Demographic, Economic and Financial Perspectives, 2006-2030

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Changes in life expectancy in Quebec: Recent trends and perspectives

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*The author wishes to thank Ramana Zanfongnon and Karine Garneau, Masters' students in demography for their collaboration

Presentation Outline

- Significant changes in life expectancy at birth and at age 65
- Sex differential in life expectancy
- Mortality at older ages
- Improved quantity and quality of life: where does healthy life expectancy stand?
- Mortality projections, 2003-2056

Section 1

Life expectancy at birth and at age 65: Quebec, Canada and international comparisons

Sources:

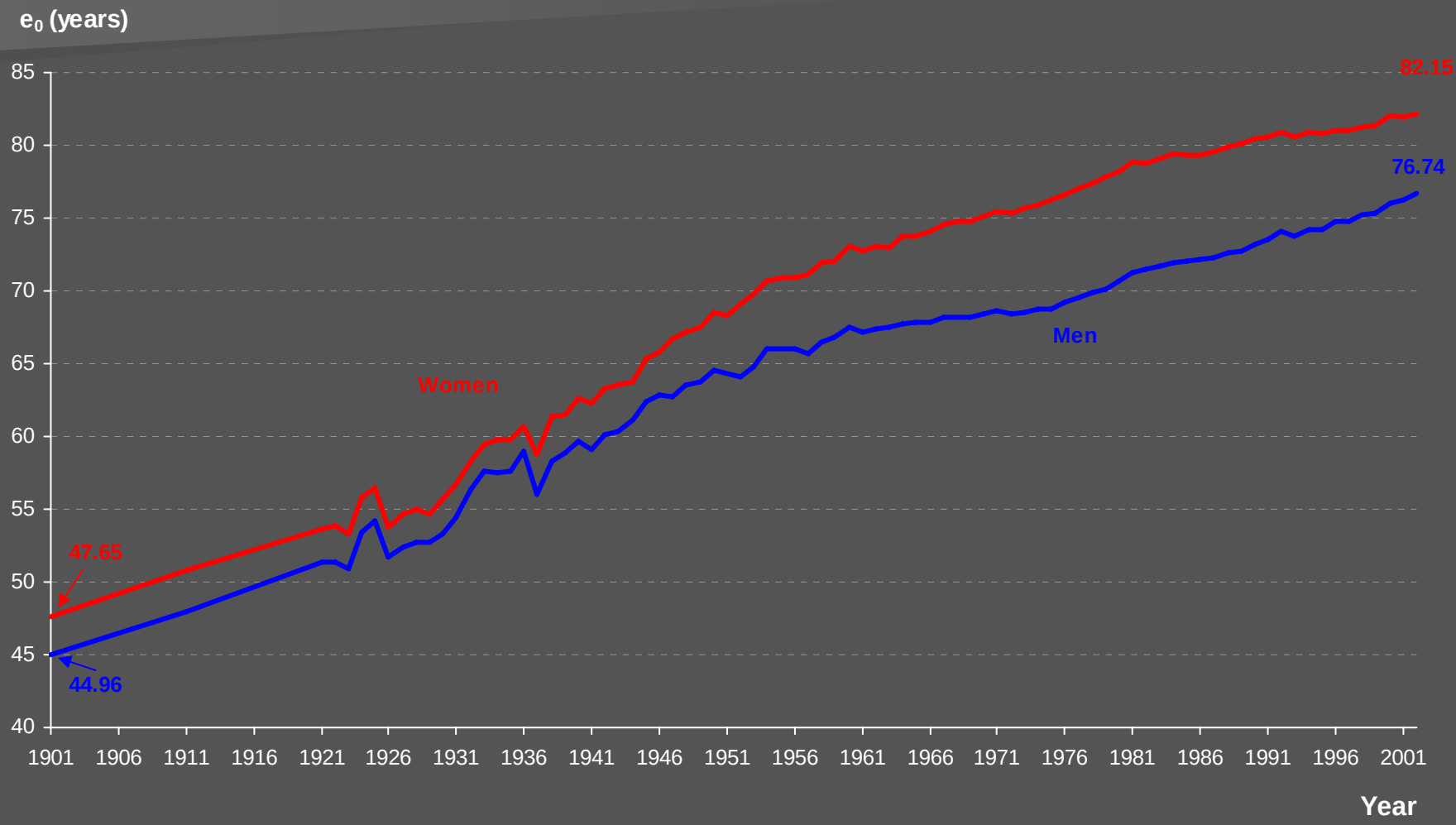
CHMD: Canadian Human Mortality Database (www.bdlc.umontreal.ca/chmd)

HMD: Human Mortality Database (www.mortality.org)

ISQ: Institut de la statistique du Québec (www.stat.gouv.qc.ca)

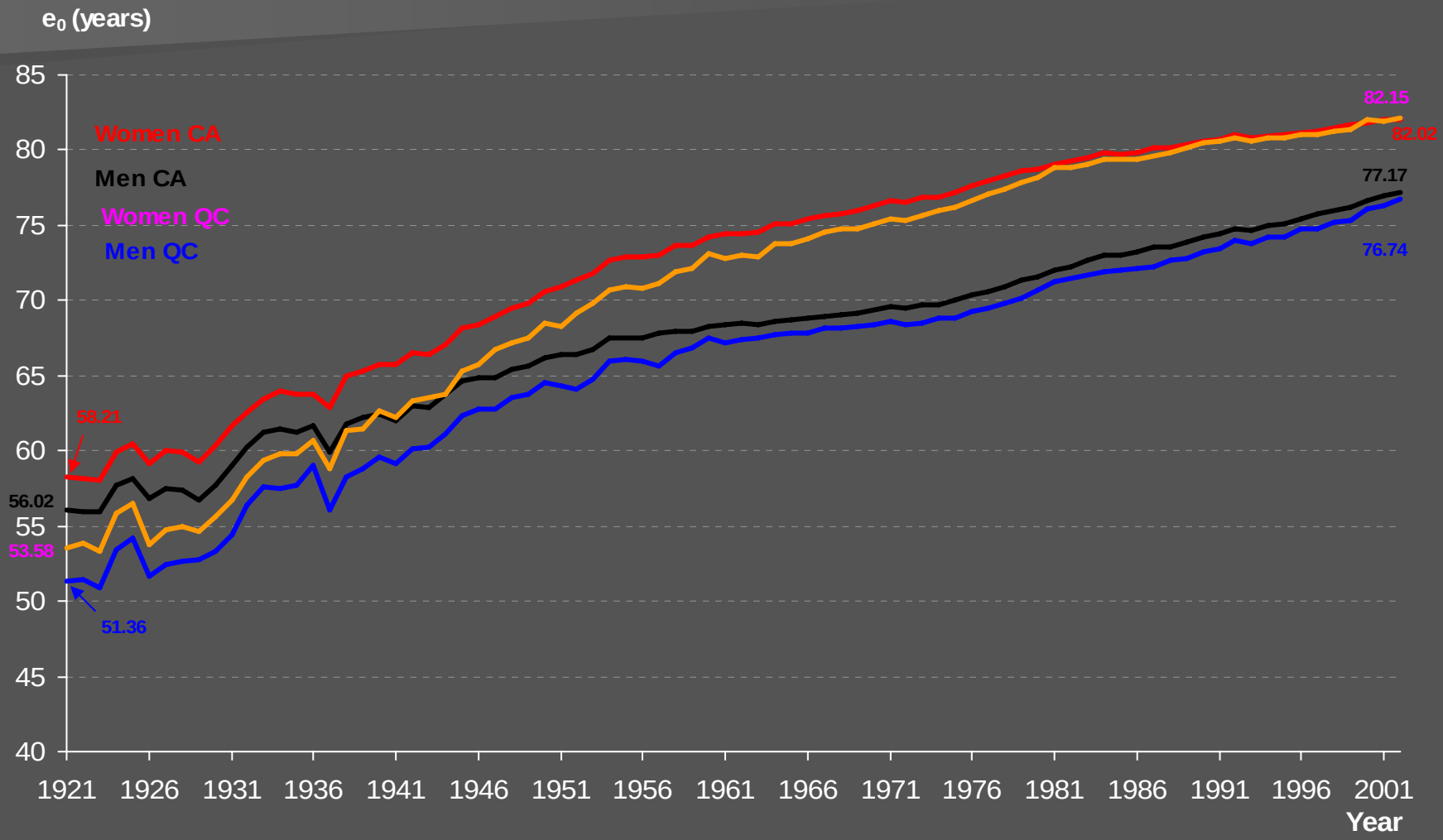
SC: Statistics Canada (www.statcan.ca)

Life expectancy at birth (e_0) by sex, Quebec, 1901-2002



Sources: 1901 and 1911 : Bourbeau et al., 1997; 1921 to 2000: CHMD; 2001-2002: ISQ

Life expectancy at birth (e_0) by sex, Quebec and Canada, 1921-2002



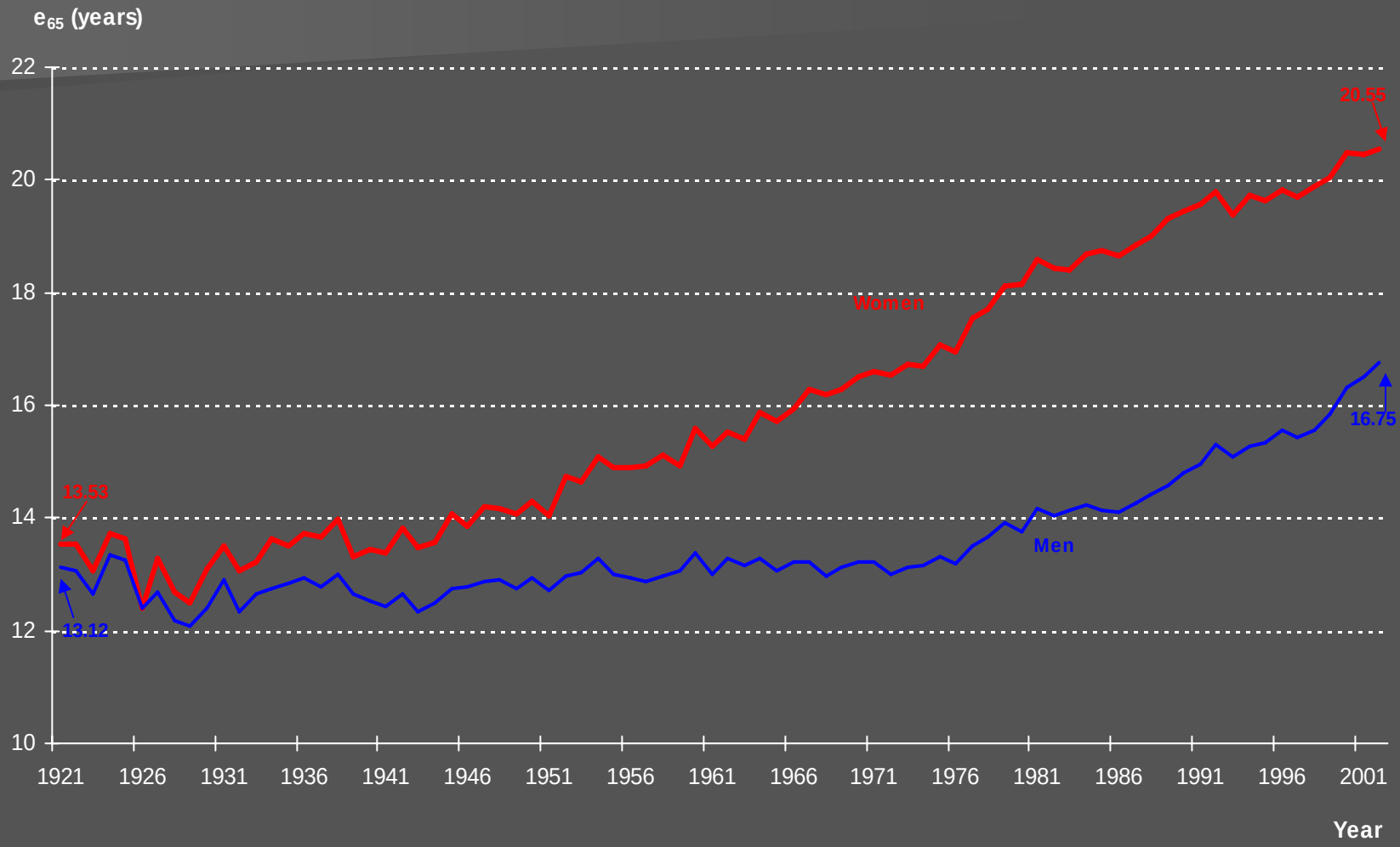
Sources: 1921 to 2000: CHMD; 2001-2002, Canada: HMD. 2001-2002, Quebec: ISQ

International comparison of life expectancy at birth (e_0) by sex, 2002

Country	Women	Country	Men
Japan	85.22	Iceland	78.52
Spain	83.10	Japan	78.34
Switzerland	83.03	Australia	77.78
France	83.00	Switzerland	77.77
Italy	82.97	Sweden	77.71
Australia	82.70	Canada	77.17
Iceland	82.34	Italy	77.10
Quebec*	82.15	Quebec*	76.74
Sweden	82.09	Norway	76.40
Canada	82.02	England/Wales	76.21
Austria	81.64	France	75.73
Norway	81.46	Spain	75.70
England/Wales	80.74	Austria	75.68
United States	79.78	United States	74.54

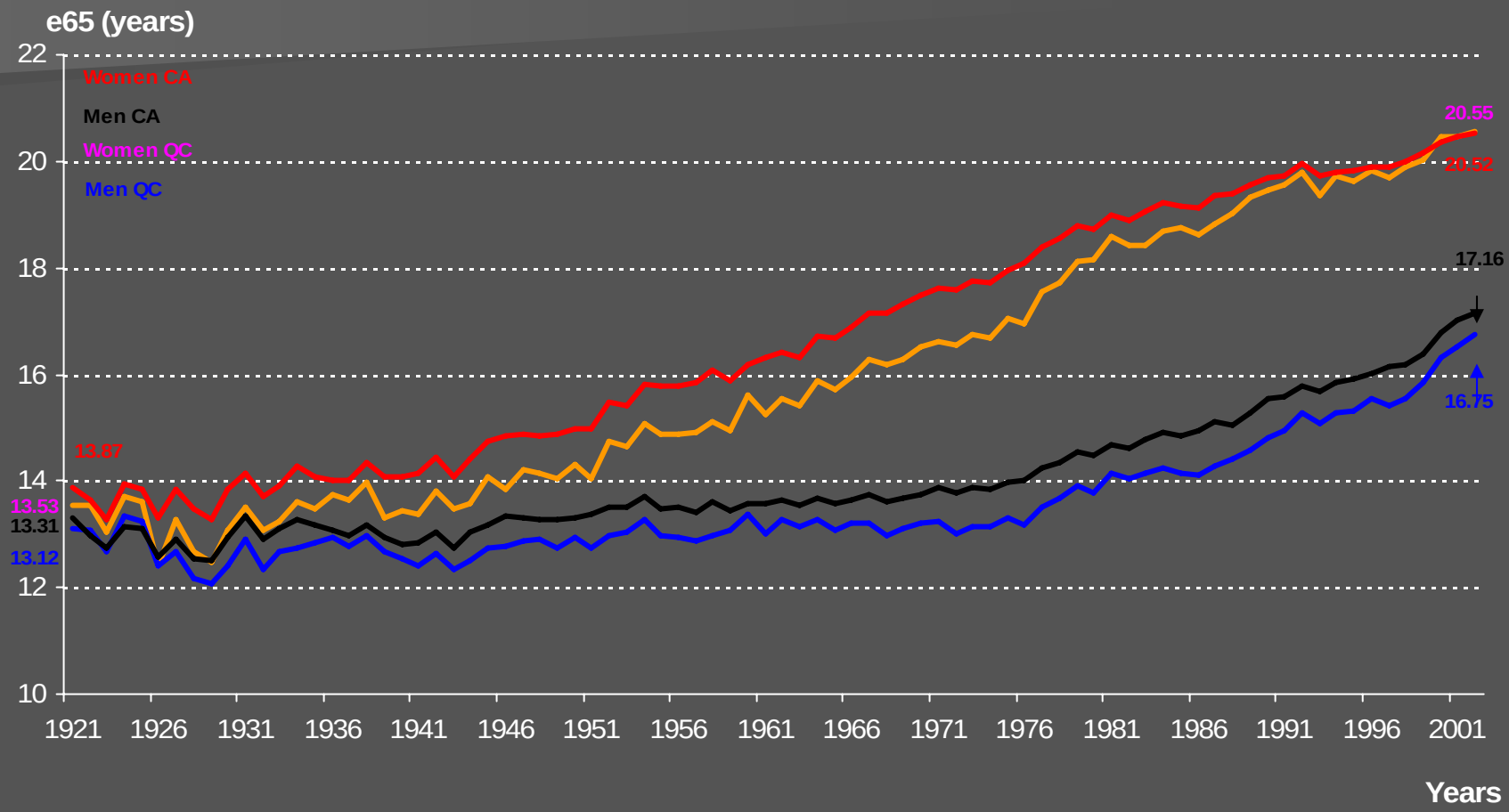
Sources: HMD; * ISQ

Life expectancy at age 65 (e_{65}) by sex, Quebec, 1921-2002



Source: 1921-2000: CHMD; 2001-2002: ISQ

Life expectancy at age 65 (e_{65}) by sex, Quebec and Canada, 1921-2002



Sources: 1921-2000: CHMD; 2001-2002: ISQ; 2001-2002, Canada: HMD

International comparison of life expectancy at age 65 (e_{65}), 2002

Country	Women	Country	Men
Japan	22.95	Japan	17.98
France	21.39	Iceland	17.61
Switzerland	21.06	Australia	17.58
Australia	20.88	Switzerland	17.48
Spain	20.87	Canada	17.16
Italy	20.84	France	17.05
Iceland	20.61	Italy	16.92
Quebec*	20.55	Sweden	16.88
Canada	20.52	Spain	16.83
Sweden	20.00	Quebec*	16.75
Austria	19.76	United States	16.56
Norway	19.74	England/Wales	16.26
United States	19.43	Austria	16.25
England/Wales	19.23	Norway	16.21

