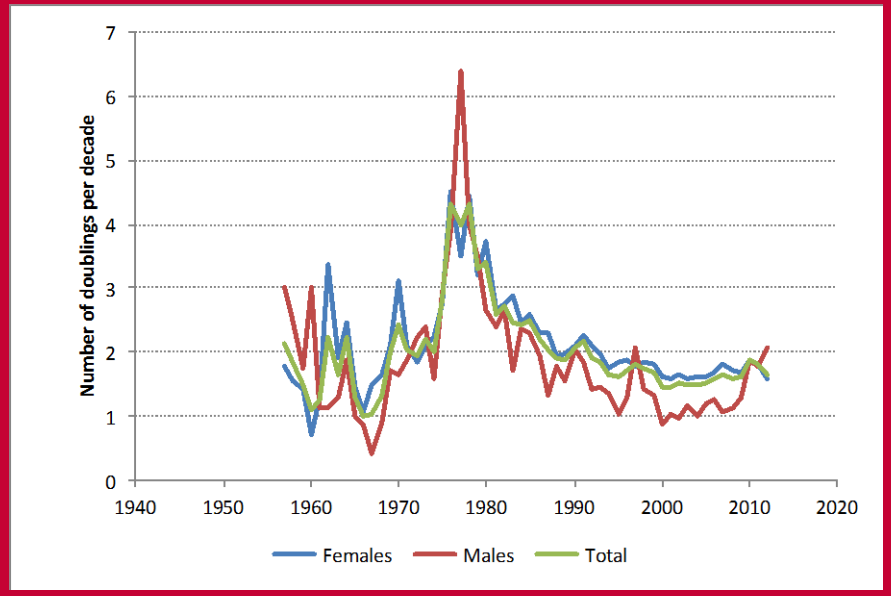
- The few representative studies of centenarians have demonstrated that they are in relatively poor health with a significant proportion being bedridden and/or demented
  - only 1% of Italian centenarians are fully independent
  - none of them continued social or productive activities that could be considered as examples of successful ageing

Number of centenarians (100+): Japan vs. Denmark









Source 5-COOP, GSA 2014

Journal of Gerontology: MEDICAL SCIENCES
2008, Vol. 63A, No. 11, 1186–1192

Cite as: *J Gerontol A Biol Sci Med Sci*

Genetic and Environmental Determinants of Healthy Aging

Improving Activities of Daily Living in Danish Centenarians—But Only in Women: A Comparative Study of Two Birth Cohorts Born in 1895 and 1905

Henriette Engberg,[1] Kaare Christensen,[1] Karen Andersen-Ranberg,[1]
James W. Vaupel,[2] and Bernard Jeune[1]

[1]The Danish Aging Research Center, Institute of Public Health, University of Southern Denmark, Odense.
[2]Max Planck Institute for Demographic Research, Rostock, Germany.

Background. The number of centenarians has increased rapidly since the 1950s. In Denmark, 42% more of the 1905

Results. The 1905 cohort displayed better self-reported ADLs than the 1895 cohort did. Stratified by gender, this apparent cohort advantage was due to women in the 1905 cohort performing significantly better than their female counterparts in the 1895 cohort.

Activities of Daily Living (ADLs) were assessed in both cohorts.

Conclusion. The increasing number of female centenarians does not entail increasing proportions of disabled individuals. In contrast, there is a lack of improvement in ADLs among male centenarians even though the number of male centenarians is stagnating.

Key Words: Centenarians—Activities of Daily Living—Cohort comparisons.

Physical and cognitive functioning of people older than 90 years: a comparison of two Danish cohorts born 10 years apart

Kaare Christensen, Mikael Thinggaard, Anna Oksuzyan, Troels Steenstrup, Karen Andersen-Ranberg, Bernard Jeune, Matt McGue, James W Vaupel

Summary

Background A rapidly increasing proportion of people in high-income countries are surviving into their tenth decade. Concern is widespread that the basis for this development is the survival of frail and disabled elderly people into very old age. To investigate this issue, we compared the cognitive and physical functioning of two cohorts of Danish nonagenarians, born 10 years apart.

Methods People in the first cohort were born in 1905 and assessed at age 93 years (n=2262); those in the second cohort were born in 1915 and assessed at age 95 years (n=1584). All cohort members were eligible irrespective of type of residence. Both cohorts were assessed by surveys that used the same design and assessment instrument, and had almost identical response rates (63%). Cognitive functioning was assessed by mini-mental state examination and a composite of five cognitive tests that are sensitive to age-related changes. Physical functioning was assessed by an activities of daily living score and by physical performance tests (grip strength, chair stand, and gait speed).

Interpretation Despite being 2 years older at assessment, the 1915 cohort scored significantly better than the 1905 cohort on both the cognitive tests and the activities of daily living score, which suggests that more people are living to older ages with better overall functioning.

the physical performance tests, but the 1915 cohort had significantly better activities of daily living scores than did the 1905 cohort (2·0 [SD 0·8] *vs* 1·8 [0·7]; p<0·0001).

Interpretation Despite being 2 years older at assessment, the 1915 cohort scored significantly better than the 1905 cohort on both the cognitive tests and the activities of daily living score, which suggests that more people are living to older ages with better overall functioning.

Funding Danish National Research Foundation; US National Institutes of Health—National Institute on Aging; Danish Agency for Science, Technology and Innovation; VELUX Foundation.

Lancet 2013; 382: 1507–13

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July 11, 2013
http://dx.doi.org/10.1016/S0140-6736(13)60777-1

See Comment page 1473

See Online for a podcast interview with Kaare Christensen

Danish Aging Research Center, Institute of Public Health (Prof K Christensen MD, M Thinggaard MSc, A Oksuzyan MD, [illegible] Denmark; Odense, Denmark; **Department of Clinical Genetics** (K Christensen), **Department of Clinical Biochemistry and Pharmacology** (K Christensen), **and Department of Geriatrics** (K Andersen-Ranberg), **Odense University Hospital, Odense, Denmark; Department of Psychology, University of Minnesota, Minneapolis, MN, USA** (Prof M McGue PhD); **and**

Japanese studies, from 1973 to 2000

Prevalence of centenarians confined to the room

Year	Population size	Sampling rate	% confined to the room		% bedridden	
			Males	Females	Males	Females
1973 (1)	405	28.9	19.1	37.5	14.3	21.9
1975 (2)	548	39.1	38.5	46.8	15.4	25.7
1981 (3)	1072	94.2	33.1	50.7	18.2	27.9
1992 (4)	4152	13.2	36.5	59.8	21.2	36.6
1993 (5)	4802	59.9	39.3	61.1	17.9	34.4
2000 (6)	13036	14.6	57,0	78,0	22.2	41.1

Research reports

(1) Tokyo metropolitan institute of aging (1973)
(2) Center for development of elderly welfare (1976)
(3) Japan Health promotion and Fitness Foundation (1992)
(4) Japan College of Social Work (1992)
(5) Japan Health promotion and Fitness Foundation (1993)
(6) Japan Health promotion and Fitness Foundation (2002)

Courtesy Yasuyuki Gondo

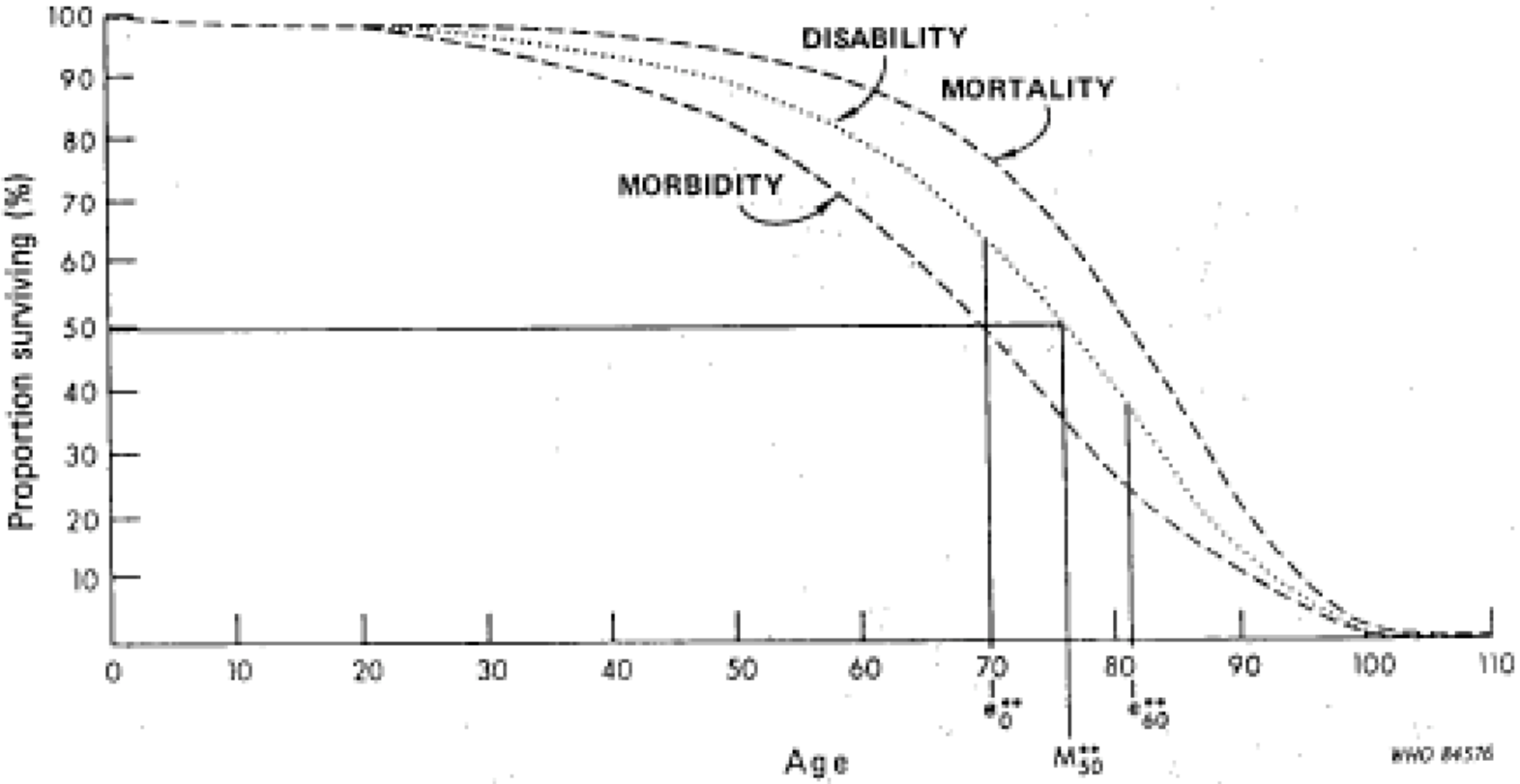
The Five Country Oldest Old Project (5-COOP): Relationships between the level of mortality selection and the health status of the oldest old

Denmark, France, Japan, Sweden & Switzerland

Robine et al, Centenarians today: New insights on selection from the 5-COOP study. *CGGR* 2011

More broadly is healthy life expectancy increasing faster than total life expectancy?

Fig. 4. The observed mortality and hypothetical morbidity and disability survival curves for females in the United States of America in 1980



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.

Is healthy life expectancy increasing faster than total life expectancy?