Sources: HMD; *ISQ

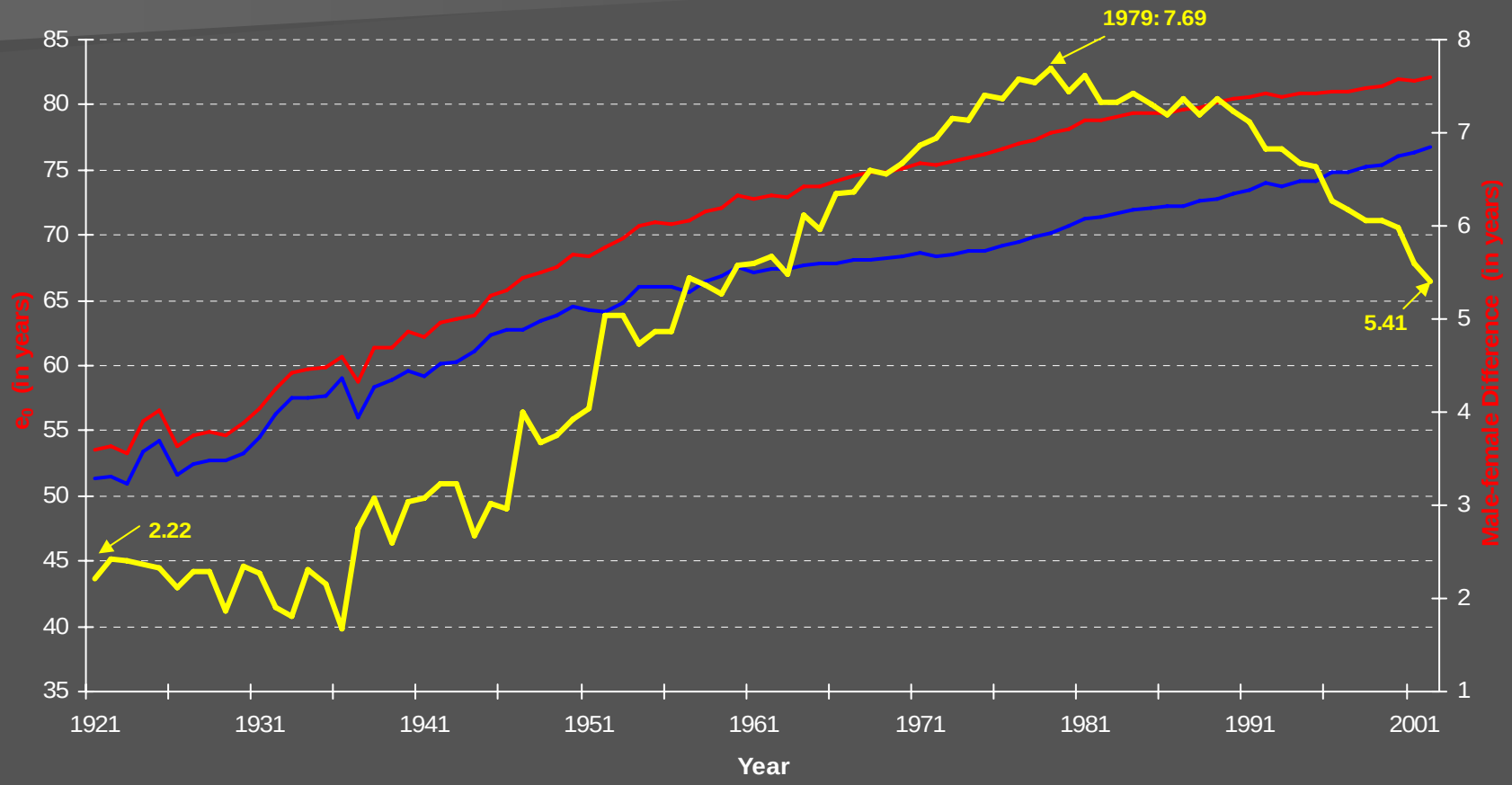
International comparison of average annual growth in life expectancy at age 65 for various observation periods

	Japan		France		Sweden		Italy		Canada		Quebec	
Periods	W	M	W	M	W	M	W	M	W	M	W	M
1992-2002	1.14	0.89	0.45	0.69	0.35	0.78	0.74	0.93	0.26	0.79	0.35	0.87
1992-1997	1.06	0.71	0.41	0.48	0.54	0.73	0.64	0.69	-0.04	0.37	-0.08	0.14
1997-2002	0.96	0.89	0.41	0.76	0.10	0.67	0.69	0.97	0.52	1.05	0.73	1.44
2000-2002	0.80	0.88	0.25	0.66	-0.12	0.38	0.60	0.75	0.28	0.75	0.13	0.90

Section 2

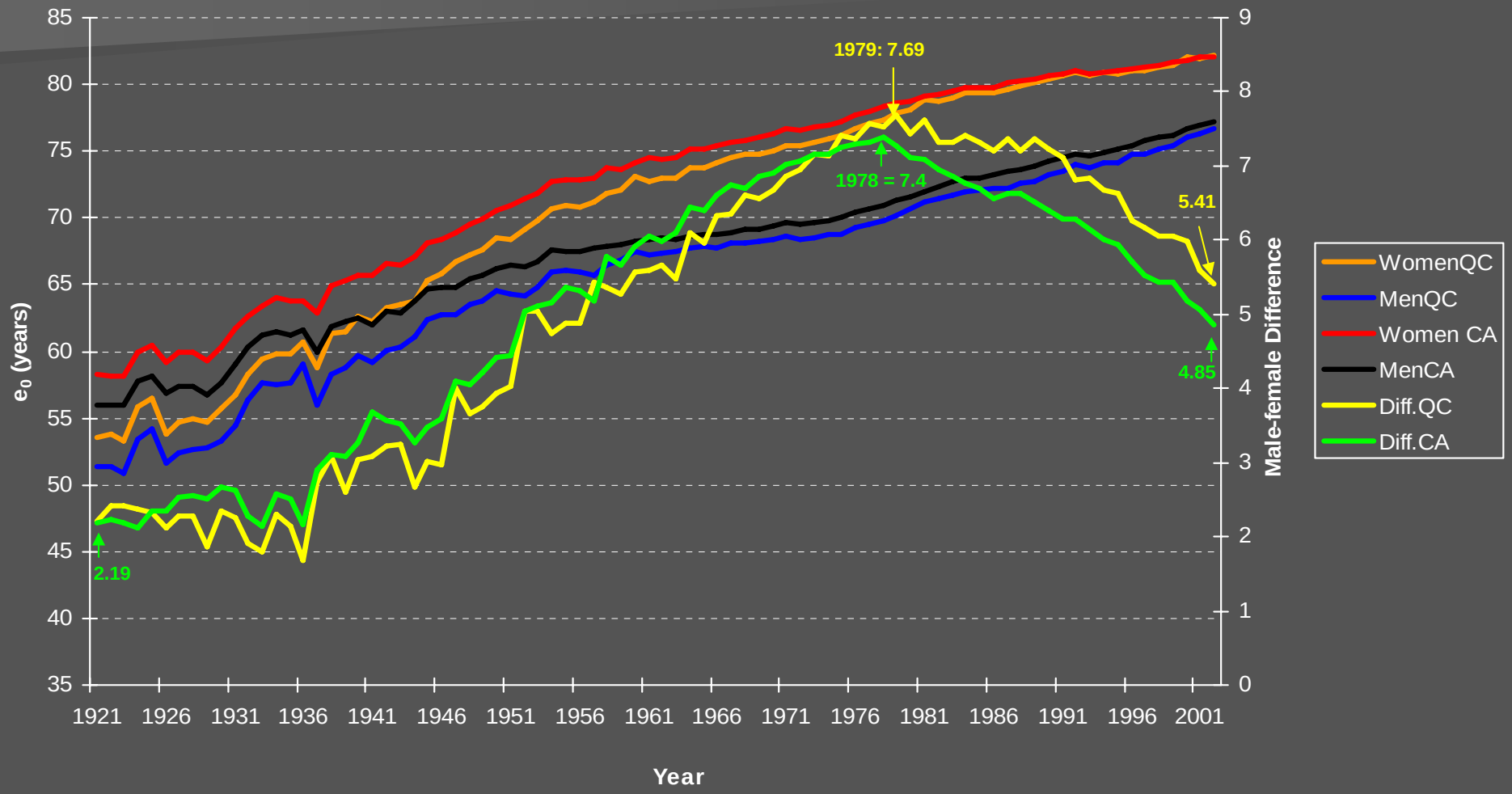
Life expectancies at birth and at age 65: Sex differential changes by region

Life expectancy at birth (e_0) by sex and male-female difference, Quebec, 1921-2002



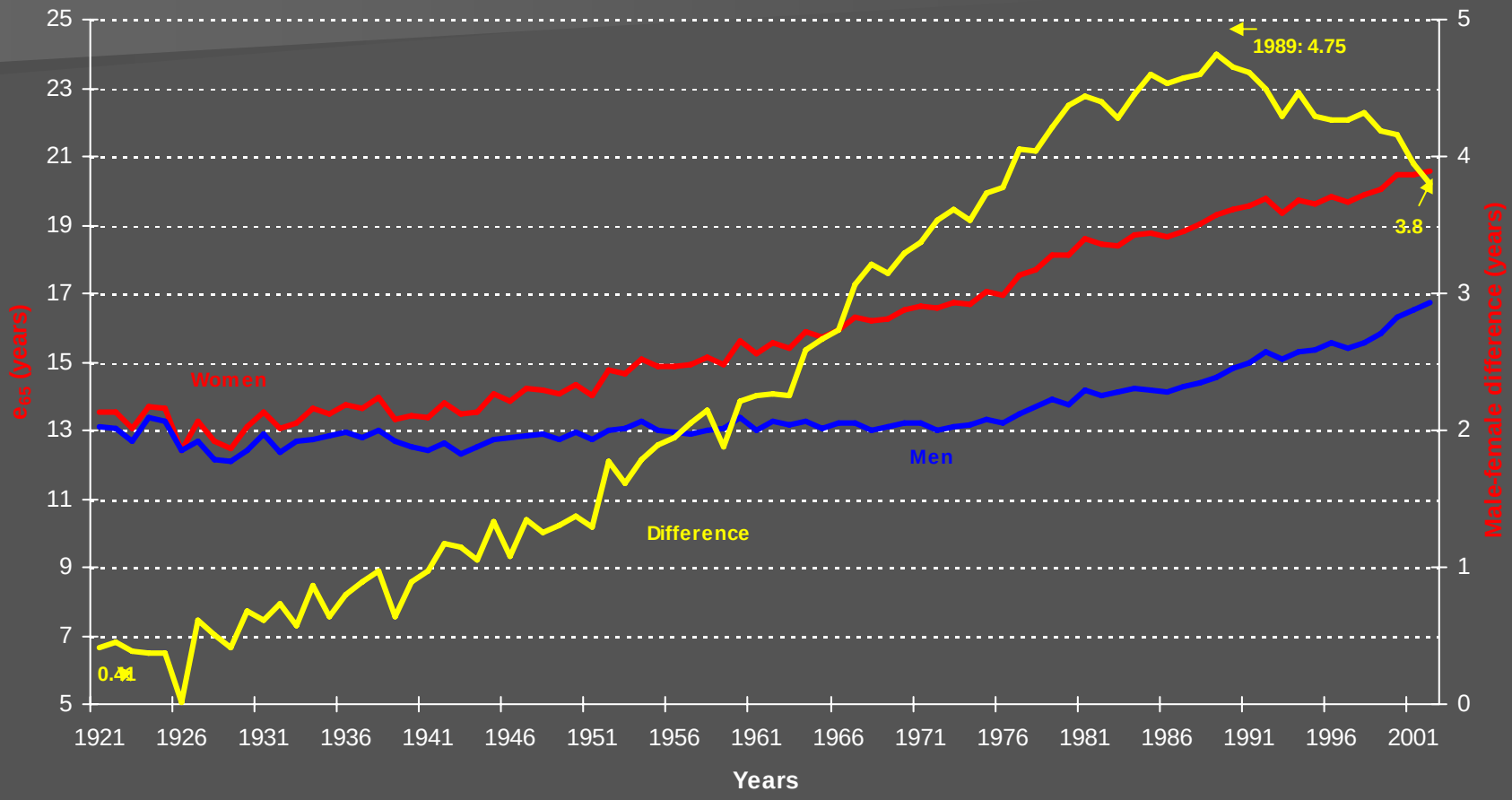
Sources: 1921-2000: CHMD; 2001-2002: ISQ

Life expectancy at birth (e_0) by sex and male-female difference, Quebec and Canada, 1921-2002



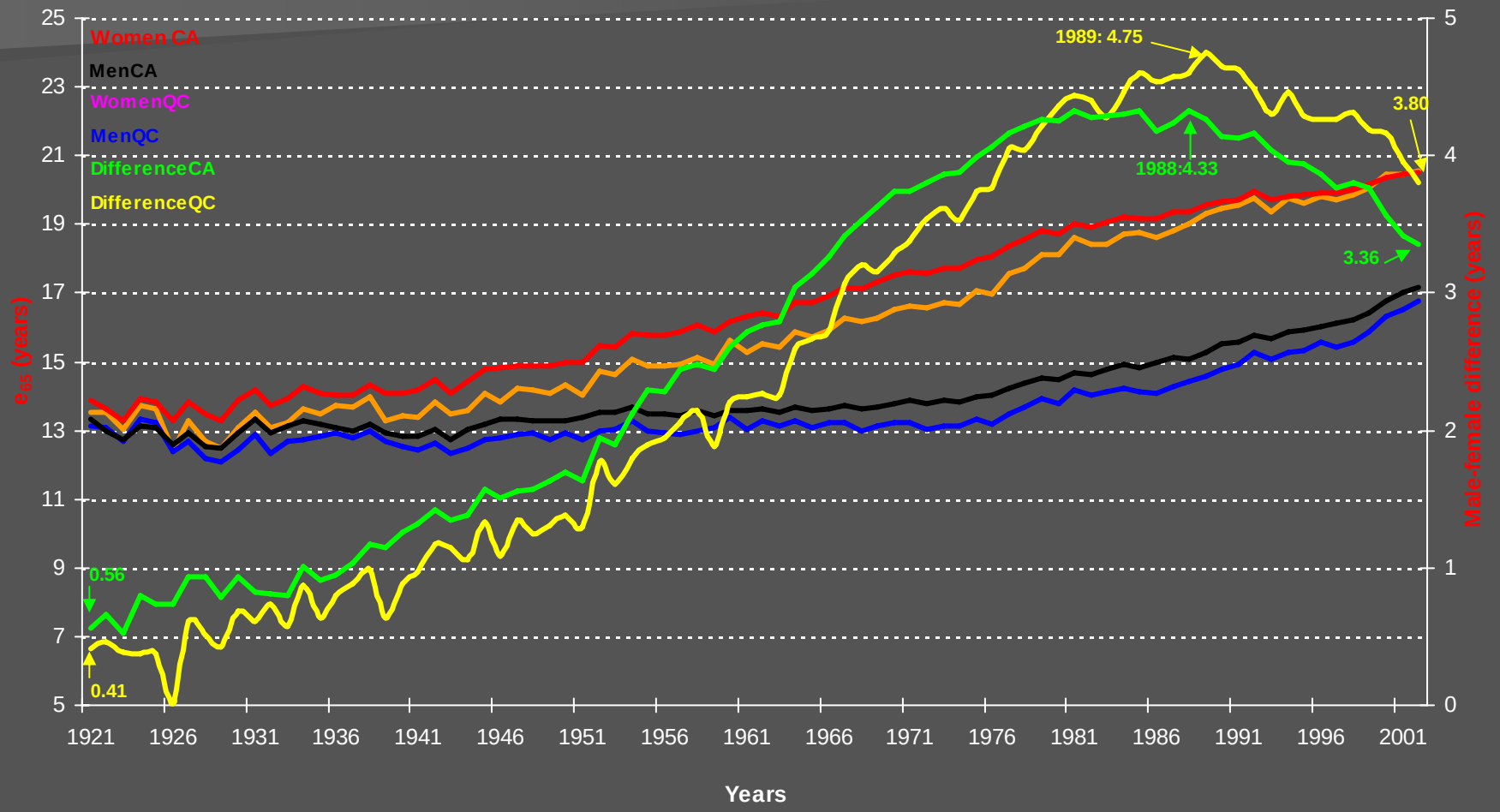
Sources: 1921-2000: CHMD; 2001-2002, Quebec: ISQ; 2001-2002, Canada: HMD

Life expectancy at age 65 (e_{65}) and male-female difference, Quebec, 1921-2002



Sources: 1921-2000: CHMD; 2001-2002, ISQ

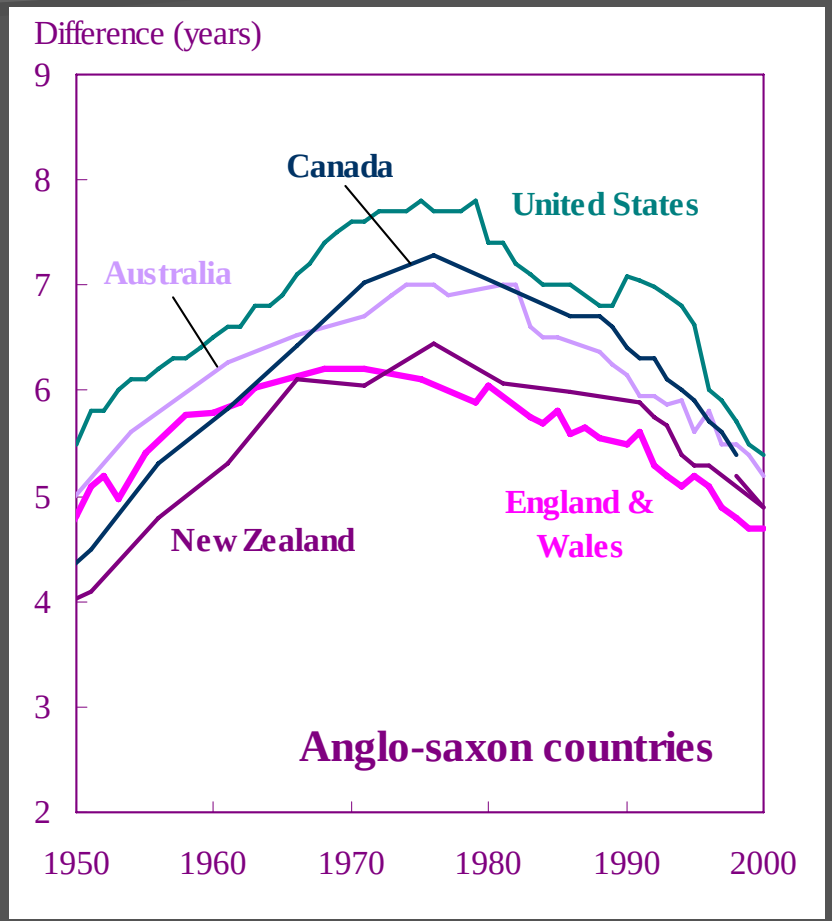
Life expectancy at age 65 (e_{65}) and male-female difference, Quebec and Canada, 1921-2002

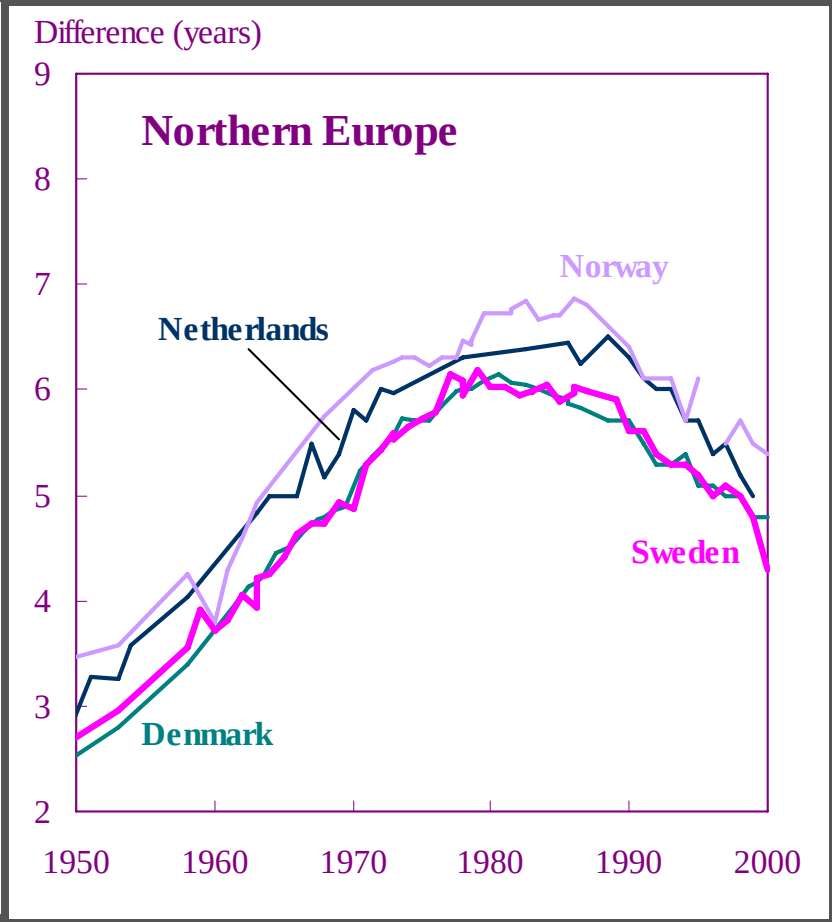


Sources: 1921-2000: CHMD; 2001-2002, Quebec: ISQ; 2001-2002, Canada: HMD

International comparisons of the evolution in the male-female difference in life expectancy at birth : Almost a general trend

The precursors

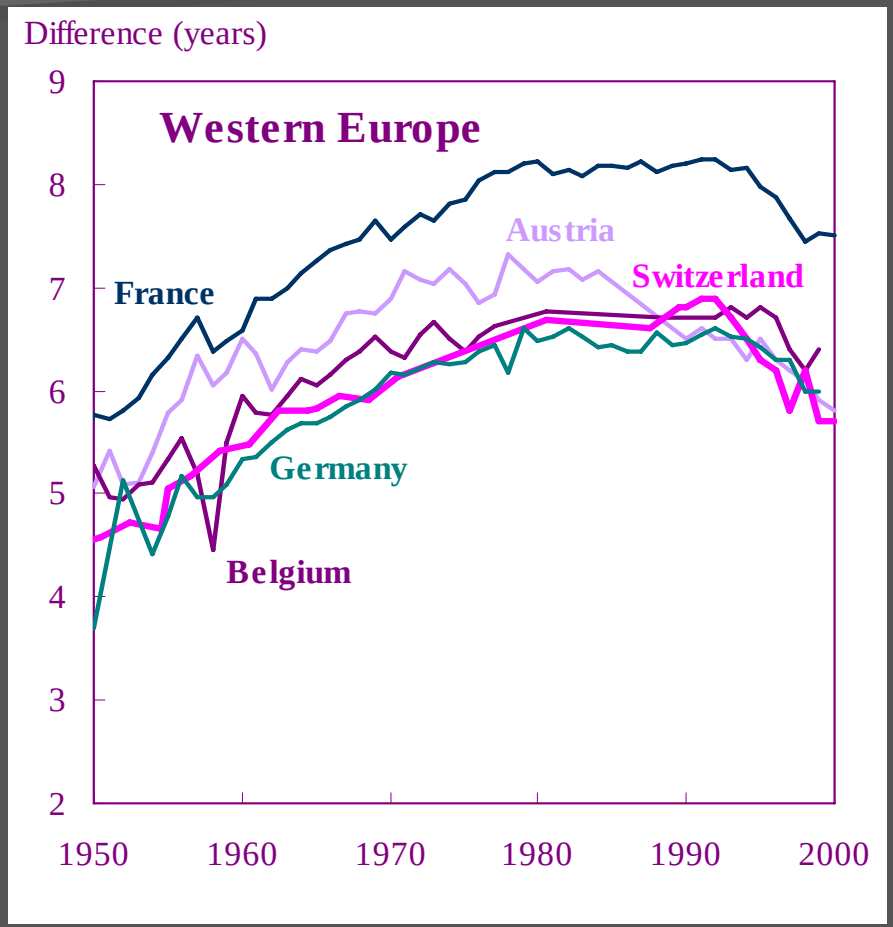


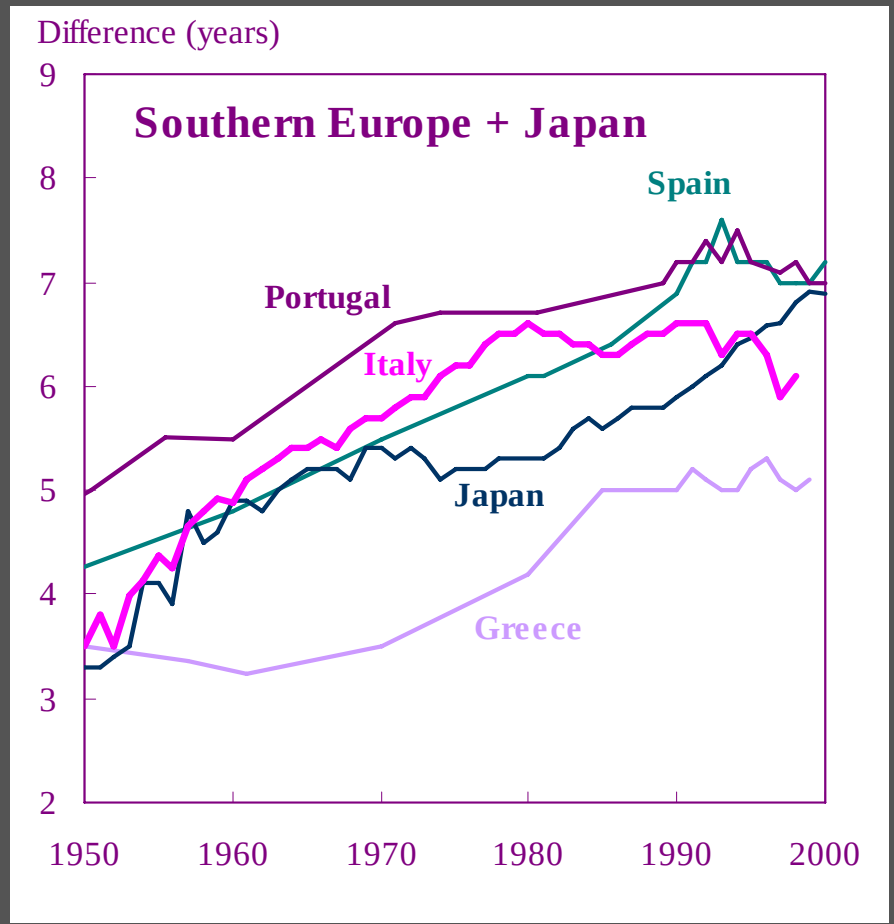


Source: France Meslé, 2004 (INED)

International comparisons of the evolution in the male-female difference in life expectancy at birth : Almost a general trend