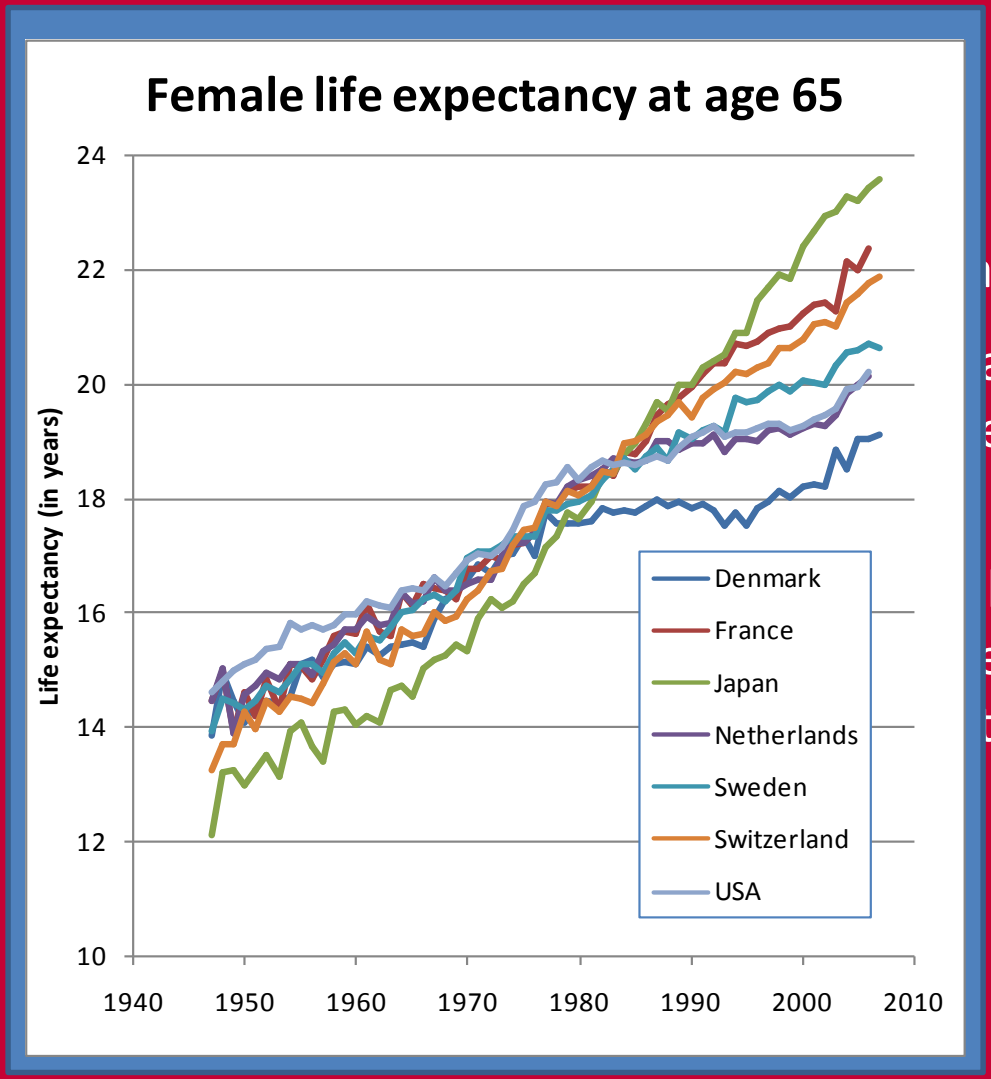
- An OECD study found mixed results on ADL disability trends among the population aged 65 and over (2007).
  - Out of the 12 countries studied only five showed clear evidence of a decline in disability among elderly people.
  - Three countries reported an increasing rate of severe disability among people aged 65 and over during the last five to ten years.
- The most worrying was the fact that the countries showing clear evidence of disability decline were the countries displaying the weaker increase in life expectancy at age 65.
- It may be difficult to reduce the level of disability among older people in countries where life expectancy at age 65 strongly increases.

Chronological series of health expectancies published since 2000

Country	Period	n	Domain	Method	References
Austria	1978-1998	4	SPH	Sullivan	Doblhammer and Kytir 2001
Belgium	1997-2004	3	SPH LSI AL	Sullivan	Van Oyen et al 2008
China	1987-2006 1987-2006	2 2	IMP IMP	Sullivan Sullivan	Liu at al 2009 Lai 2009
Czech Rep.	1993-2002	4	SPH	Sullivan	Hrkal 2004
Denmark	1987-2000 1987-2005	4 5	SPH LSI FL SPH LSI FL	Sullivan Sullivan	Bronnum-Hansen 2005 Jeune and Bronnum-Hansen 2008
France	1980-2003	3	AL	Sullivan	Cambois et al 2006 and 2008
Germany	1984-1998	2	SPH AL	Sullivan	Kroll et al 2008.
Italy	1991-2000 1994-2005	3 3	SPH AL SPH AL	Sullivan Sullivan	Burgio et al 2009 Egidi et al 2009
Japan	1986-2004	7	SPH	Sullivan	Yong and Saito 2009
Lithuania	1997-2004	2	SPH	Sullivan	Kalédiené and Petrauskiené 2004
Netherlands	1981-2007 1989-200	e. year e. year	SPH LSI FL LSI AL W	Sullivan Sullivan	Bruggink et al 2009 Perenboom et al 2005, 2004a&b
Spain	1986-1999 1987-2003	2 4	AL SPH	Sullivan Sullivan	Sagardui-Villamor et al 2005 Gomez Redondo et al 2005
Switzerland	1992-2002	2	SPH	Sullivan	Gulley 2005
Thailand	1986-1995	2	SPH	Sullivan	Jitapunkul and Chayovan 2000
U. S. A.	1970-1990 1982-1999 1992-2003 1982-1999 1982-2004 1970-2000	3 5 2 5 6 4	AL AL AL AL AL HAP	Sullivan Sullivan Multistate Sullivan Sullivan Sullivan	Crimmins and Saito, 2001 Manton et al 2006 Cai and Lubitz 2007 Manton 2008 Manton et al 2008 Yang 2008
U. Kingdom	1980-1996 1981-2002 2001-2004 2000-2006	e. year e. year 2 2	SPH, LSI SPH LSI&D SPH LSI&D SPH LSI&D	Sullivan Sullivan Sullivan Sullivan	Kelly et al 2000 Health expectancies in the UK 2002 and 2004 Smith et al 2008

Jagger et Robine, 2011

Is healthy life expectancy increasing faster than total life expectancy? (2)



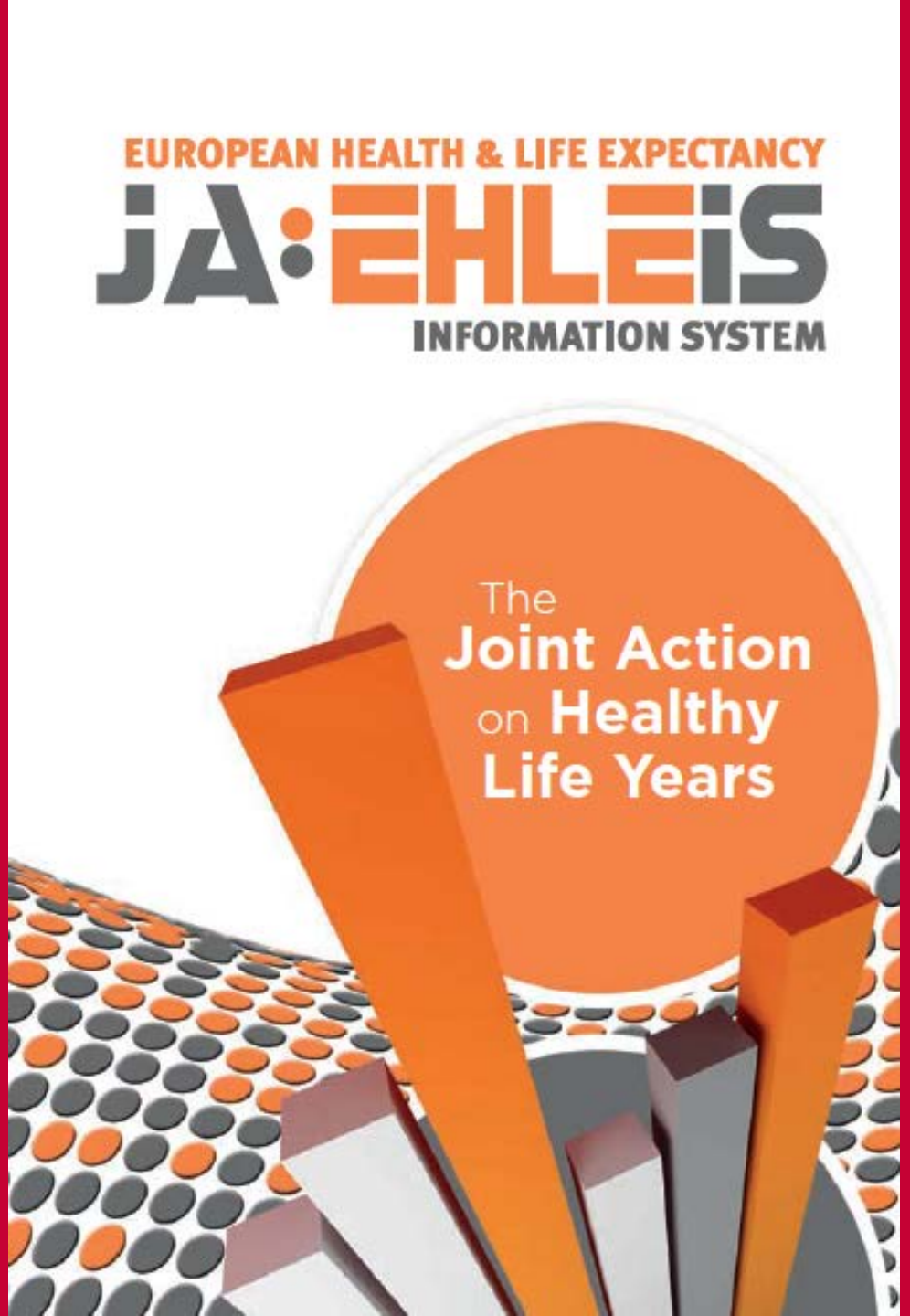
of health expectancies (available
life expectancy is increasing most
as China or Thailand) and Eastern
nced Western economies.

at evidence of compression of
es.

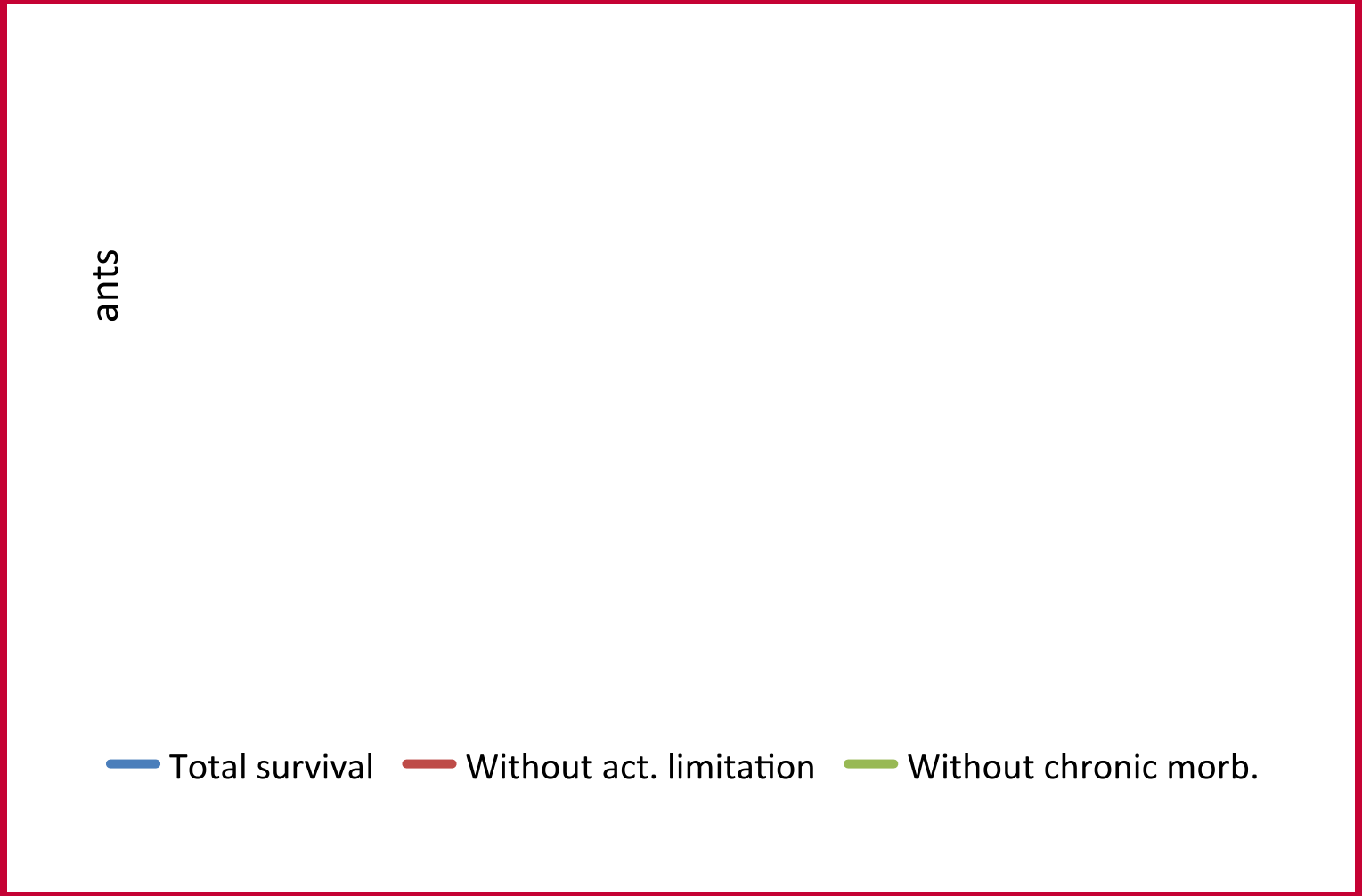
clearly displayed a compression of
he last decades, Denmark, the
e the three countries which lag
term of life expectancy at age 65.