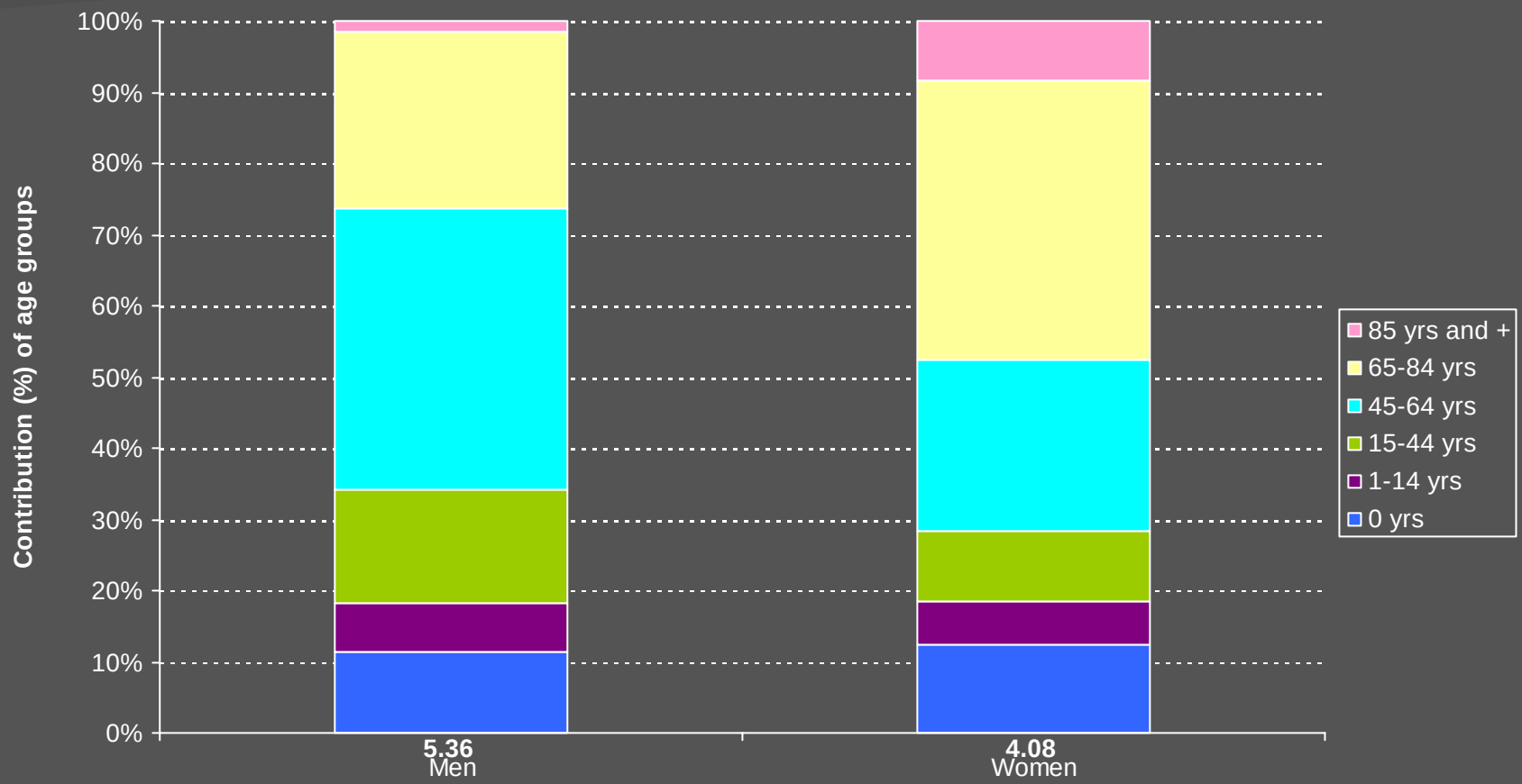
The exceptional case of Japan



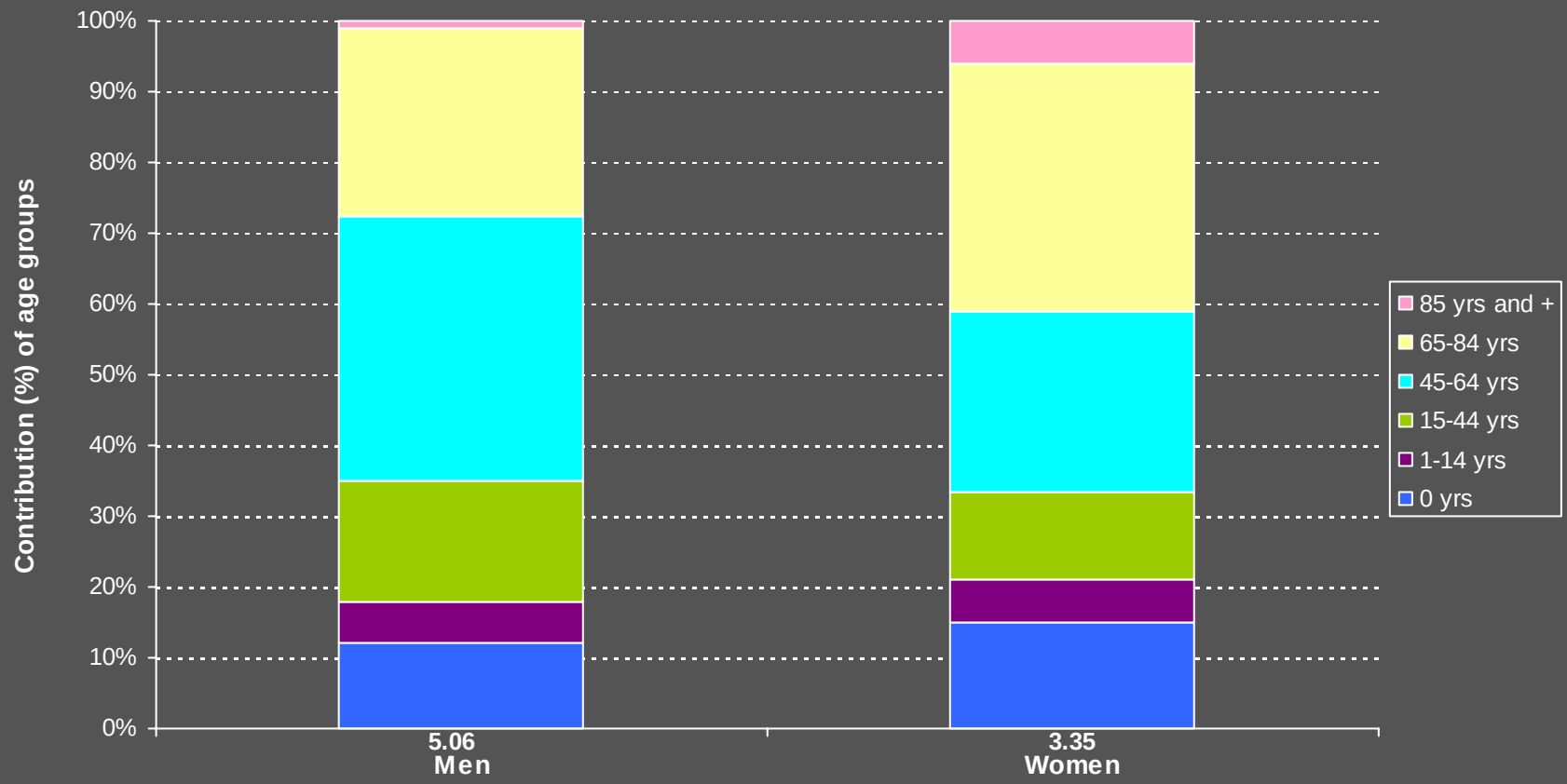


Source: France Meslé, 2004 (INED)

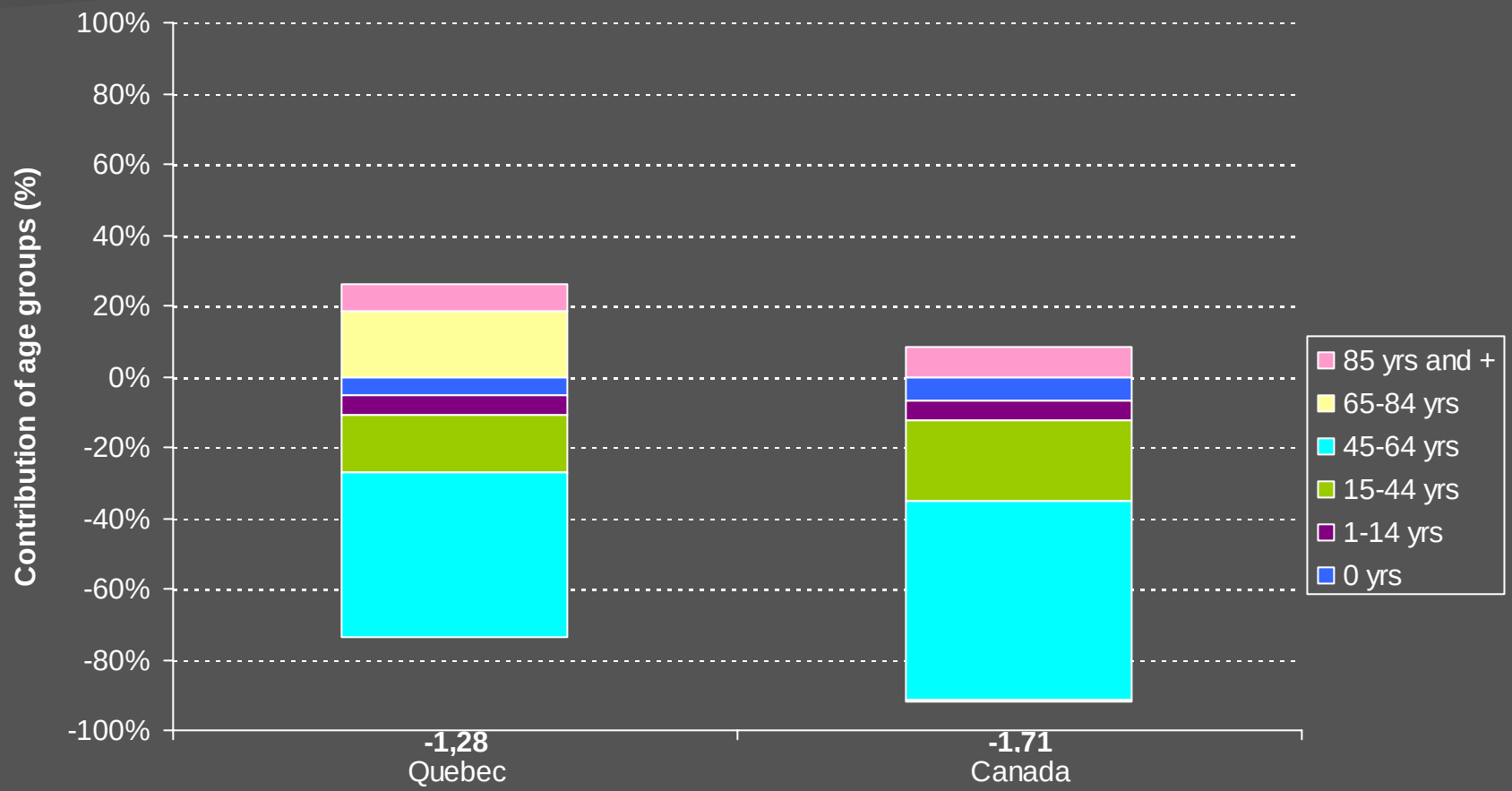
Relative Contribution (in %) of each age group to the gain in life expectancy at birth by sex from 1975-79 to 1995-99, Quebec



Relative Contribution (in %) of each age group to the gain in life expectancy at birth by sex from 1975-79 to 1995-99, Canada



Relative contribution (in %) of each age group to the reduction of the male-female difference in life expectancy at birth from 1975-79 to 1995-99, Quebec and Canada



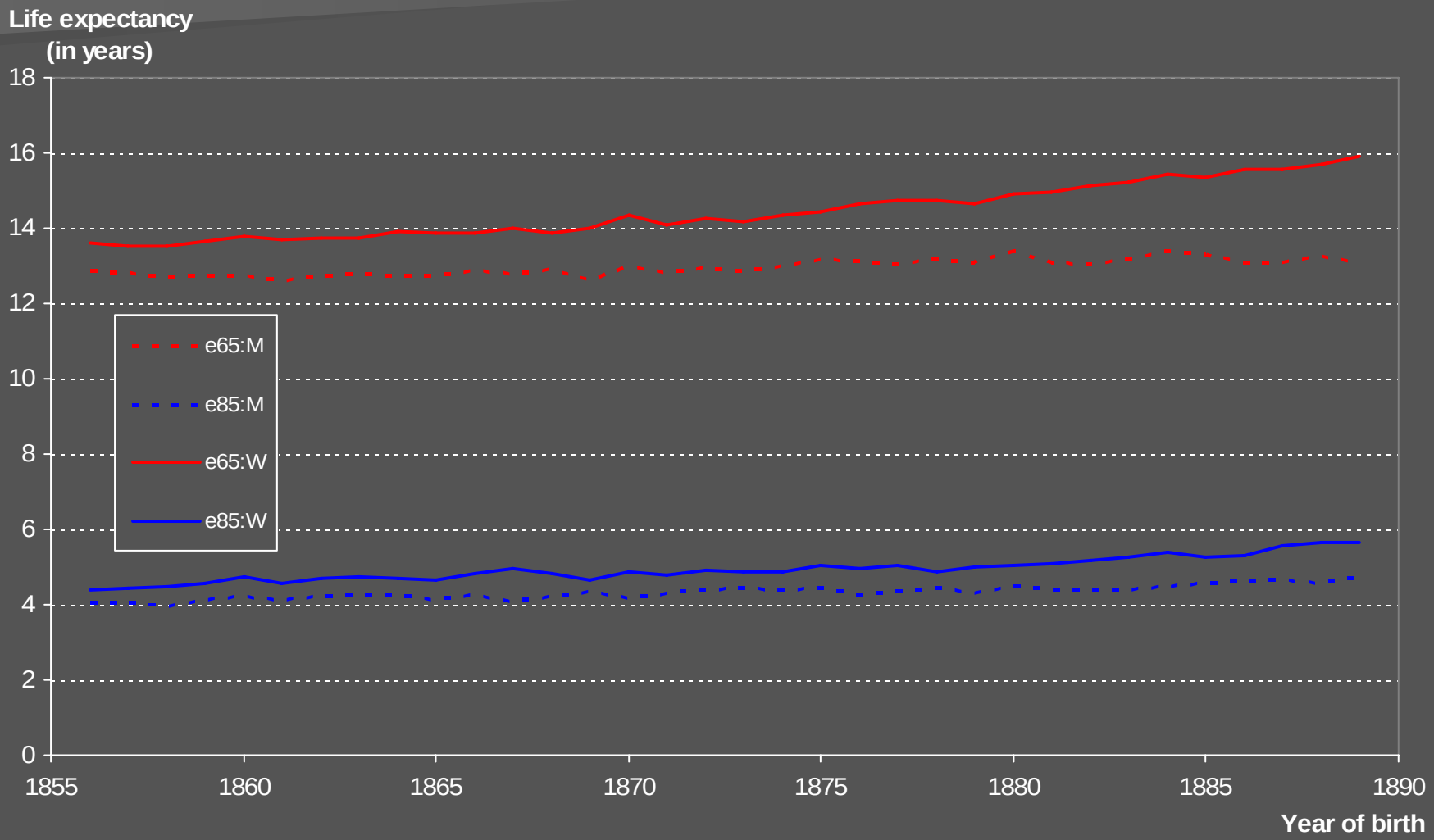
Section 3

Mortality at older ages

Mortality at older ages

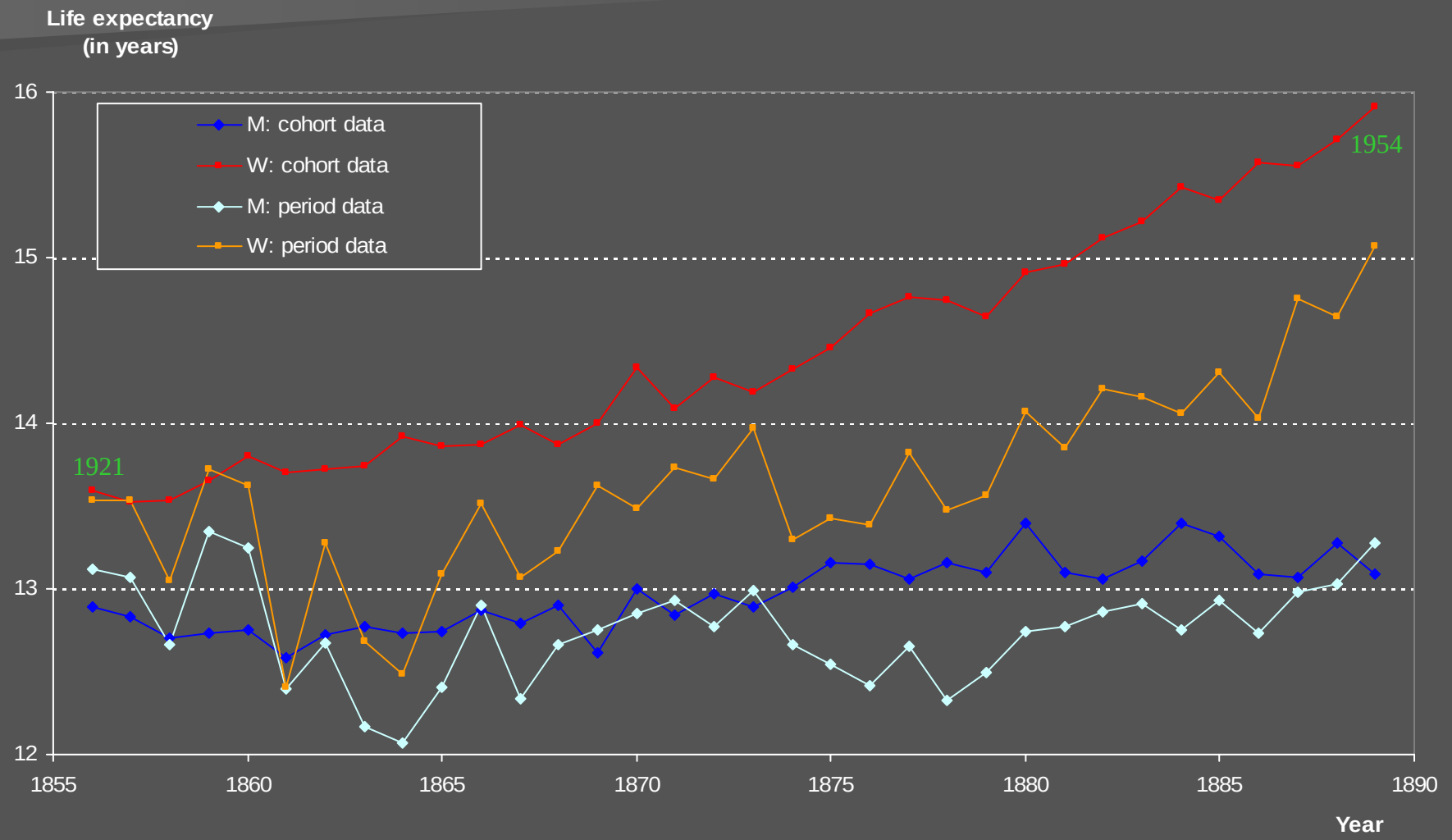
- Future gains: beyond age 65
- Relevance of using specific measures for mortality at older ages
  - Longitudinal data

Evolution of life expectancies at age 65 (e_{65}) and at age 85 (e_{85}), Quebec, 1856-1889 Cohorts