Monitoring gaps and changes over time in healthy life expectancy

2011-2014

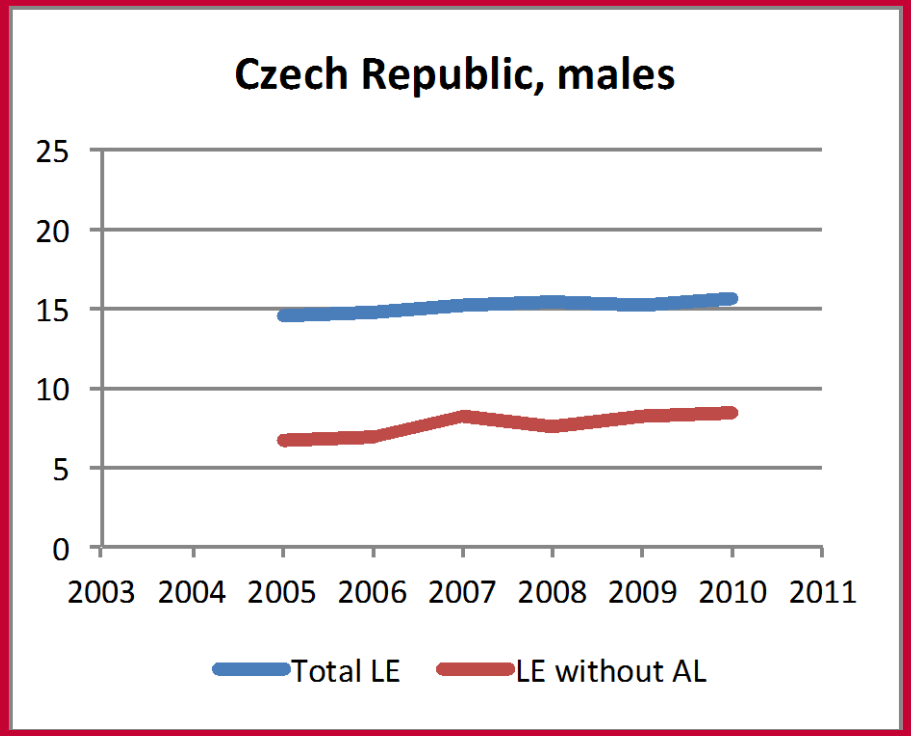


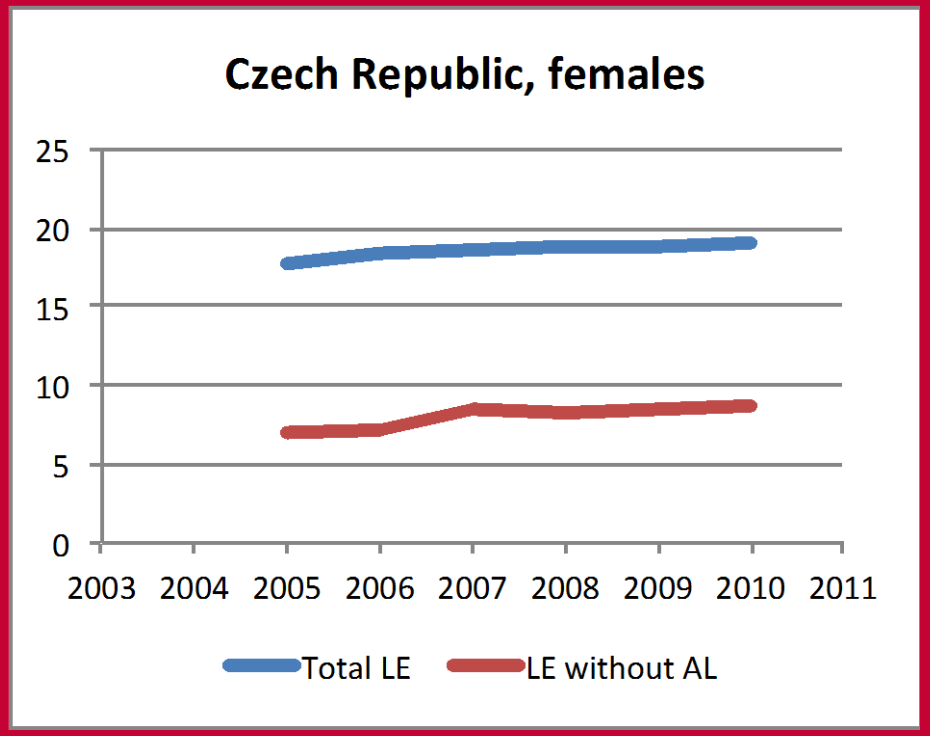
Total survival curve from birth, survival without chronic morbidity and survival without activity limitation from age 16 - Observed for men in EU27 in 2010



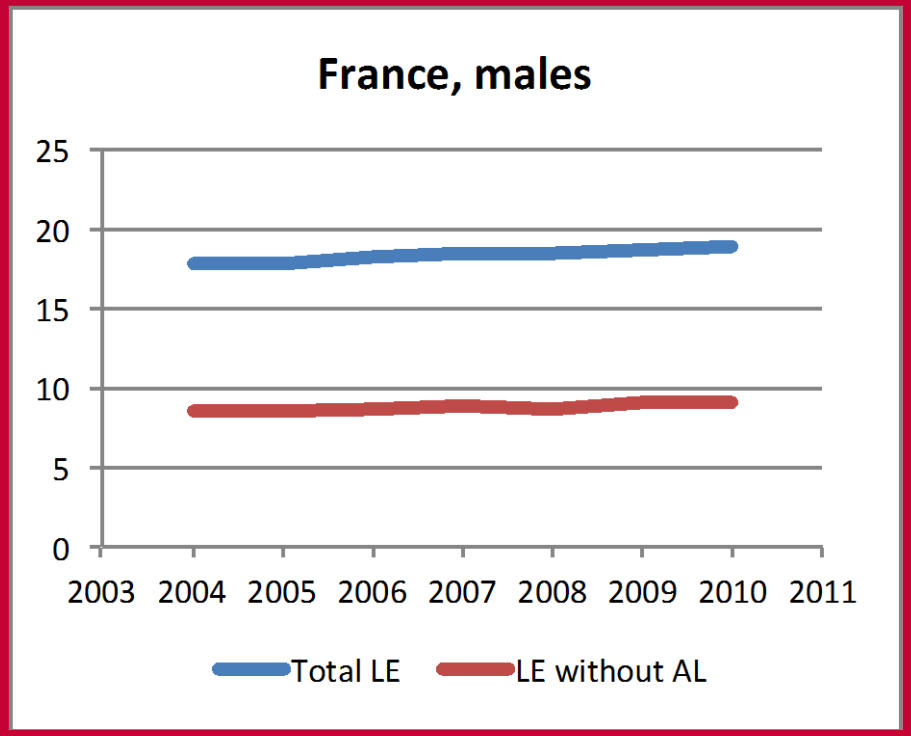
Trends in disability-free life expectancy at age 65 in Europe

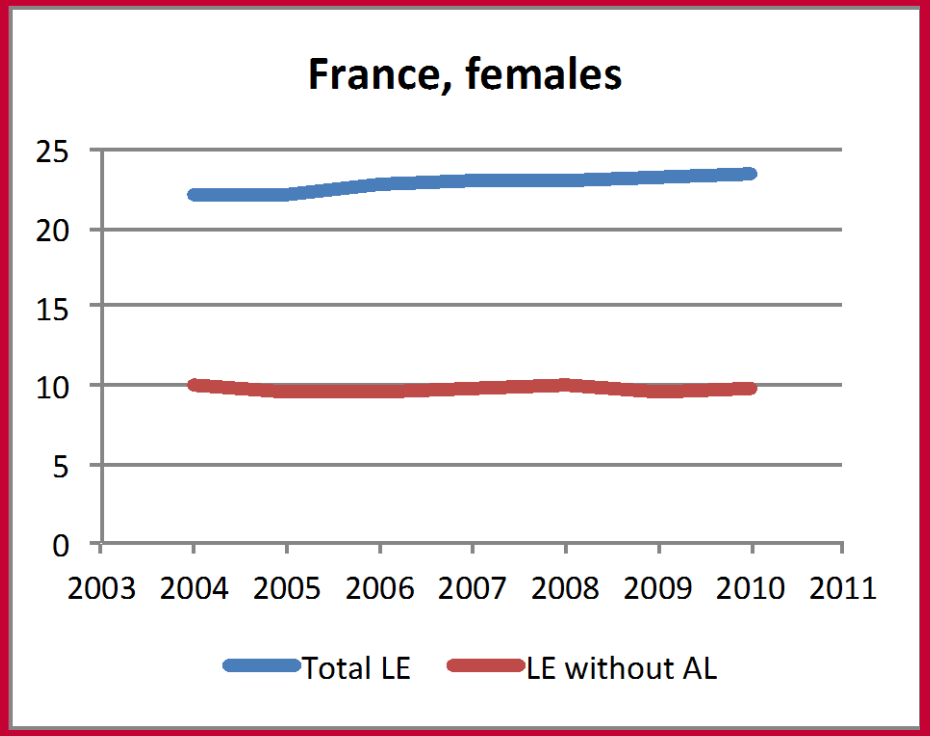
Compression of disability?



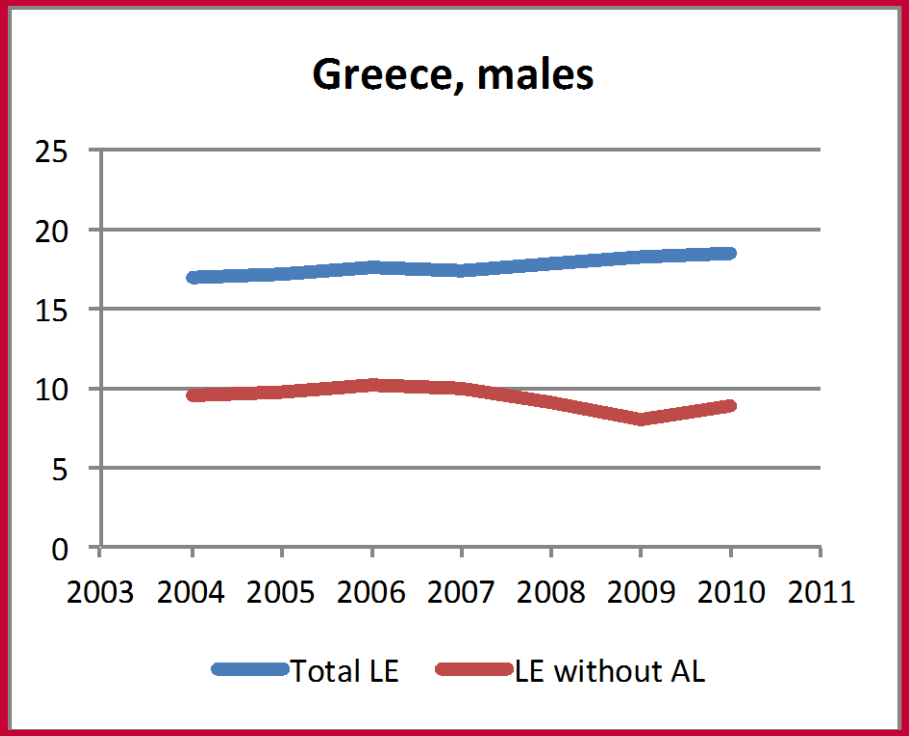


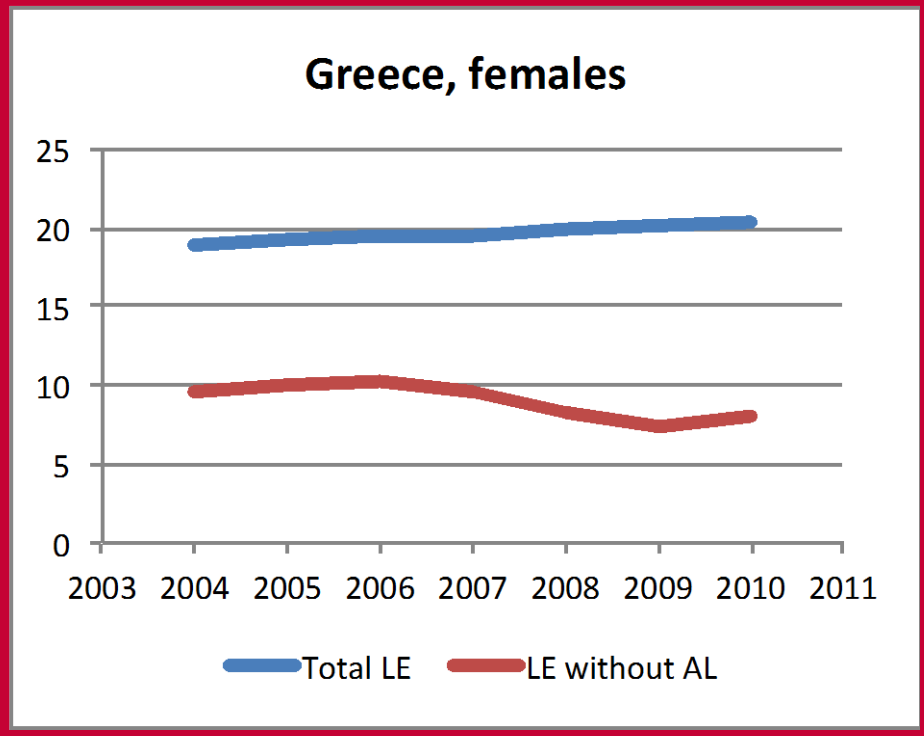
Dynamic equilibrium?