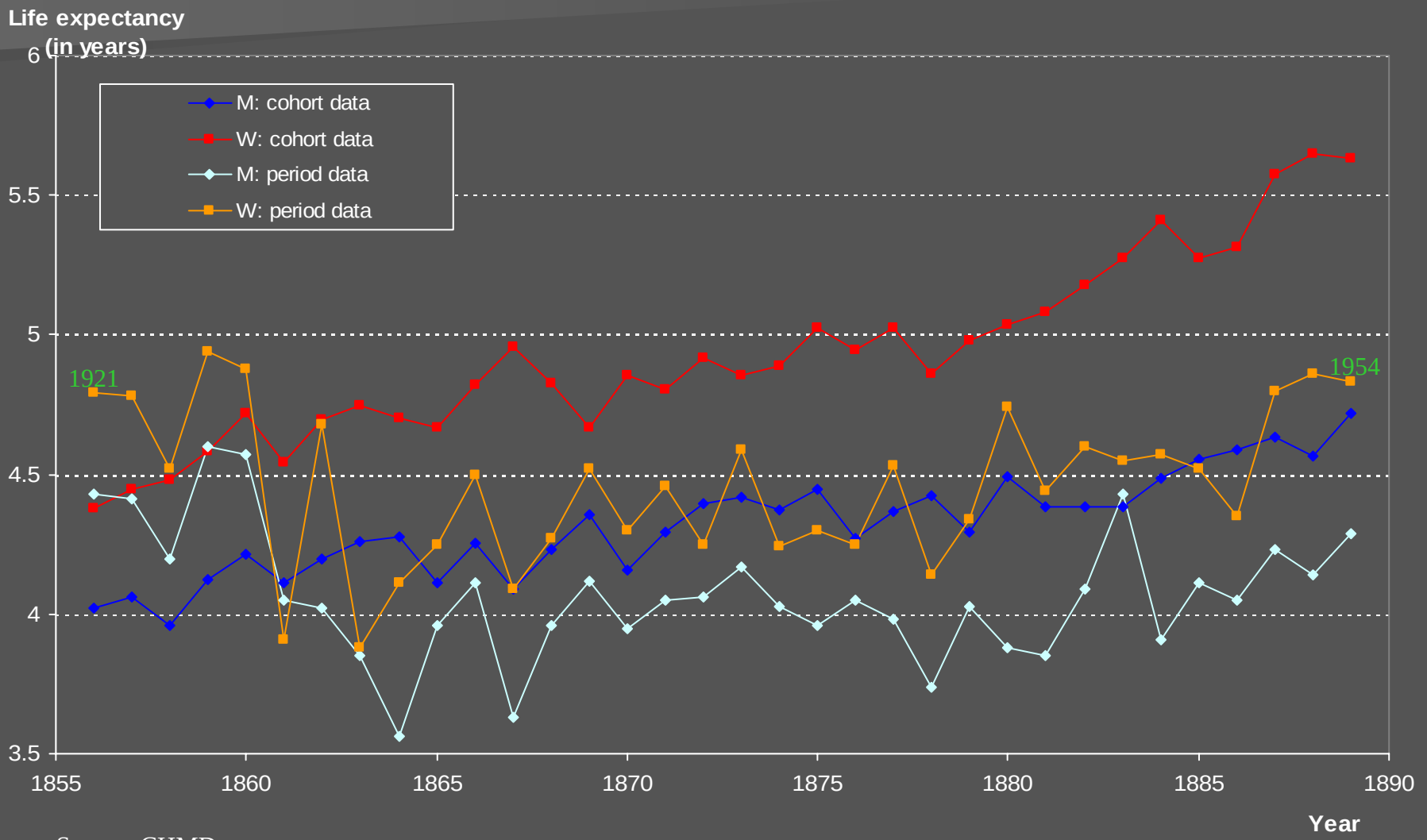
Source: CHMD

Comparison of life expectancy at age 65 (e_{65}), Quebec, 1856-1889 Cohorts and 1921-1954 Periods



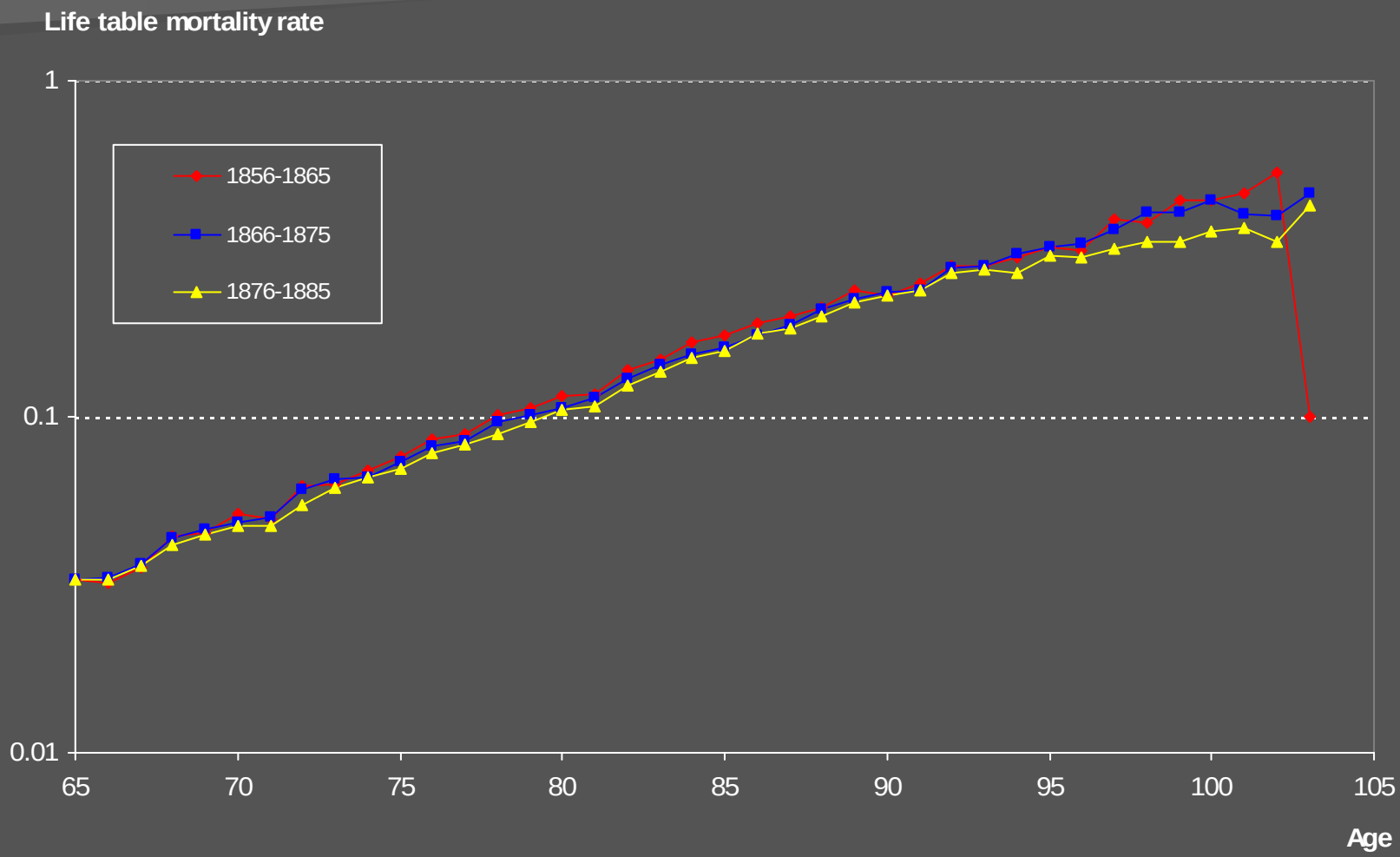
Source: CHMD

Comparison of life expectancy at age 85 (e_{85}), Quebec, 1856-1889 Cohorts and 1921-1954 Periods



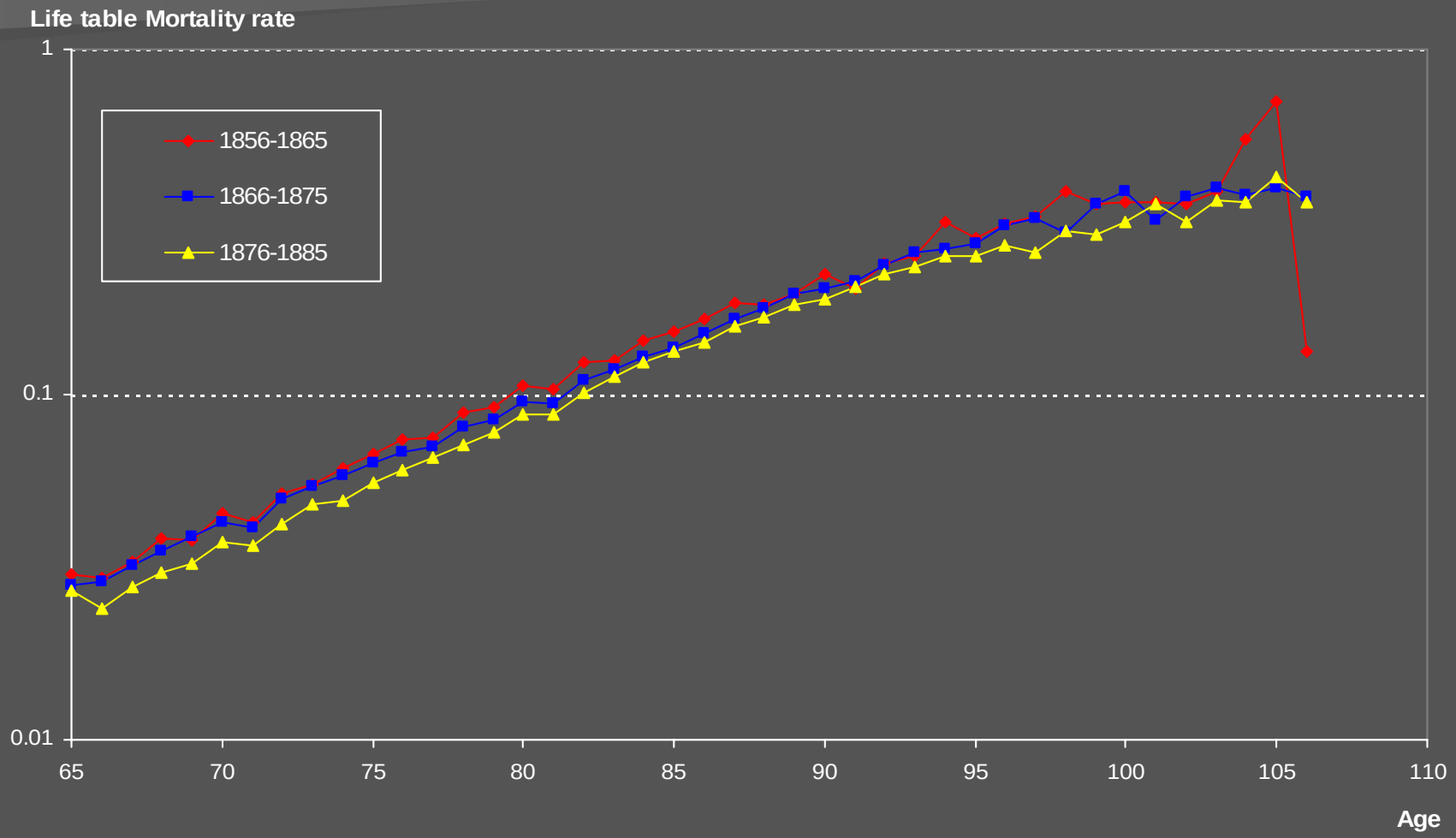
Source: CHMD

Evolution in age-specific life table mortality rates from age 65 for males, Quebec, 1856-1865, 1866-1875 and 1876-1885 Cohorts



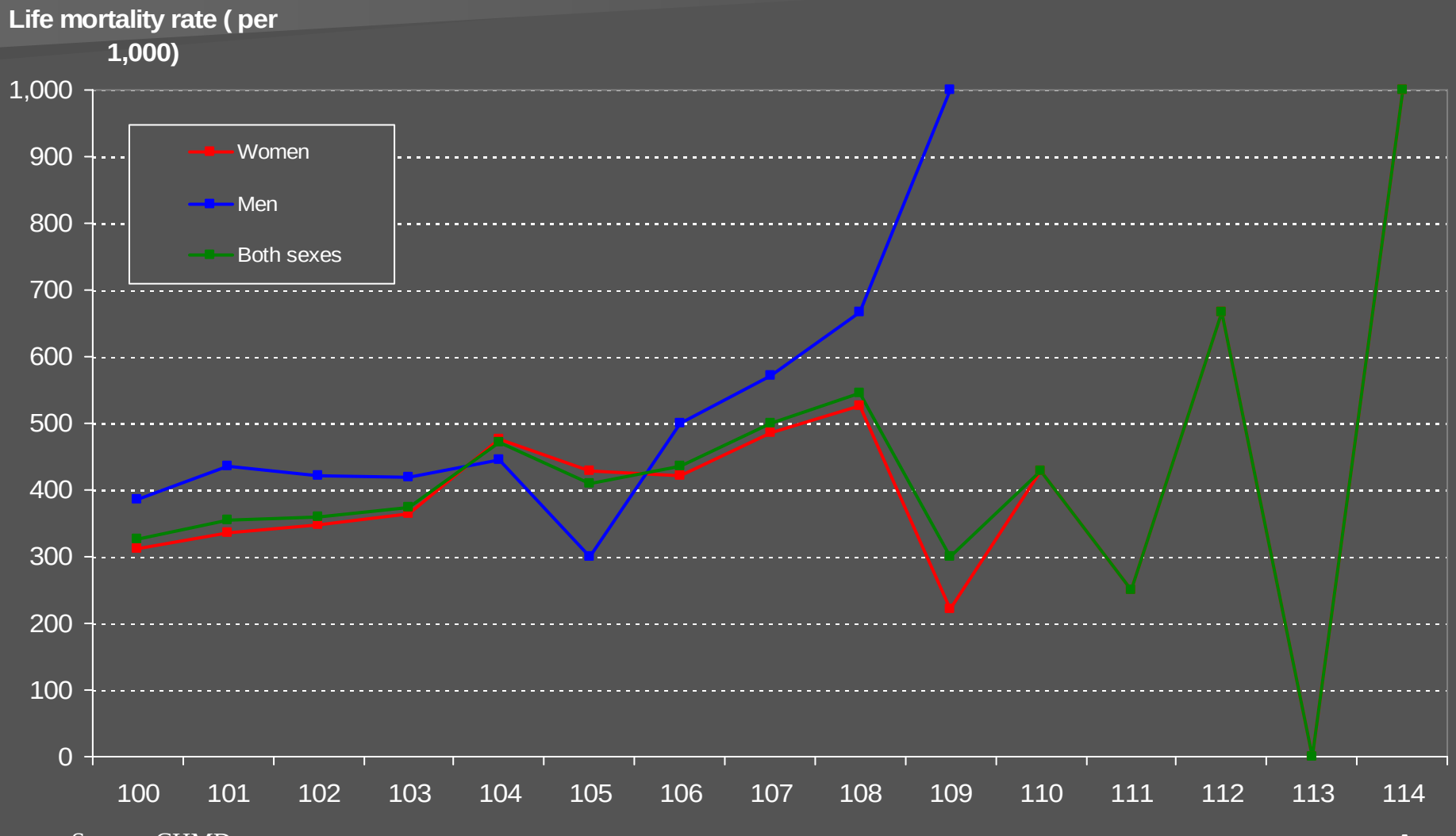
Source: CHMD

Evolution in age-specific life table mortality rates from age 65 for females, Quebec, 1856-1865, 1866-1875 and 1876-1885 Cohorts



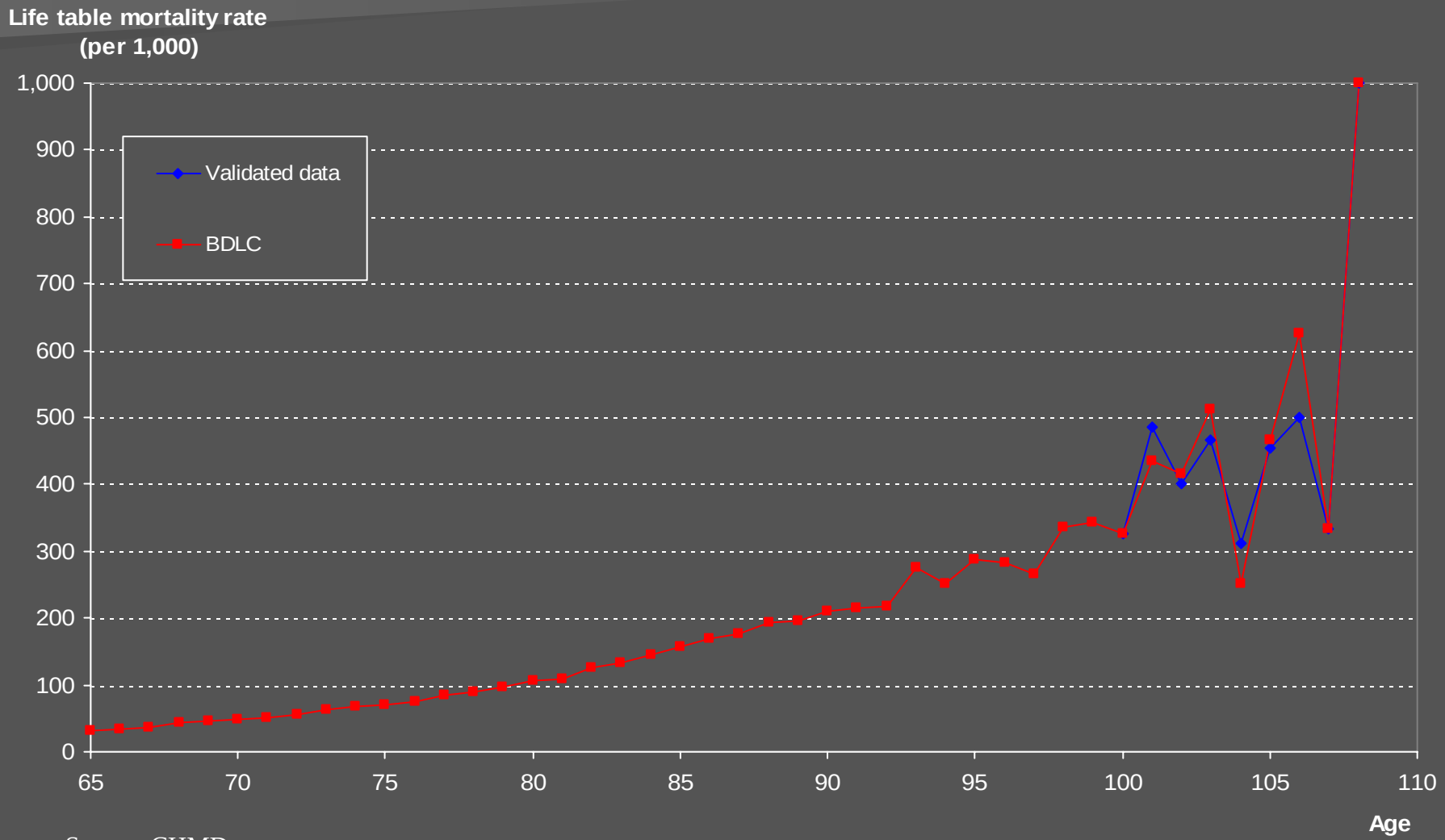
Source: CHMD

Age-specific mortality rates from age 100, Quebec, 1885-1894 Quebec Birth Cohort



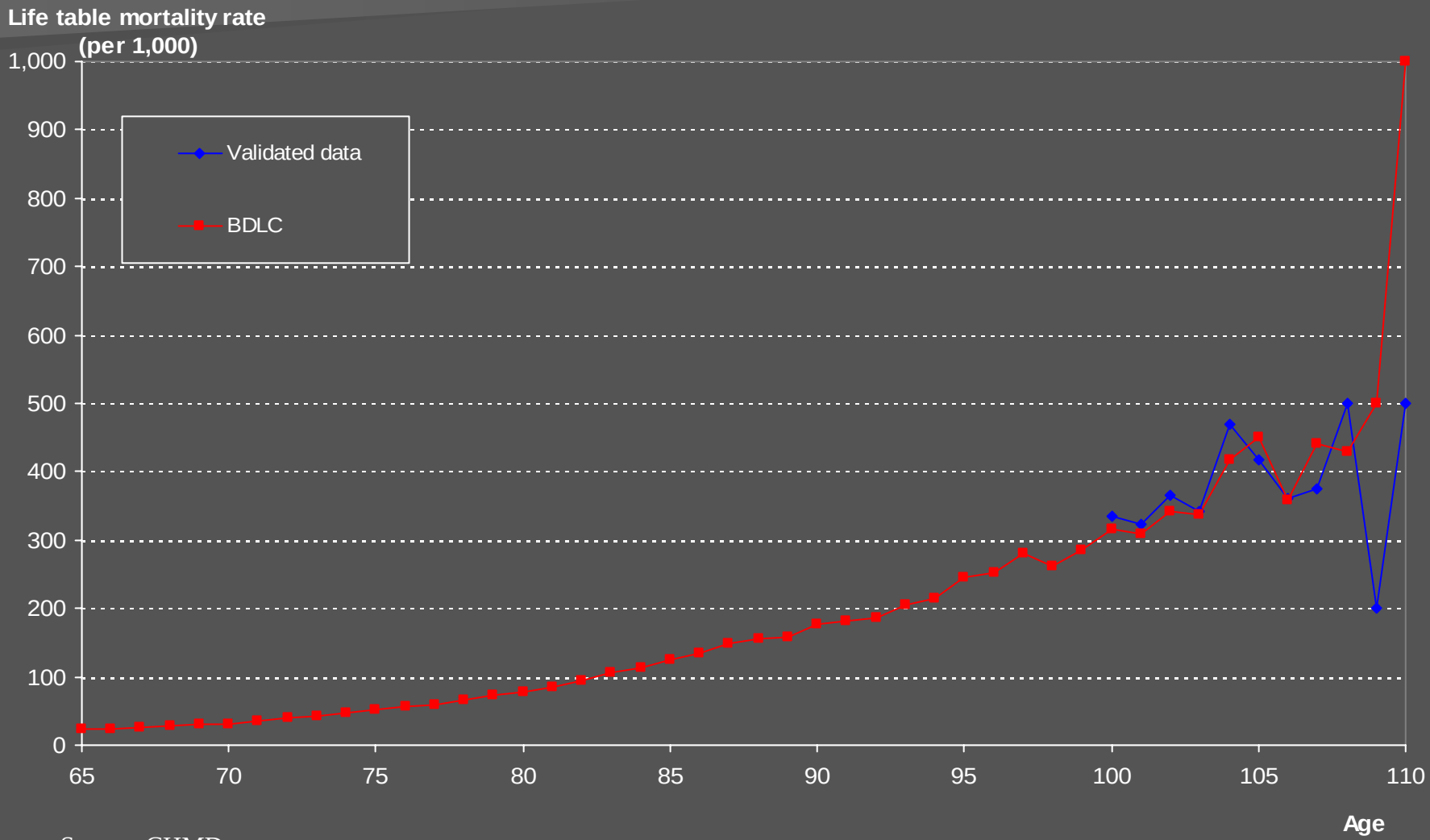
Source: CHMD

Age-specific life table mortality rates from age 65, Quebec, 1885-1889 Male Cohort



Source: CHMD

Age-specific life table mortality rates from age 65, Quebec, 1885-1889 Female Cohort



Source: CHMD

Section 4

Improved quantity and quality of life: where does the healthy life expectancy stand?

Total and healthy life expectancies at birth by sex, Quebec, 1978-1979 to 1998

		1978-1979	1986	1987	1992-1993	1998
Life expectancy at birth (in years)	**Males**					
	Total life expectancy	69.7	72.0	72.2	73.6	74.6
	Healthy life expectancy	60.4	62.4	63.9	65.9	65.4
	Difference	9.3	9.5	8.3	7.7	9.2
	Females					
	Total life expectancy	77.6	79.5	79.7	80.8	81.1
	Healthy life expectancy	63.1	66.3	68.5	69.3	68.1
	Difference	14.5	13.1	11.2	11.5	13.0

Sources : 1978-1979 : Dillard, 1983 ; 1986 : Wilkins, 1991 ; 1987 to 1998 : Pageau et al., 2001.

Total and healthy life expectancies at birth, males, Quebec

Author of the measure	Pampalon et al., 2001	Wilkins and Sauvageau, 1988	Wilkins, 1994	INSPQ, 2001	Wilkins, 1994	INSPQ, 2001	Statistics Canada, 2005	Pampalon et al., 2001	INSPQ, 2001	MSSS (EVAS_IES), 2004	INSPQ, 2006	INSPQ, 2006
Year of disability data	1986	1987	1987	1987	1992-93	1992-93	1996	1998	1998	2000-01	2001	2003
Source of data on disabilities	HALS	ESQ	ESQ	ESQ	ESS	ESS	Census	EQLA	ESS	CCHS	Census	CCHS
Concepts used												
Life expectancy	72.2	72.1	72.3	72.2	74.2	73.6	74.9	74.7	74.6	76.1	76.2	76.2
Life expectancy without disability	61.5	64						61.7				
Life expectancy without dependency	68.2							69.4				
Life expectancy without limitation of activities				63.9		65.9	68.1		65.4			
Life expectancy without loss of functional independence			64		65.9							
Health-adjusted life expectancy							72					
Life expectancy adjusted based on health										69		69.2
Life expectancy without frequent disability											70.9	
Life expectancy in good health											65.9	

Source: L'espérance de santé au Québec: Revue des différentes estimations pour 1986 à 2003, INSPQ, to be released

Total and healthy life expectancies at birth, females, Quebec

Author of the measure	Pampalon et al., 2001	Wilkins and Sauvageau, 1988	Wilkins, 1994	INSPQ, 2001	Wilkins, 1994	INSPQ, 2001	Statistics Canada, 2005	Pampalon et al., 2001	INSPQ, 2001	MSSS (EVAS_IES), 2004	INSPQ, 2006	INSPQ, 2006
Year of disability data	1986	1987	1987	1987	1992-93	1992-93	1996	1998	1998	2000-01	2001	2003
Source of data on disabilities	HALS	ESQ	ESQ	ESQ	ESS	ESS	Census	EQLA	ESS	CCHS	Census	CCHS
Concepts used												
Life expectancy	79.8	79.5	79.8	79.7	81.1	80.6	81.2	81.2	81.1	82.1	81.9	81.9
Life expectancy without disability	66.1	68.7						64				
Life expectancy without dependency	71.5							70.6				
Life expectancy without limitation of activities				68.5		69.3	72.3		68.1			
Life expectancy without loss of functional independence			68.2		68.8							
Health-adjusted life expectancy							77.4					
Life expectancy adjusted based on health										72		72.8
Life expectancy without frequent disability											74.3	
Life expectancy in good health											68.2	

Source: L'espérance de santé au Québec: Revue des différentes estimations pour 1986 à 2003, INSPQ, to be released

Total and healthy life expectancies at age 65 by sex, Quebec, 1978-1979 to 1998

		1978-1979	1986	1987	1992-1993	1998
Life expectancy at age 65 (in years)	**Males**					
	Total life expectancy	..	14.1	14.3	15.1	15.5
	Healthy life expectancy	..	8.6	10.6	11.3	10.7
	Difference	..	5.5	3.7	3.8	4.8
	Females					
	Total life expectancy	..	18.9	19.0	19.8	19.8
	Healthy life expectancy	..	10.2	13.0	13.3	13.2
	Difference	..	8.7	6.0	6.5	6.6

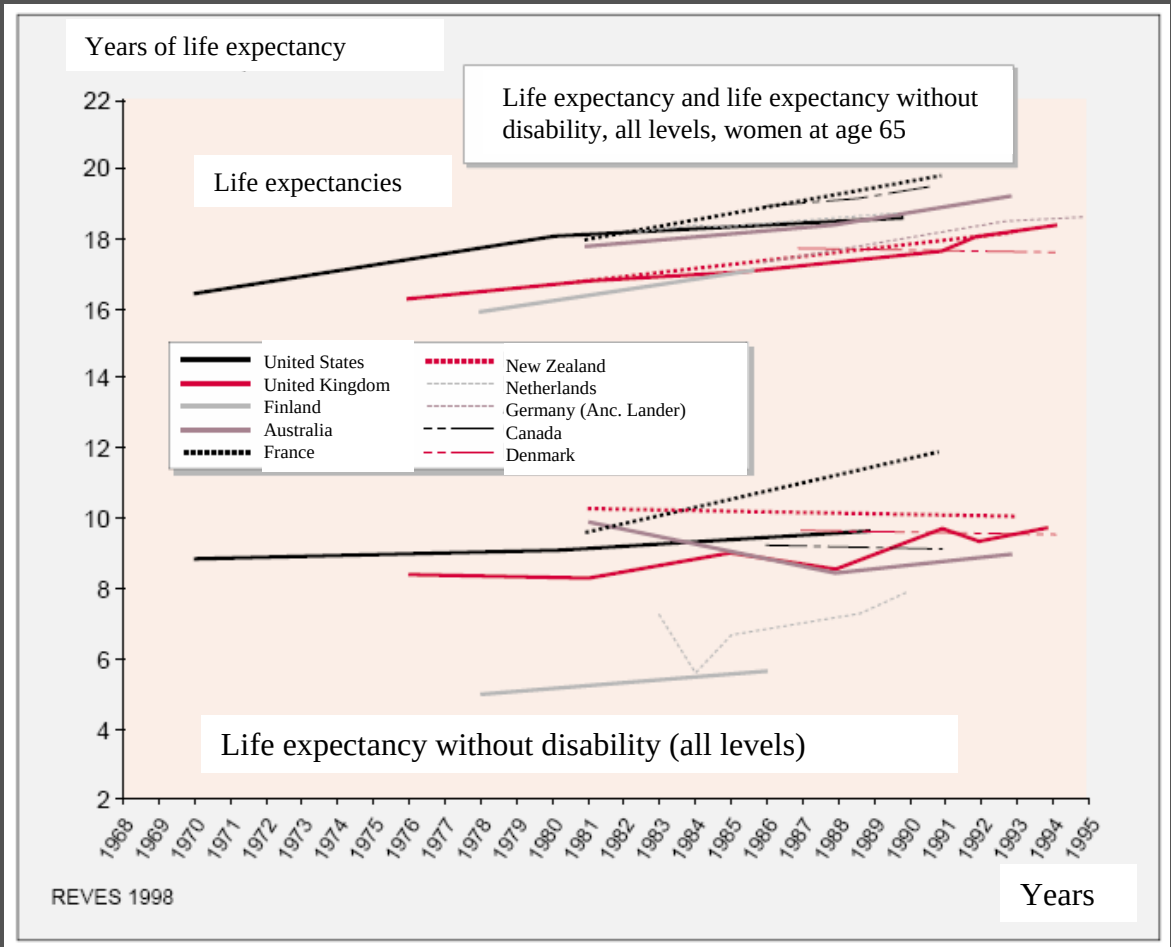
Note : .. = data not available

Sources : 1978-1979 : Dillard, 1983 ; 1986 : Wilkins, 1991 ; 1987 to 1998 : Pageau et al., 2001.

Life expectancy at age 65 by activity limitations for each sex, Quebec

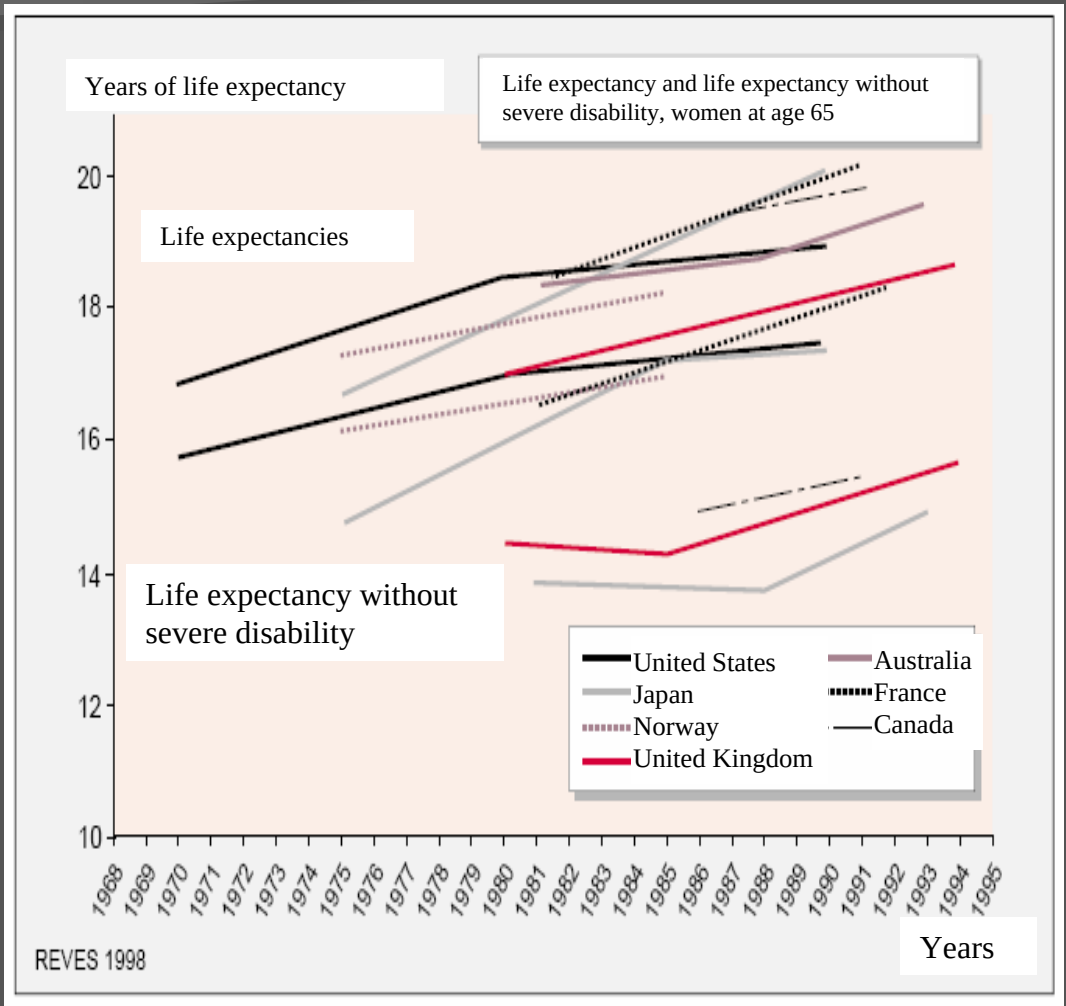
Authors	"Éco-Santé, 2005"			Lefebvre, 2003
Year of data	**1987**	**1992-93**	**1998**	**1998**
Source of data	Census, 1986; ESQ, 1987	Census, 1991; ESS, 1992-93	Census, 1996; ESS, 1998	EQLA, 1998
Men				
Life expectancy at age 65	**14.3**	**15.1**	**15.5**	**15.5**
Without activity limitations (in good health)	**10.6**	**11.3**	**10.7**	
With activity limitations	**3.7**	**3.9**	**4.7**	
Live expectancy without disability				**8.4**
Life expectancy with disability				**7.1**
Women				
Life expectancy at age 65	**19**	**19.8**	**19.8**	**20**
Without activity limitations (in good health)	**13**	**13.3**	**13.2**	
With activity limitations	**6**	**6.5**	**6.6**	
Life expectancy without disability				**9.5**
Life expectancy with disability				**10.5**