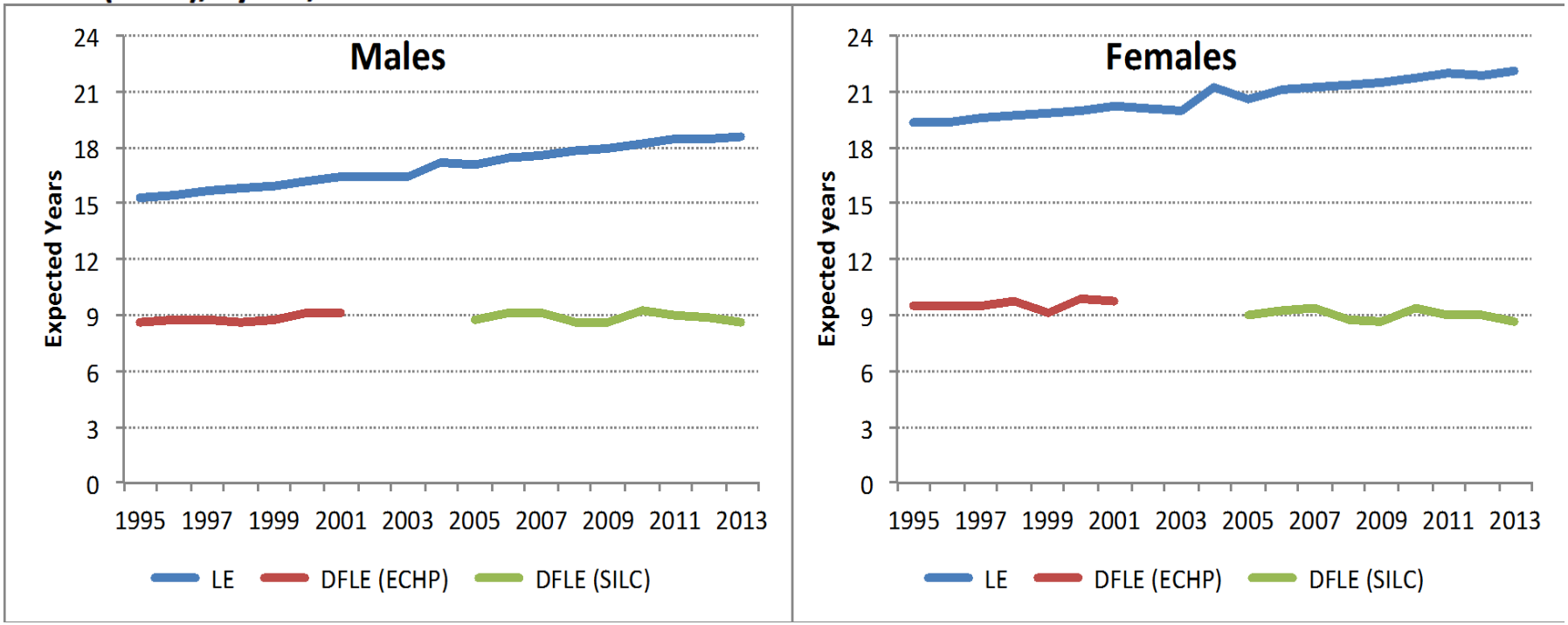
Expansion of disability?





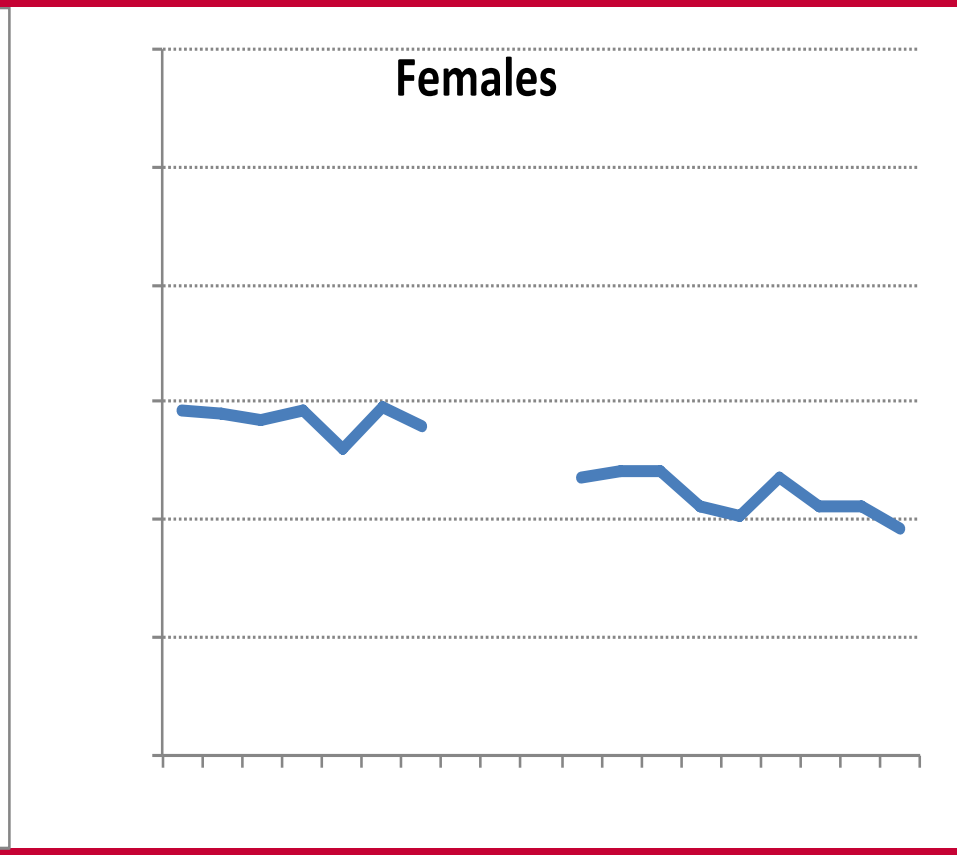
Life and HLY at age 65, EU15, 1995-2013

Life expectancy (LE) and disability-free life expectancy (DFLE) at age 65 in 15 members of the European Union (EU15), by sex, from 1995 to 2012



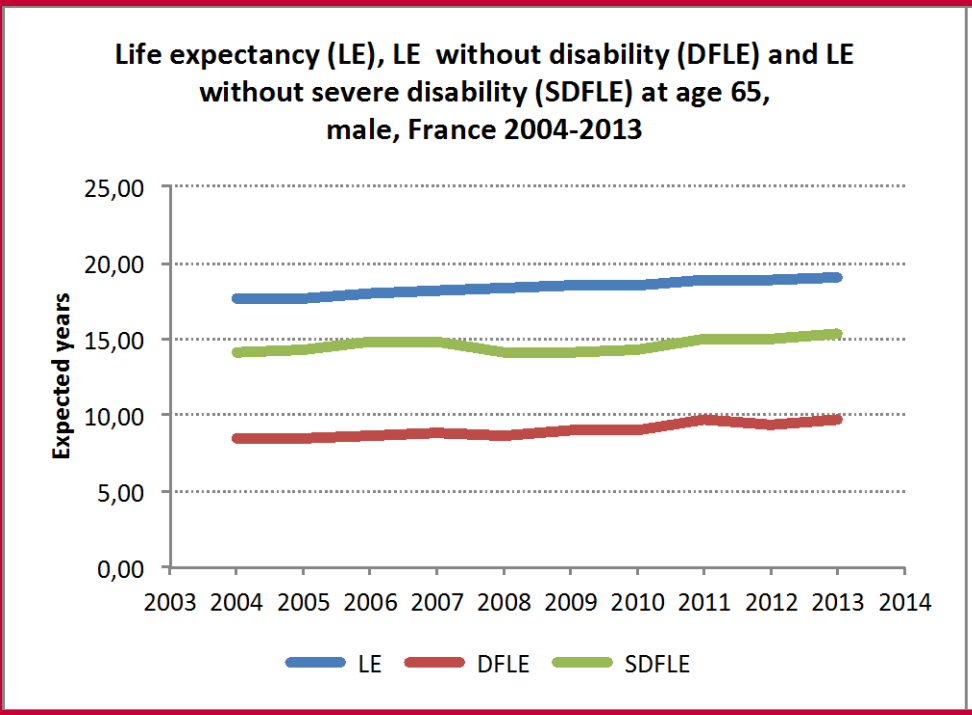
Note: Data on disability come the European Community Household Panel (ECHP) from 1995 to 2001 and from the European Statistics on Income and Living Conditions (EU-SILC) since 2005. No data are available for 2002-2004; Calculation: www.eurohex.eu

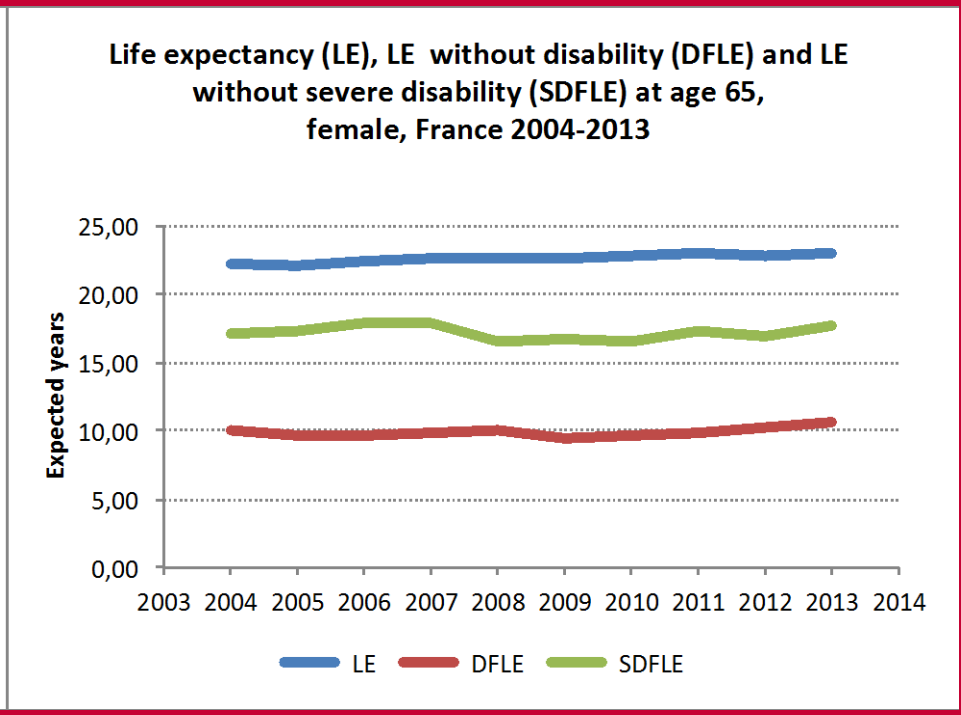
Proportion of life expectancy (LE) at age 65 free of disability, EU15, 1995-2013