Evolution in female life expectancy and life expectancy without disability – all levels – at age 65, various countries



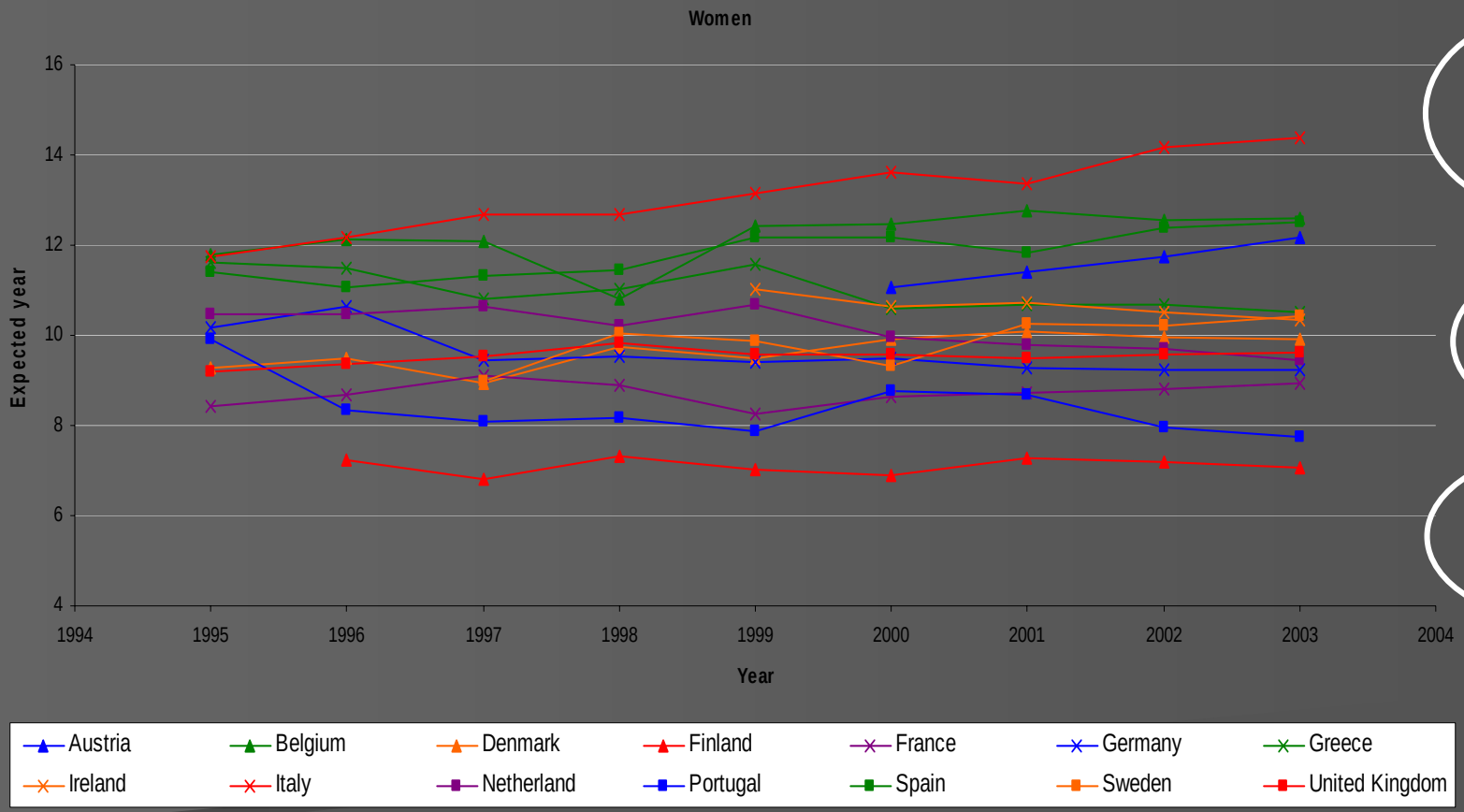
- Increase in life expectancy at age 65 for industrialized countries
- Stagnation of life expectancy at age 65 without disability (all levels)
- Years of life expectancy gained: years of disability
- For the past 15 years, the data show a slight increase in life expectancy without disability (all levels)

Evolution in female life expectancy and life expectancy without severe disability at age 65, various countries



- Life expectancy at age 65 without severe disability follows the same evolution as that of life expectancy at age 65
- The years gained in life expectancy appear to be years of light or moderate disability.
- Profiles of the evolution of life expectancies without disability depend on the level of severity considered
  - Decrease in the levels of severe disability
  - Increase in the levels of light or moderate disability

Evolution in female life expectancy without disability at age 65, 1995-2003



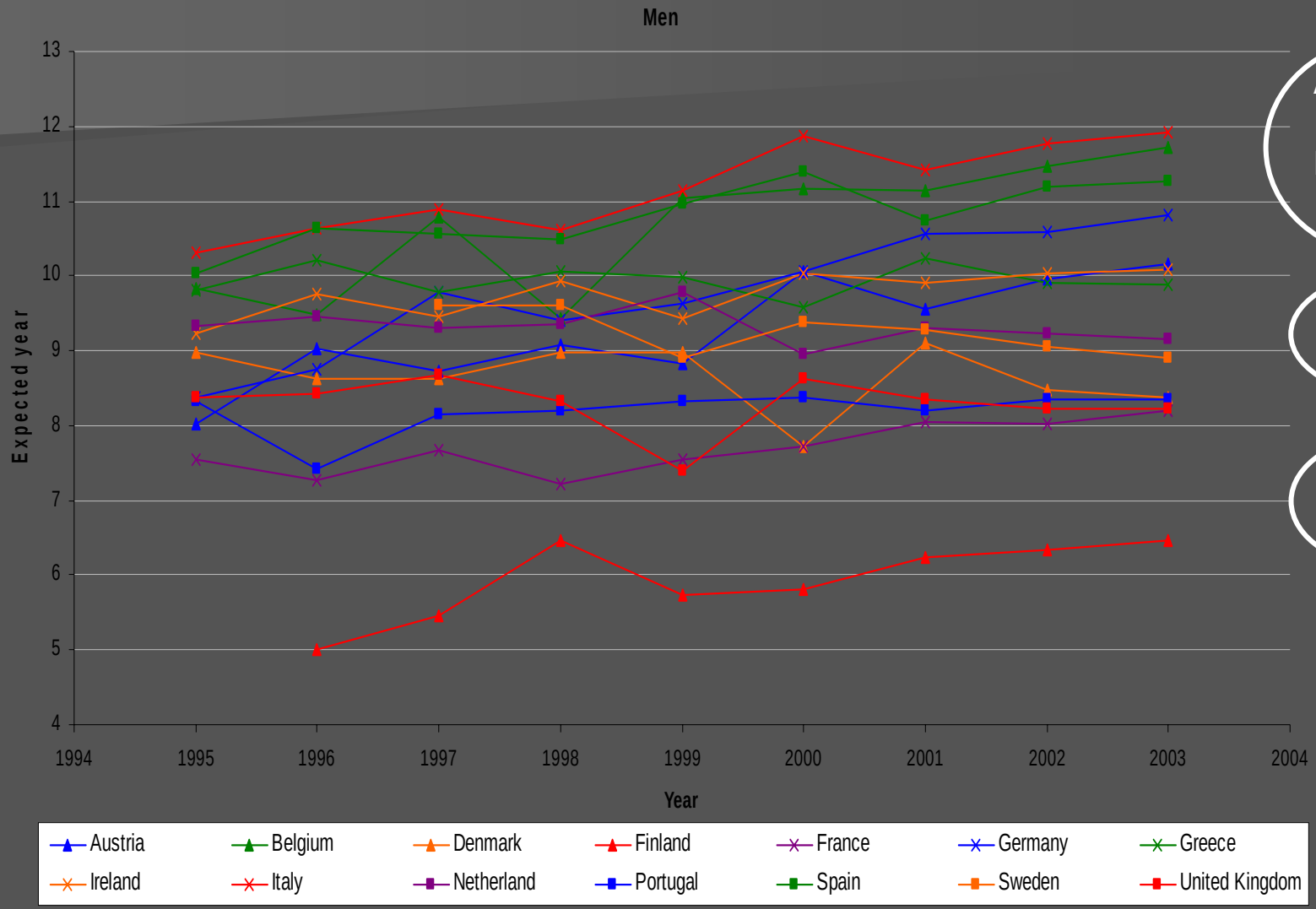
AUT, BEL, DNK, ITA, ESP, SWE

FIN, FRA, GBR

DEU, GRC, IRL, NDL, PRT

(Source: J-M Robine, 2005)

Evolution in male life expectancy without disability at age 65, 1995-2003



AUT, BEL, FIN, FRA, DEU, IRL, ITA, ESP

GRC, NDL, PRT, GBR

DNK, SWE

(Source: J-M Robine, 2005)

Section 5

Mortality projections, 2003-2056

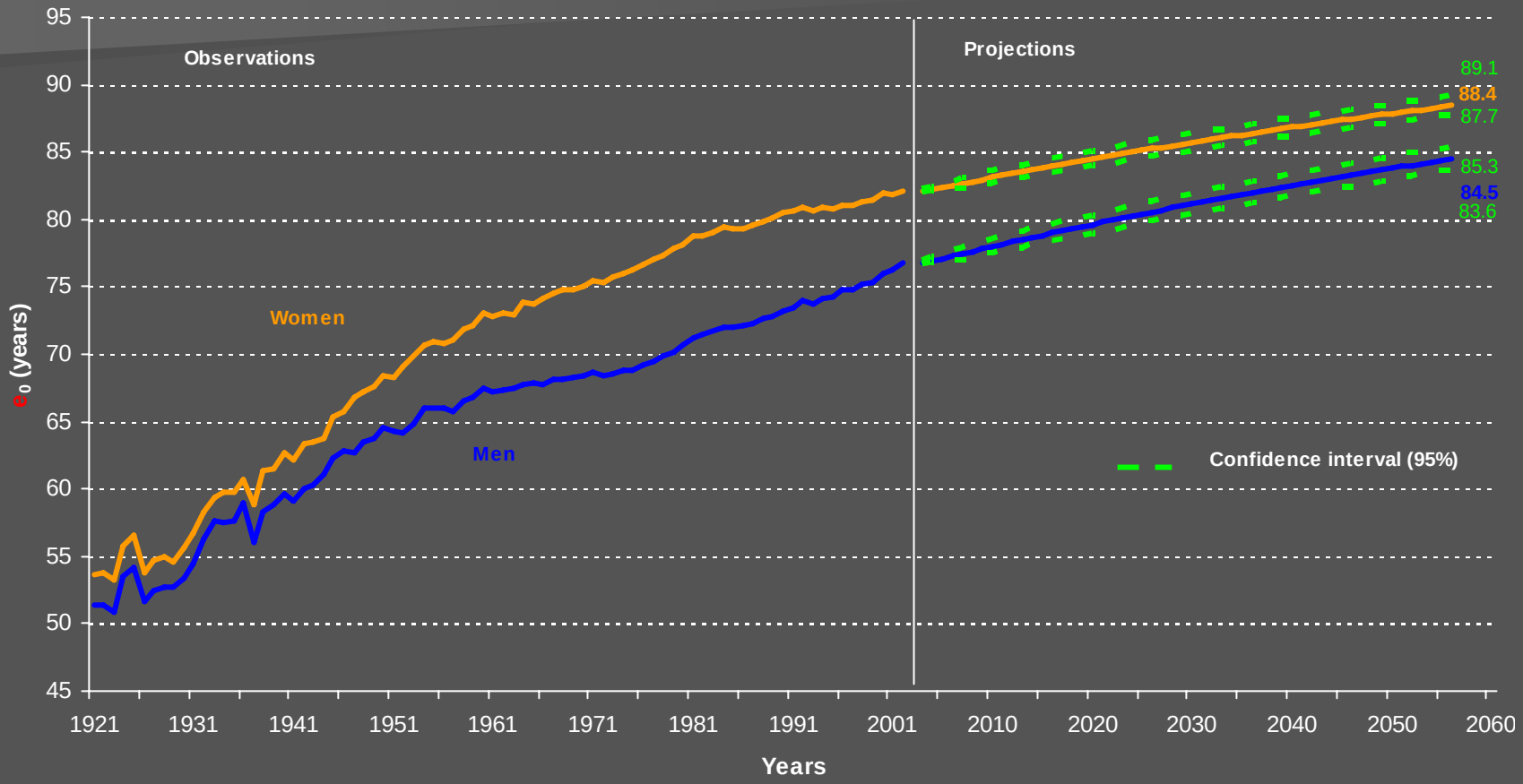
Lee and Carter model (1992)

$$\ln(m_{x,t}) = a_x + b_x k_t + \varepsilon$$

$m_{x,t}$ = mortality rate at age x and time t
a_x = average mortality pattern by age
b_x = rate of change in mortality rate at each age
k_t = mortality level parameter at time t
ε = model residual

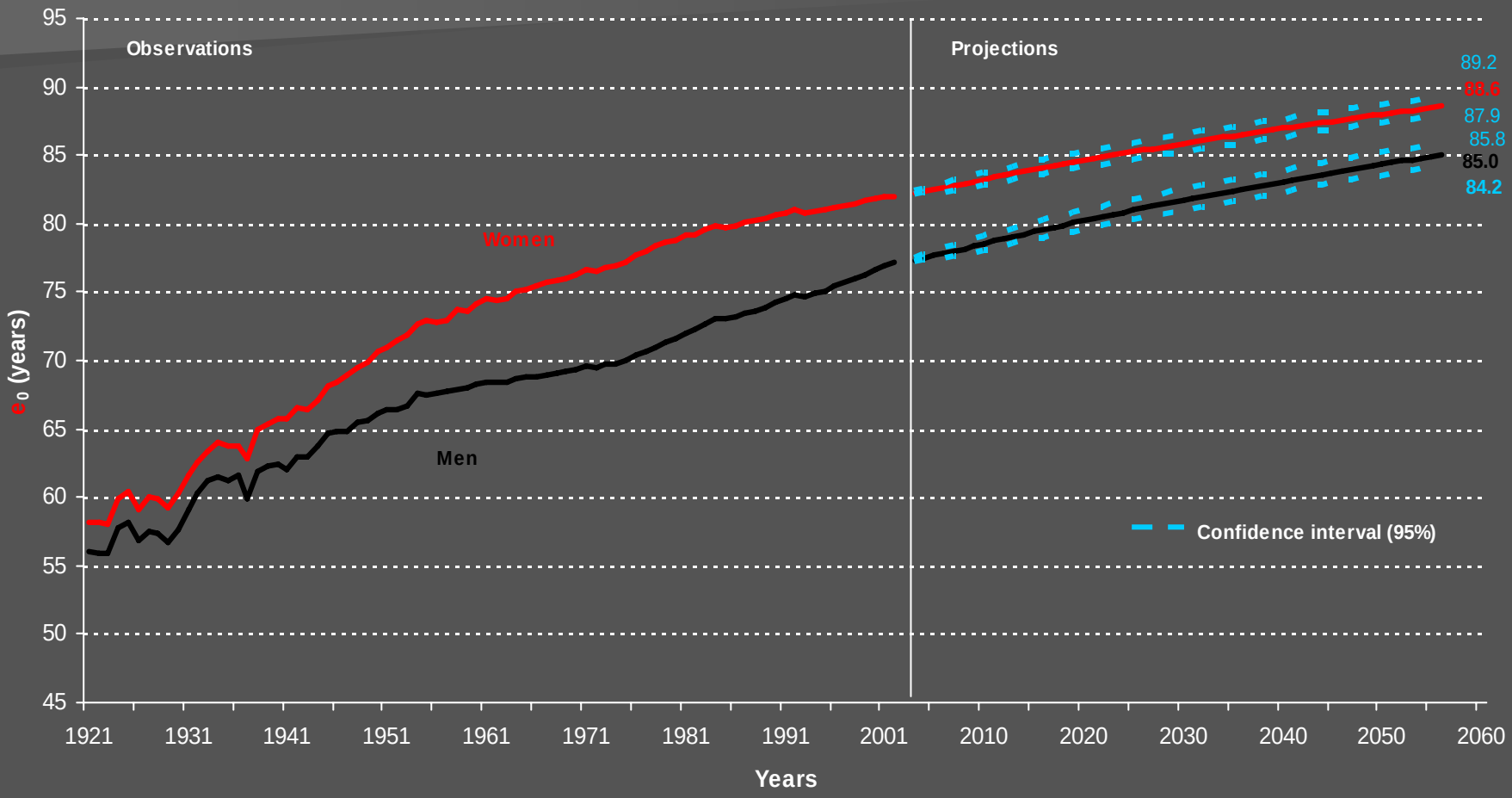
- The age and time components were determined on the basis of a period (t) of 32 years (1971-2002).
- The projection of index k_t is made over a period of 53 years (2003-2056), which allows projection of mortality rates and life expectancies for the first half of the XXIth century.