Trends in France

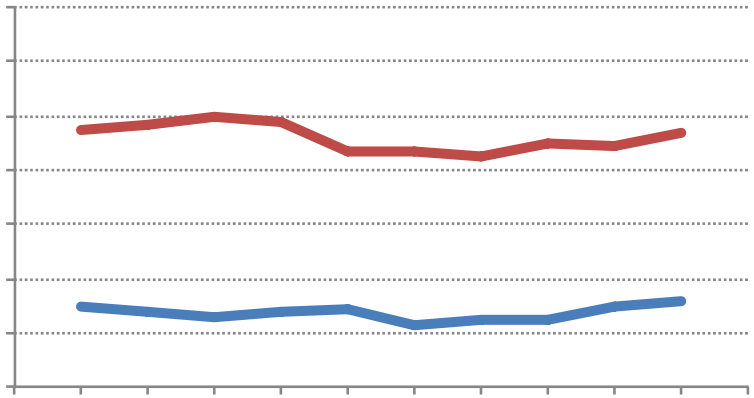
LE and HLY at age 65 in France, 2004-2013





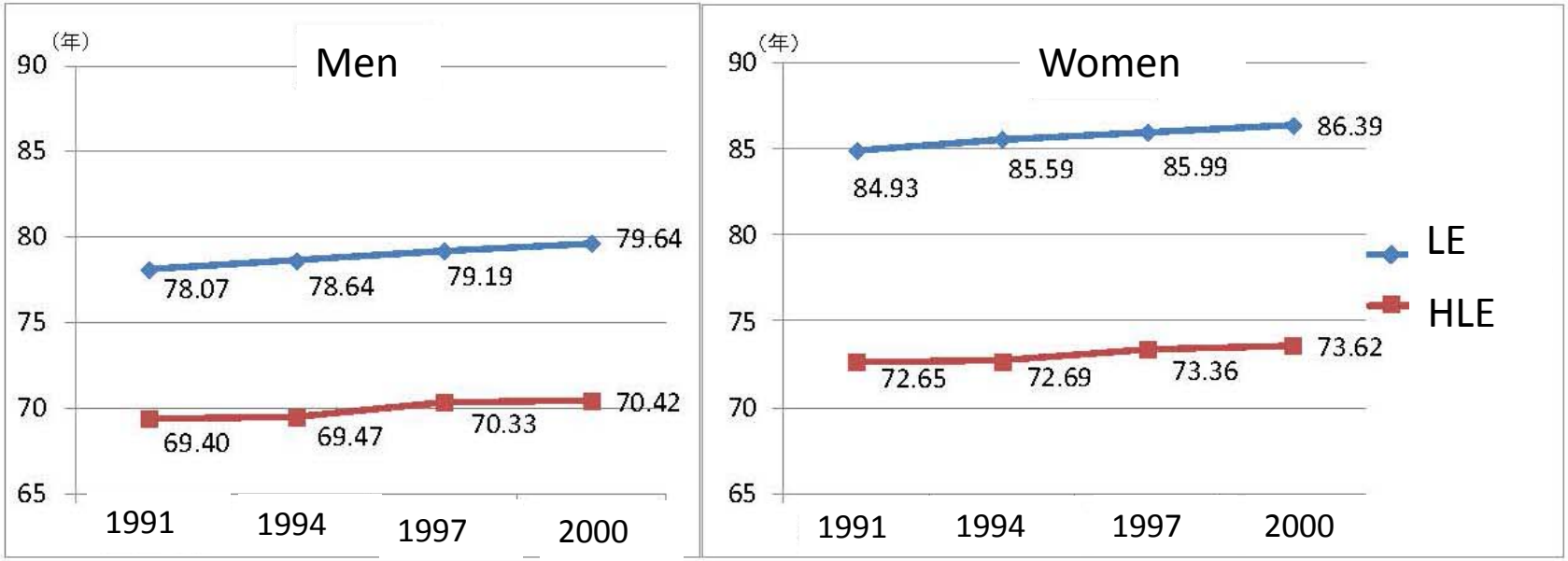
Proportion of life expectancy (LE) at age 65 free of disability,in France, 2004-2013

/LE%) at age 65, male, France 2004-2013



Trends in Japan and in the United States

Time trend of life expectancy (LE) and healthy life expectancy (HLE)

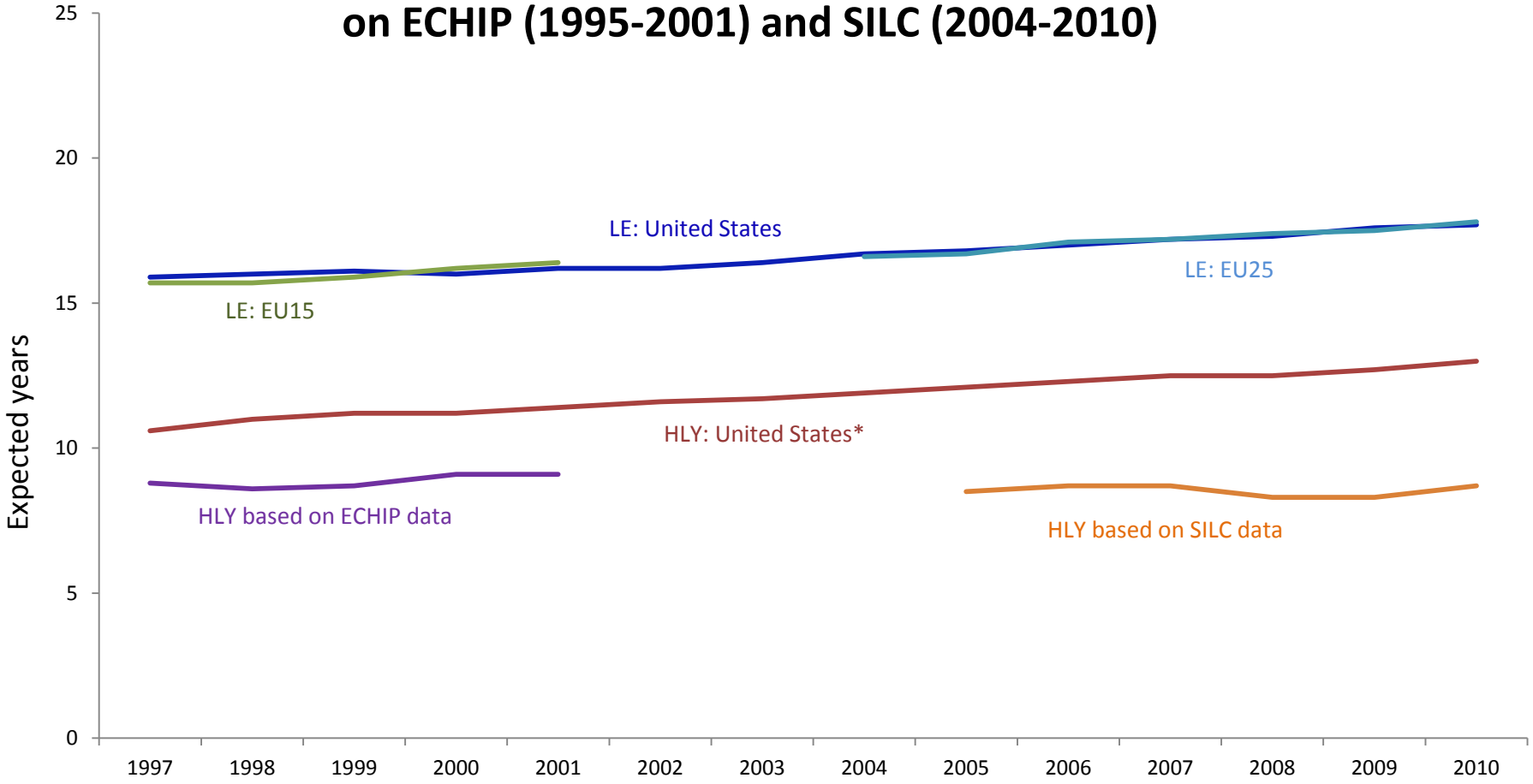


Source: LE (2000): The life table by the Ministry of Health, Labour and Welfare
HLE (2000): The Research Group about Healthy Life Expectancy

SOURCE: OJIMA, JA-EHLEIS, 2014

Official supplemental paper for Health Japan 21 (2nd edition)

Figure 1. Male Life Expectancy (LE) and Healthy Life Years (HLY) at age 65 for the U.S. based on NHIS (1997-2010)* and European Union (EU15 and EU25) based on ECHIP (1995-2001) and SILC (2004-2010)

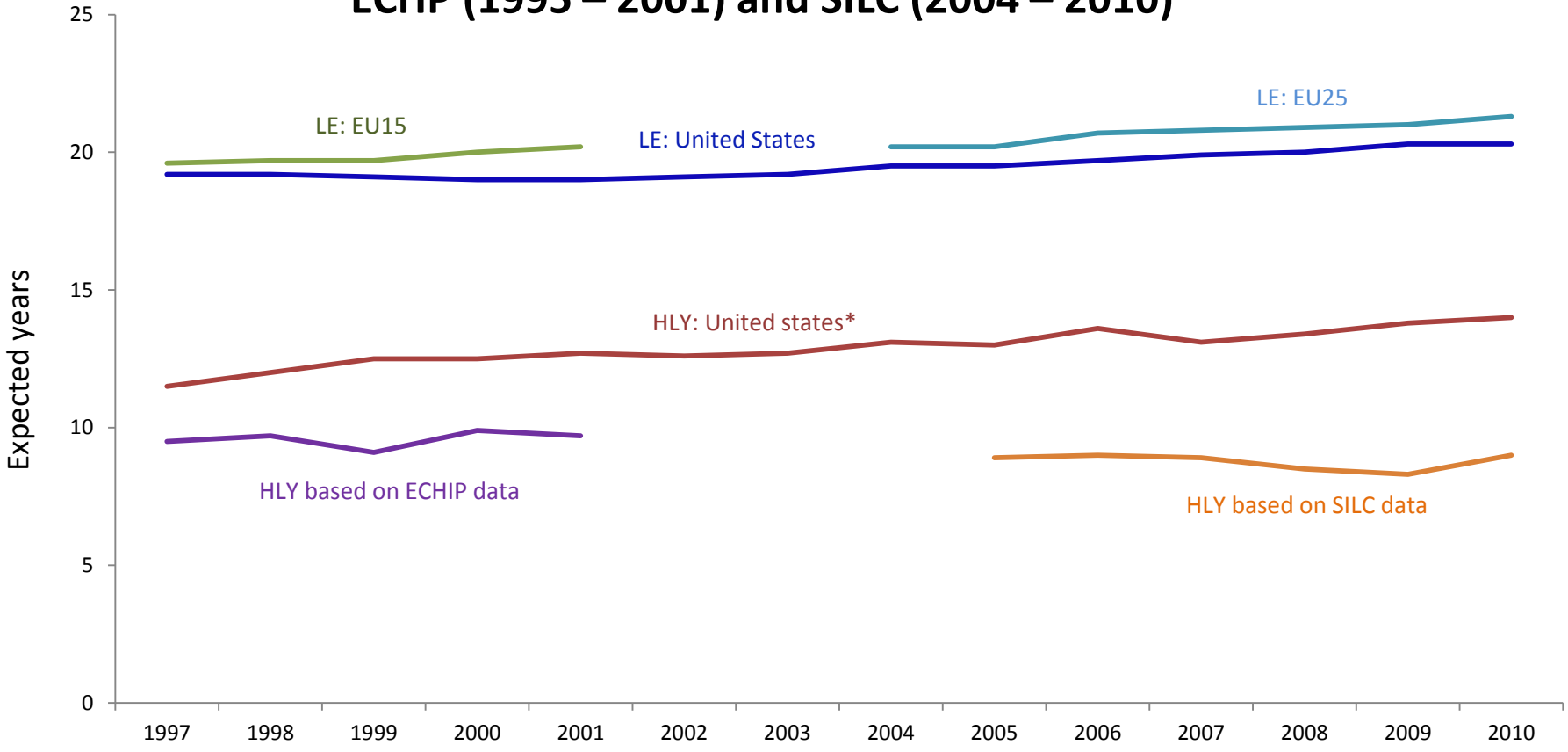


U. S.	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LE	15.9	16.0	16.1	16.0	16.2	16.2	16.4	16.7	16.8	17.0	17.2	17.3	17.6	17.7
HLY	10.6	11.0	11.2	11.2	11.4	11.6	11.7	11.9	12.1	12.3	12.5	12.5	12.7	13.0
% HLY/LE	66.5	68.5	69.9	70.1	70.5	71.7	71.5	71.4	72.2	72.4	72.5	72.2	71.9	73.2

* Based on responses to five activity limitation questions.

SOURCE: Madans JA-EHLEIS, 2014

Figure 1. Female Life Expectancy (LE) and Healthy Life Years (HLY) at age 65 for the U.S. NHIS (1997-2010)* and European Union (EU15 and EU25) based on ECHP (1995 – 2001) and SILC (2004 – 2010)

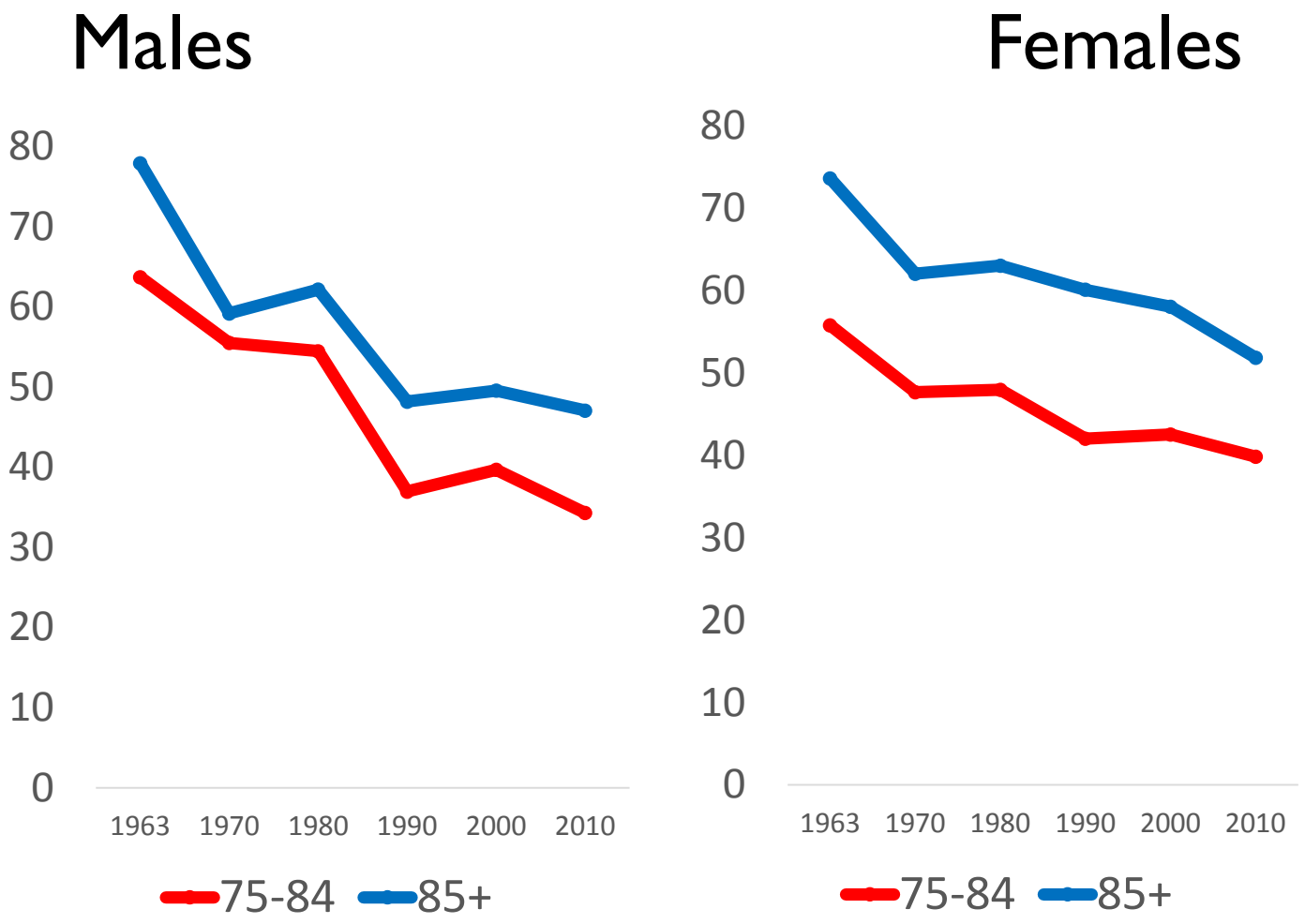


U. S.	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
LE	19.2	19.2	19.1	19.0	19.0	19.1	19.2	19.5	19.5	19.7	19.9	20.0	20.3	20.3
HLY	11.5	12.0	12.5	12.5	12.7	12.6	12.7	13.1	13.0	13.6	13.1	13.4	13.8	14.0
% HLY/LE	60.1	62.4	65.3	66.0	66.5	66.1	66.3	67.3	66.6	68.9	65.8	67.2	67.9	68.8

* Based on responses to five activity limitation questions.

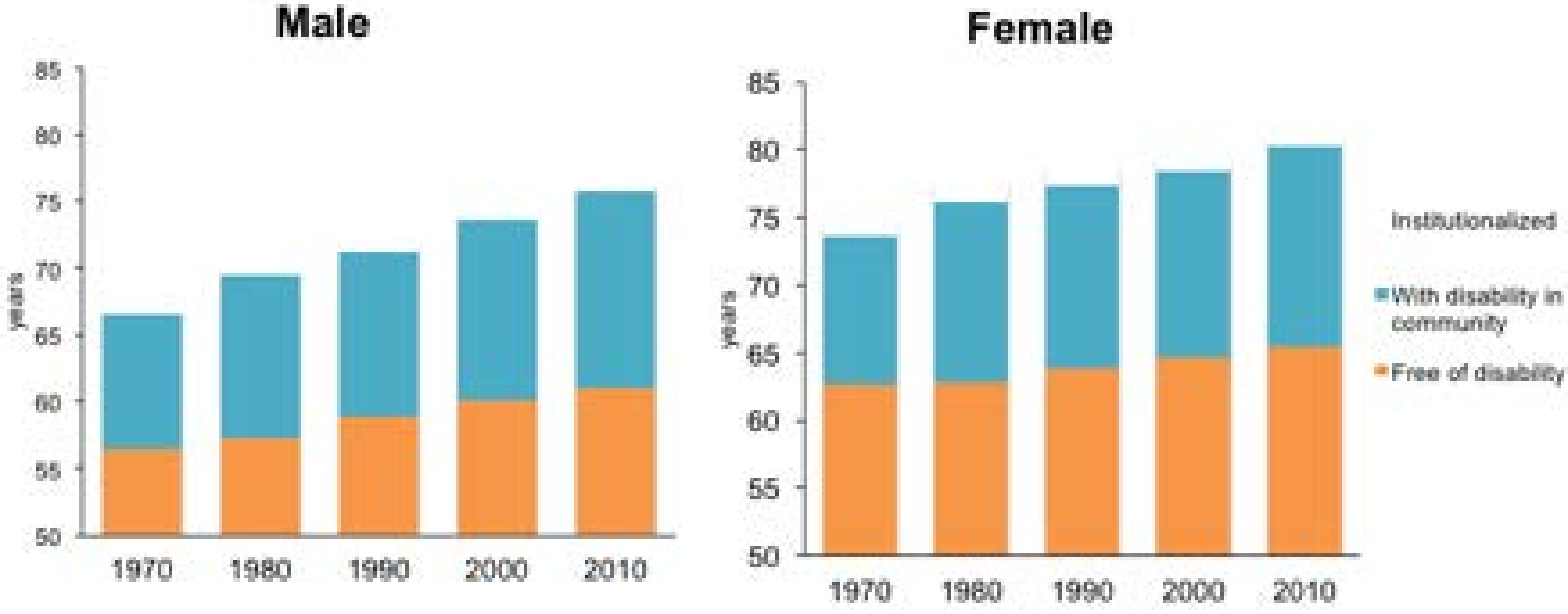
SOURCE: Madans JA-EHLEIS, 2014

Long Term Improvement in Less Severe Disability: Percent With Any Activity Limitation (USA, 1963 -2010)



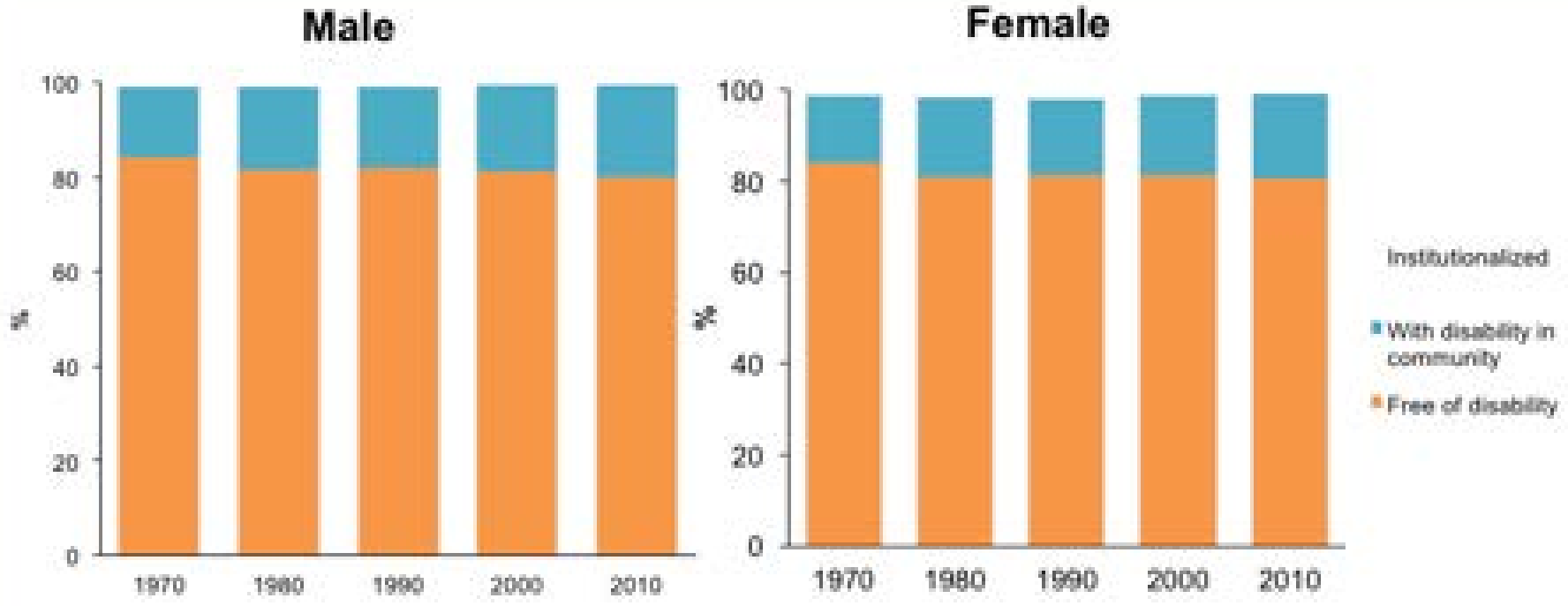
SOURCE: Crimmins, GSA, 2014

LE, DFLE at birth United States, 1970-2010



Sources: Crimmins, Zhang and Saito, 2015

Proportion of life expectancy (LE) at birth free of disability, United States, 1970-2010



Sources: Crimmins, Zhang and Saito, 2015

Trends in prevalence of dementia

Decline in the prevalence of dementia

Selected Recent Studies of the Dementia Epidemic.

Study	Outcome	Data Source	Key Findings	Factors
Manton et al. (United States)[1]	Prevalence of severe cognitive impairment	National long-term care survey interviews, 1982–1999	Decline in dementia prevalence among people ≥65 yr of age (5.7% to 2.9%)	Higher educational level, decline in stroke incidence
Langa et al. (United States)[2]	Prevalence of cognitive impairment	Ongoing population-based survey of people ≥51 yr of age	Prevalence of cognitive impairment among people ≥70 yr of age (12.2% in 1993 vs. 8.7% in 2002)	Higher educational level; combination of medical, lifestyle, demographic, and social factors
Schrijvers et al. (Rotterdam)[3]	Incidence of dementia	Population-based cohort ≥55 yr of age in 1990, extended in 2000	Incidence rate ratios (6.56 per 1000 person-yr in 1990 vs. 4.92 per 1000 person-yr in 2000)	Higher educational level, reduction in vascular risk, decline in stroke incidence
Qiu et al. (Stockholm)[4]	Prevalence of DSM-III-R dementia*	Cross-sectional survey of people ≥75 yr of age, 1987–1989 and 2001–2004	Age- and sex-standardized dementia prevalence (17.5% in 1987–1989 vs. 17.9% in 2001–2004); lower hazard ratio for death in later cohort suggests decreased dementia incidence	Favorable changes in risk factors, especially vascular risk; healthier lifestyles
Matthews et al. (England)[5]†	Prevalence of dementia in 3 regions	Survey interviews of people ≥65 yr of age, 1989–1994 (in CFAS I) and 2008–2011 (in CFAS II)	Dementia prevalence (8.3% in CFAS I vs. 6.5% in CFAS II)	Higher educational level, better prevention of vascular disease

* In the study by Qiu et al., dementia was diagnosed according to the criteria provided in the *Diagnostic and Statistical Manual of Mental Disorders*, third edition, revised (DSM-III-R).

† CFAS denotes Cognitive Function and Ageing Study.

Larson et al, *NEJM* 2013

Discussion

- Japanese experienced an exceptional increase both in total and disability free life expectancy.
- The United States experiences a slow increase in life expectancy but a parallel increase in disability free life expectancy.
- The European Union experienced a strong increase in life expectancy and an almost stagnation in disability free life expectancy.

Thank you for your attention!

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WWTF/City of Vienna: Wien Kultur Summer School 2016

The Demography of Health and Education

Wittgenstein Centre
Summer School 2016

The Demography of Health and Education

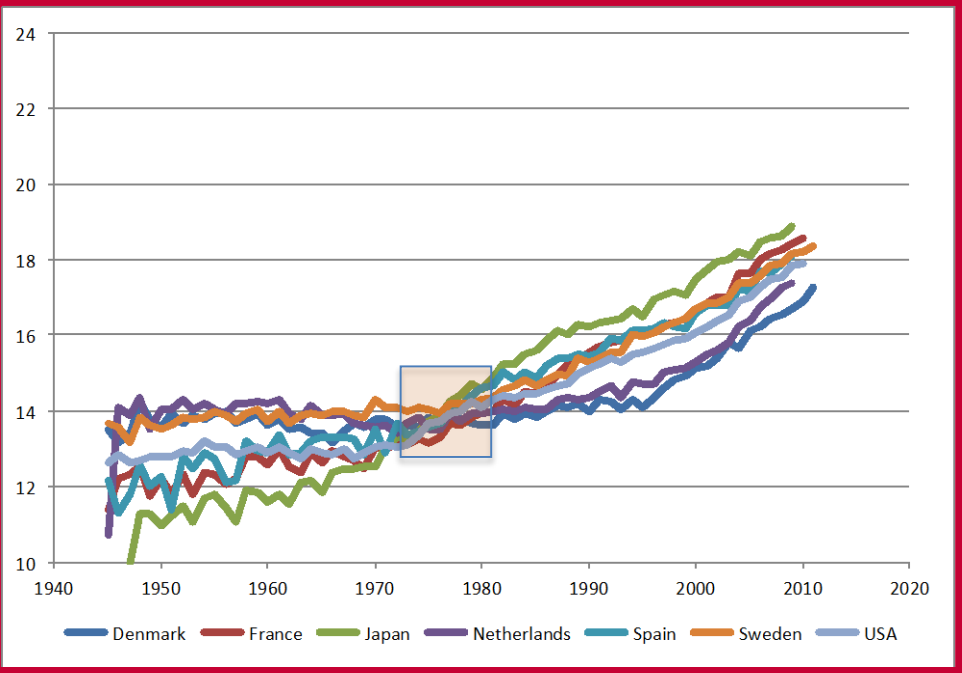
Is disability-free life expectancy stagnant or increasing?

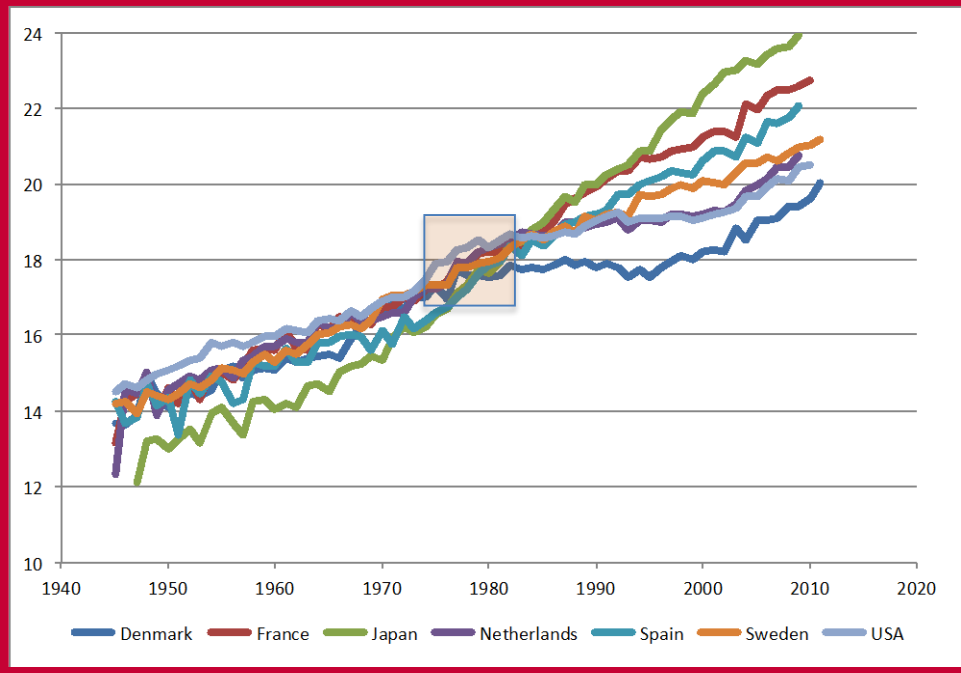
Jean-Marie Robine

INSERM – EPHE, Paris and Montpellier, France

Divergence and variability

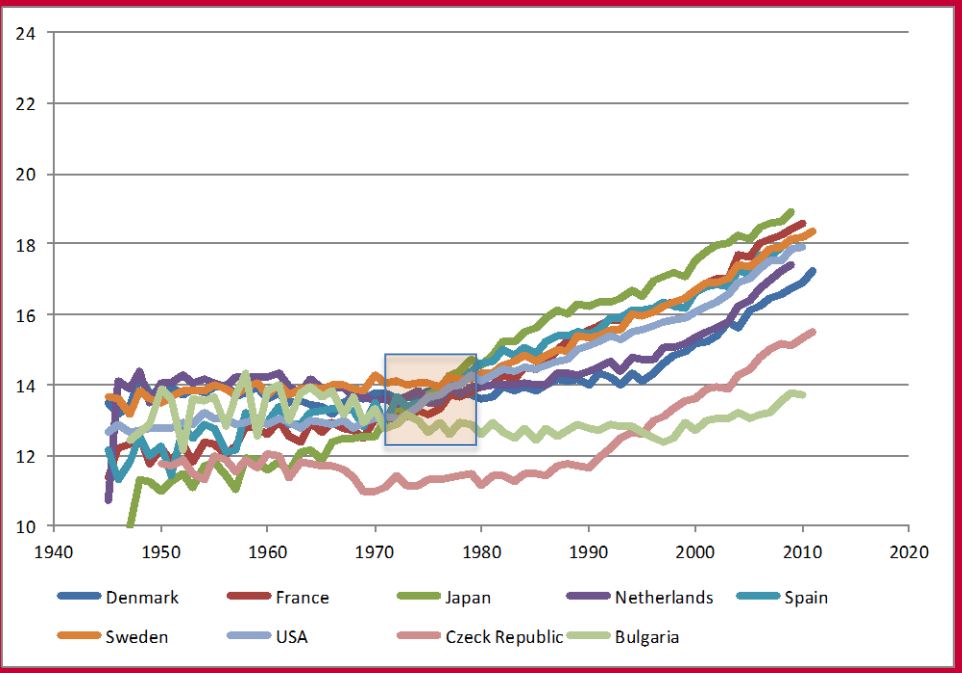
Trends in life expectancy at age 65

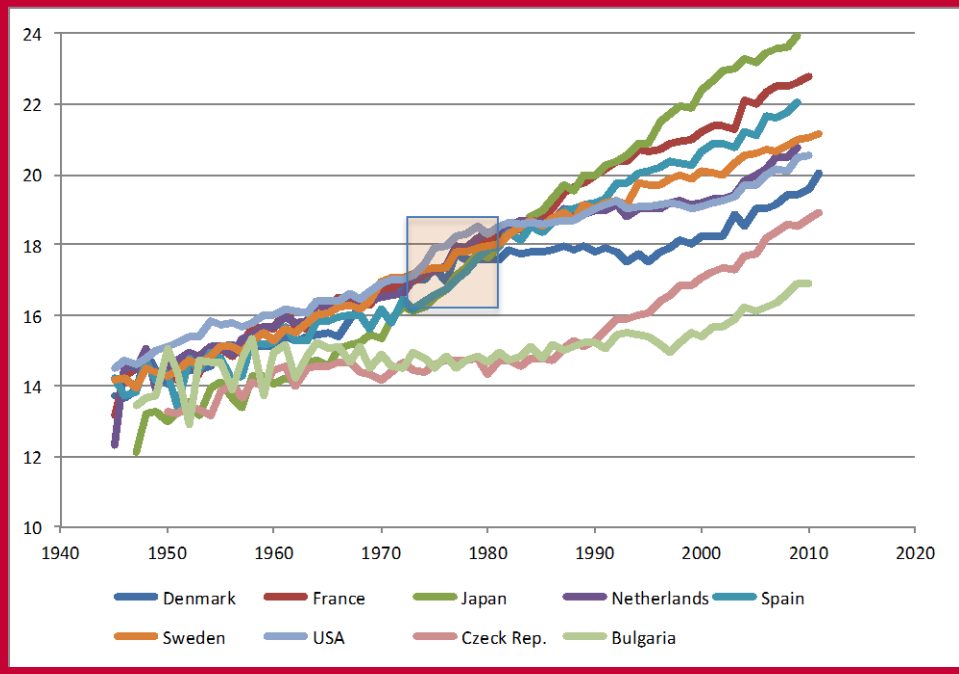




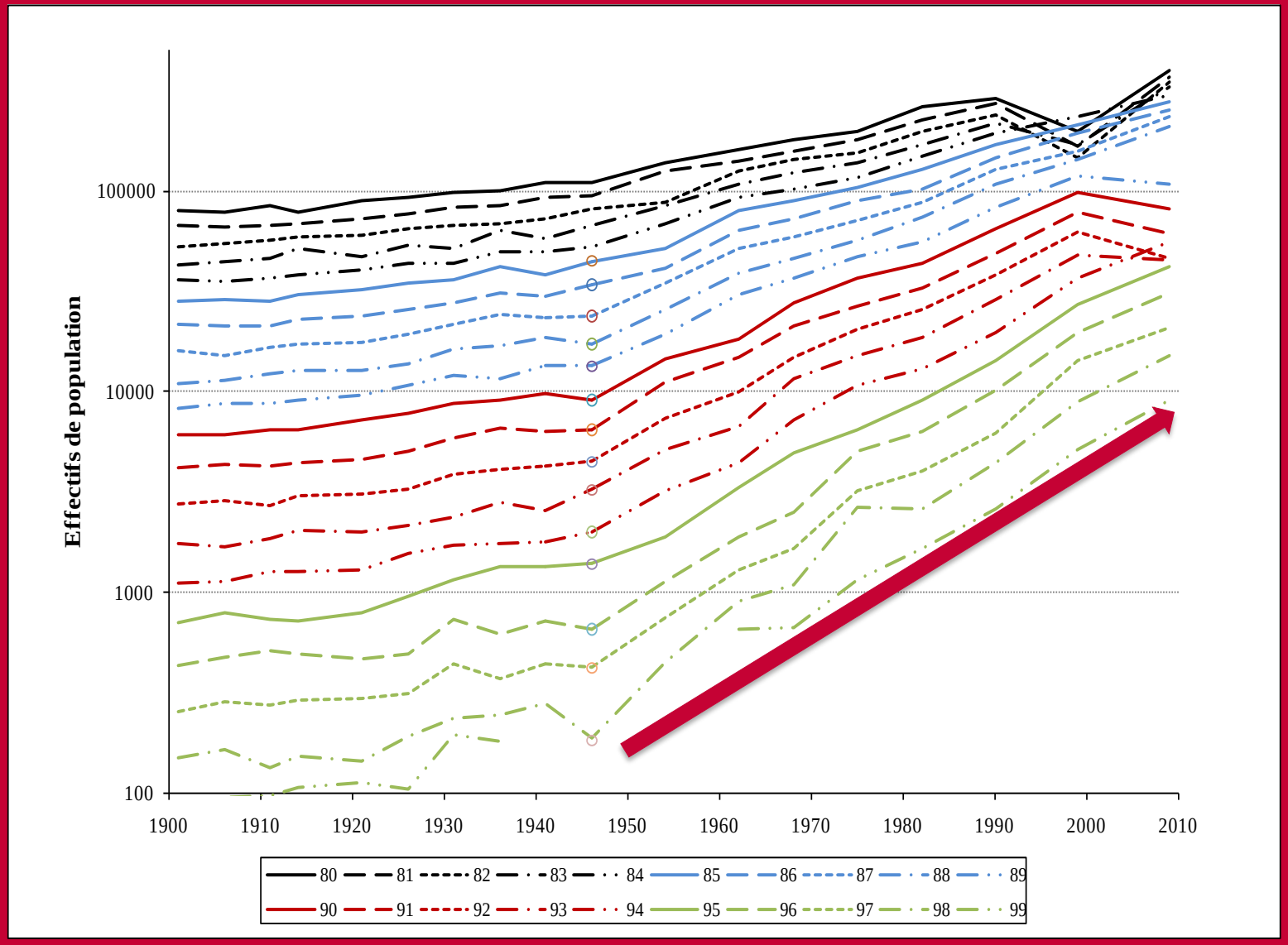
Denmark, the United States and the Netherlands

Trends in life expectancy at age 65

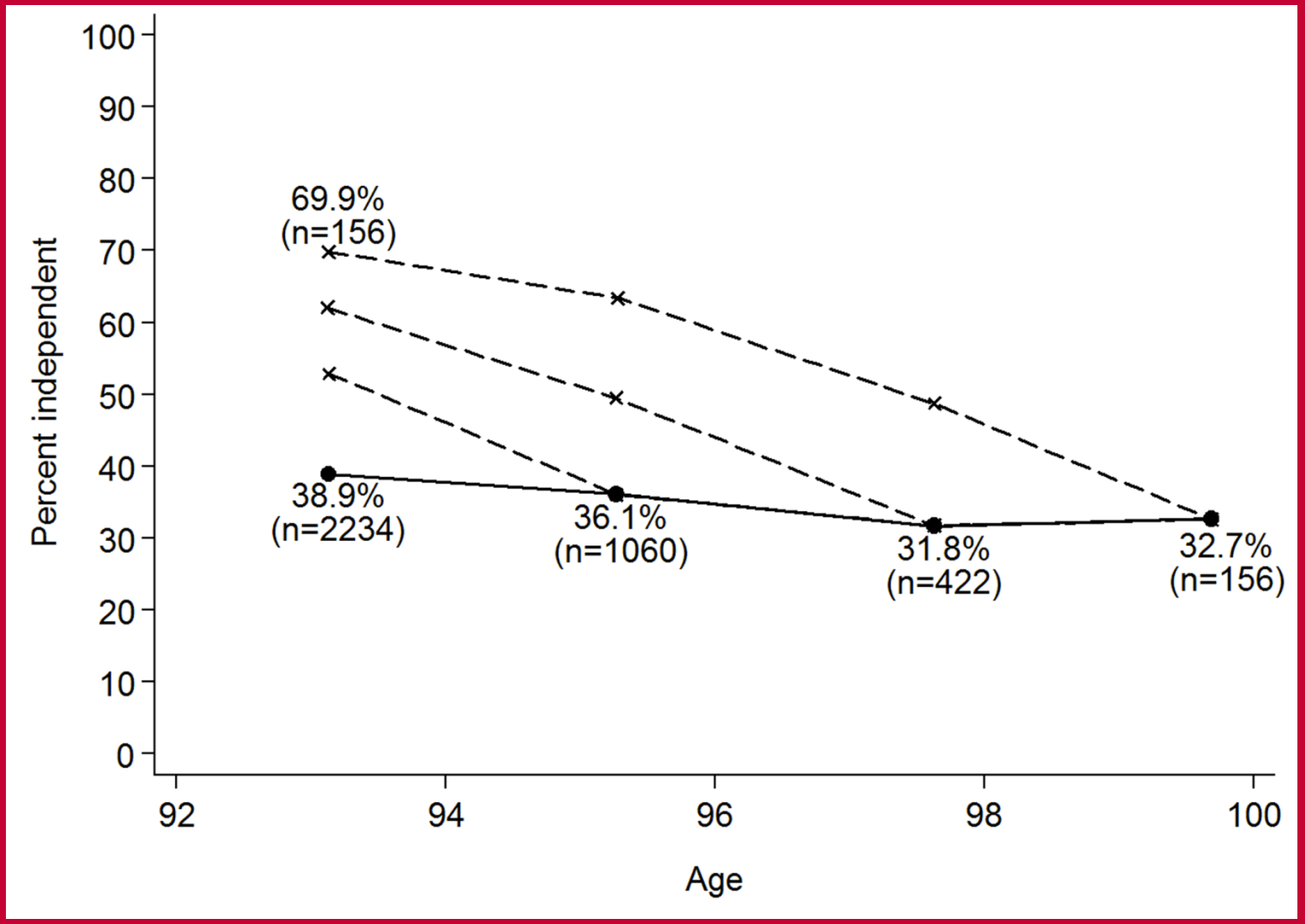




Number of oldest old in France by single age, 80 years and over

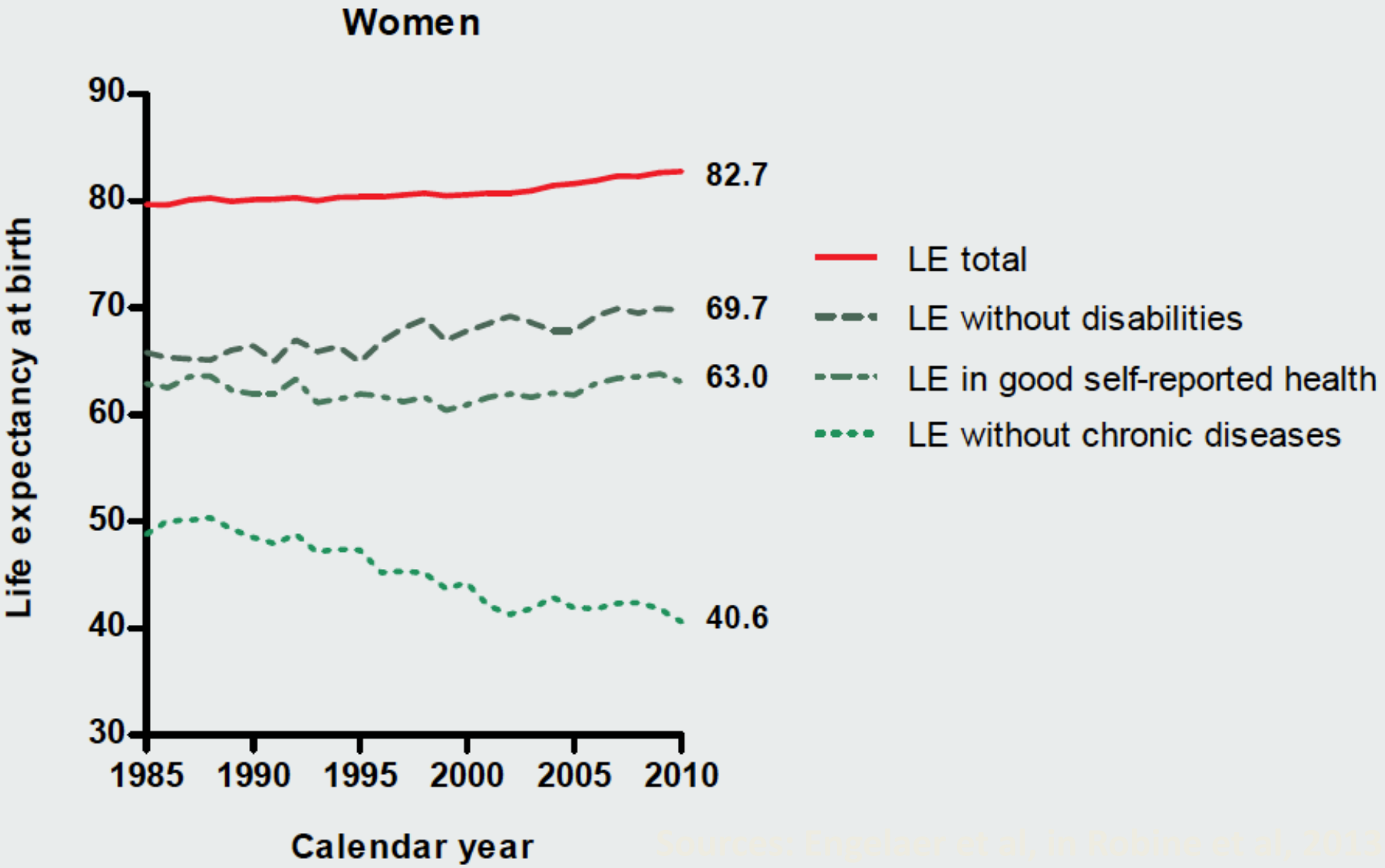


Percentages of the Danish born in 1905 classified as independent at four assessments in the period 1998–2005



Christensen et al, PNAS, 2008

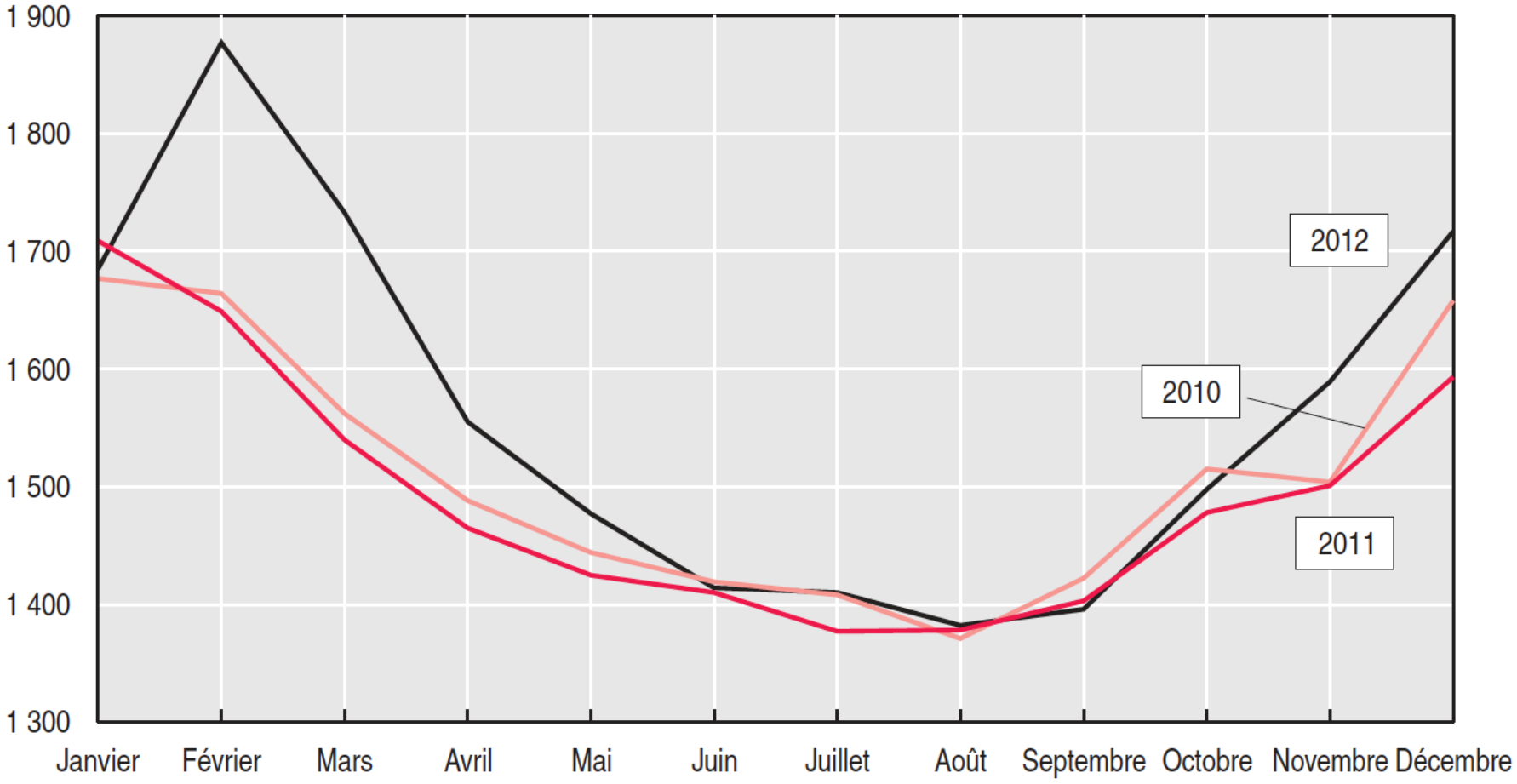
Netherlands, 1985-2010



Sources: Engelaer et al, Jagger et al, 2013

Daily number of deaths: France, 2010-2012

② **Nombre de décès par jour, selon le mois**



Champ : France hors Mayotte.

Source : Insee, estimations de population et statistiques de l'état civil.

Insee Première, N° 1429 - JANVIER 2013