Life expectancy at birth (e_0), 1921-2002 (observations), 2003-2056 (projections) and confidence intervals, Quebec



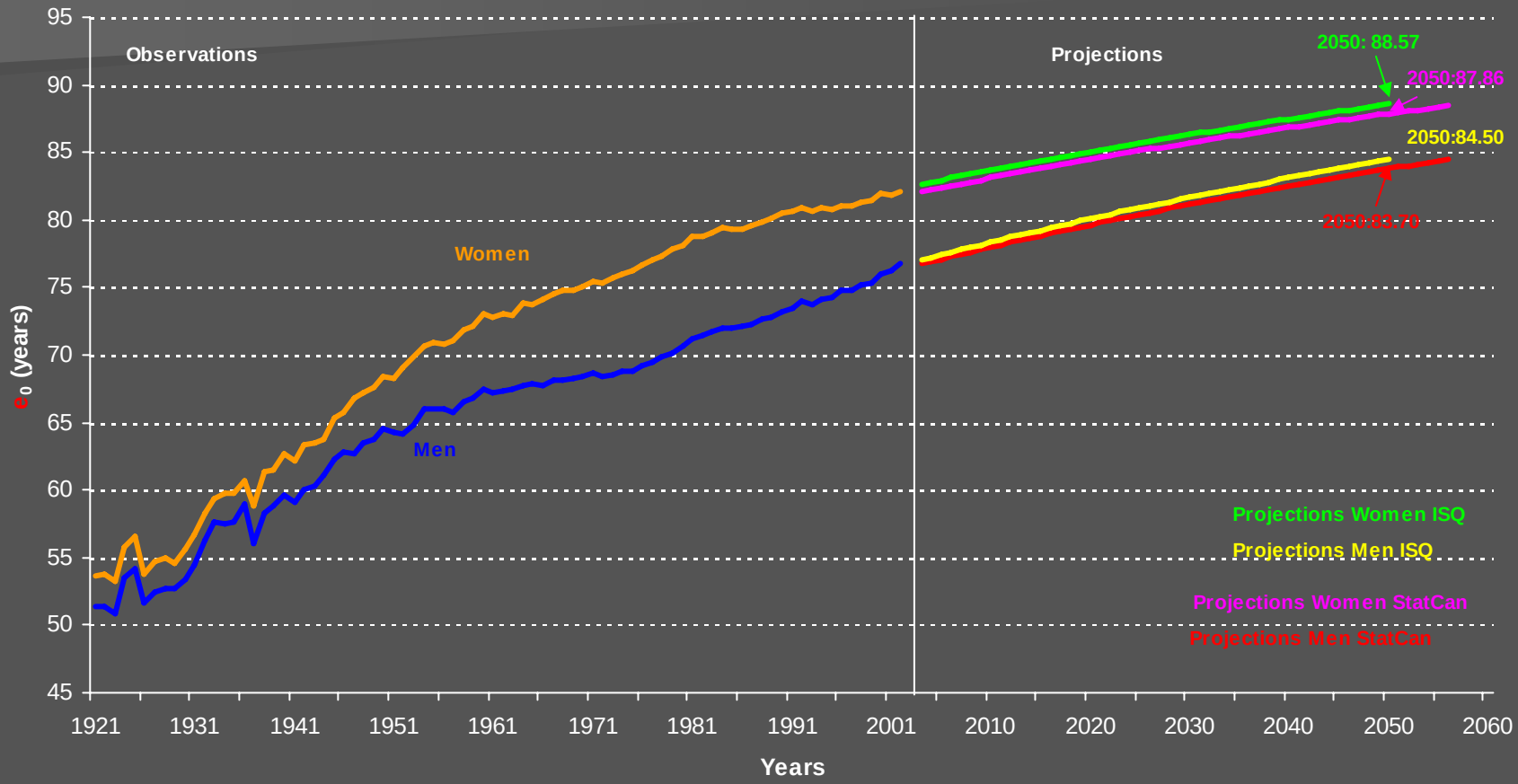
Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada

Life expectancy at birth (e_0), 1921-2002 (observations), and 2003-2056 (projections) and confidence intervals, Canada



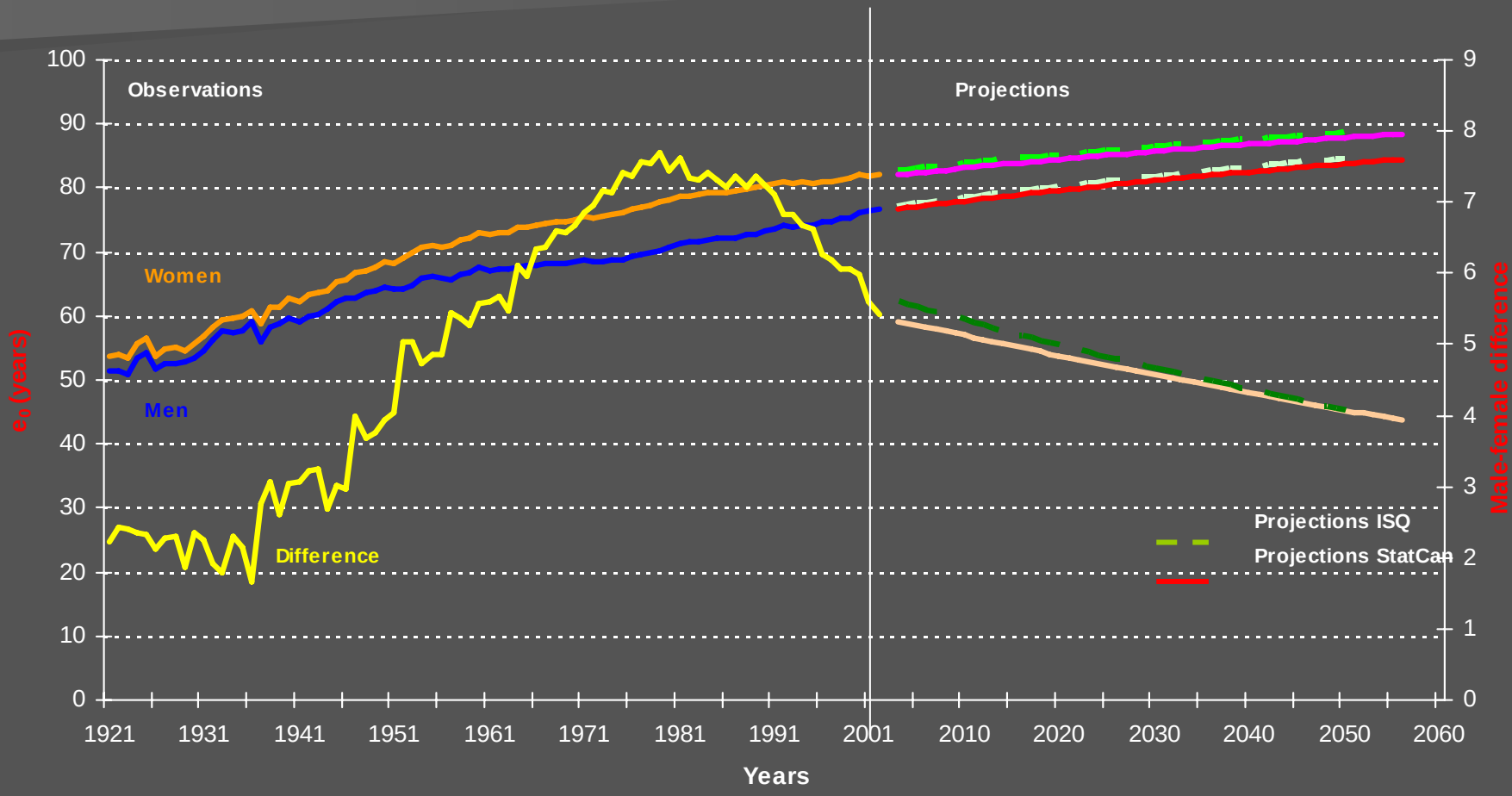
Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada

Life expectancy at birth (e_0), 1921-2002 (observations), and 2003-2056 (Statistics Canada projections) and 2003-2050 (ISQ projections), Quebec



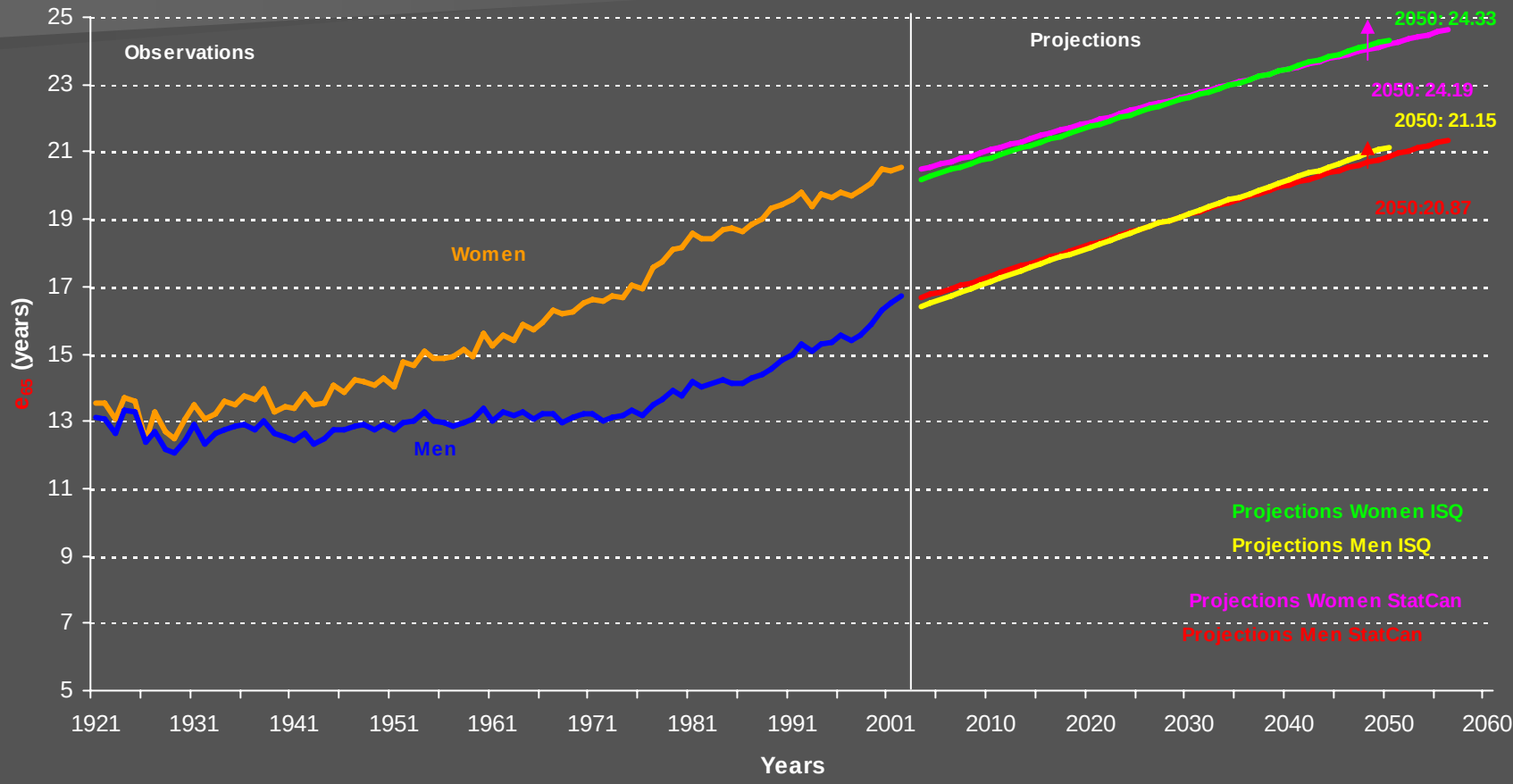
Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada; 2003-2050:ISQ

Life expectancy at birth (e_0) and male-female difference, 1921-2002 (observations), 2003-2056 (Statistics Canada projections), 2003-2050 (ISQ projections), Quebec



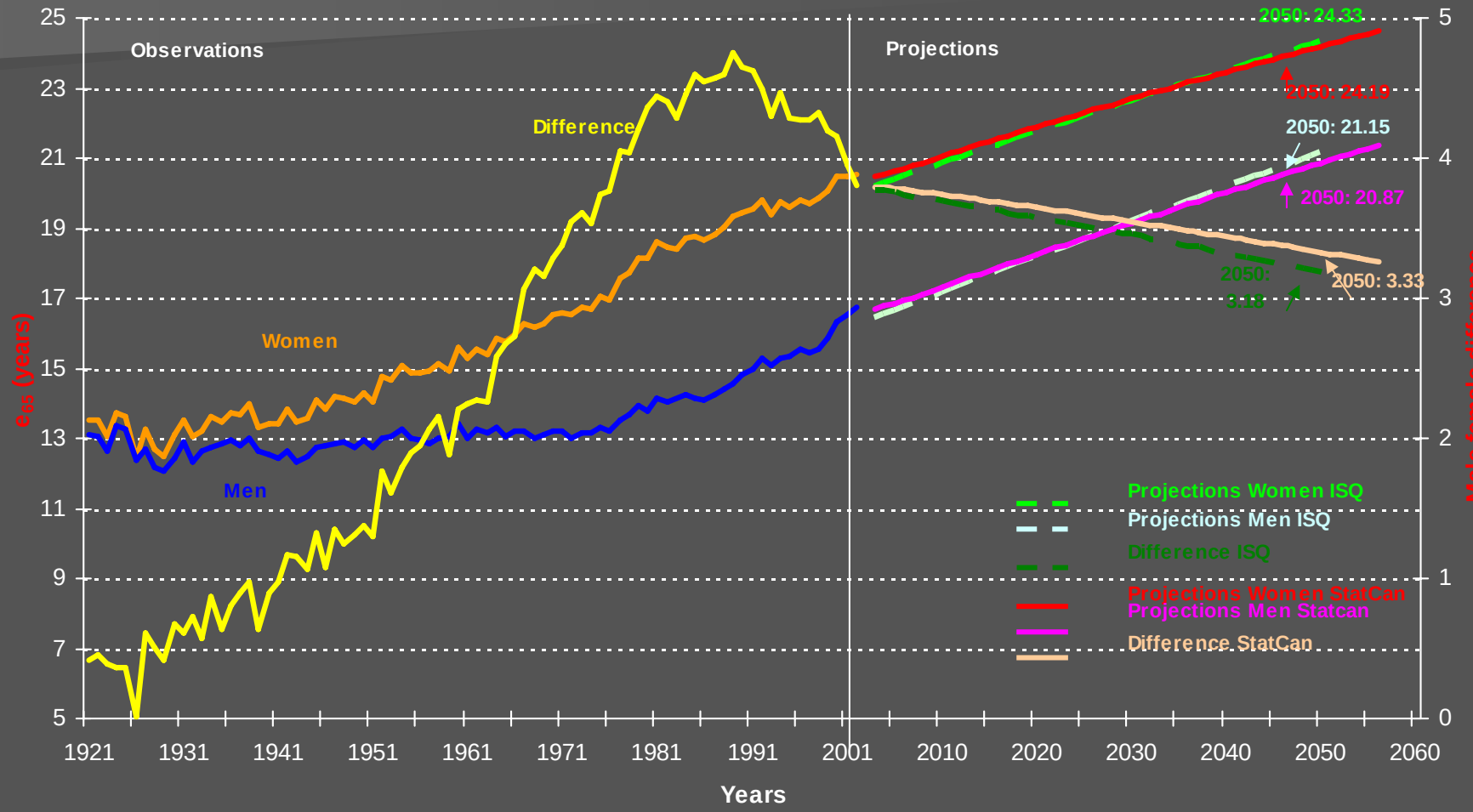
Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada; 2003-2050:ISQ

Life expectancy at age 65 (e_{65}) , 1921-2002 (observations), 2003-2056 (Statistics Canada projections), 2003-2050 (ISQ projections), Quebec



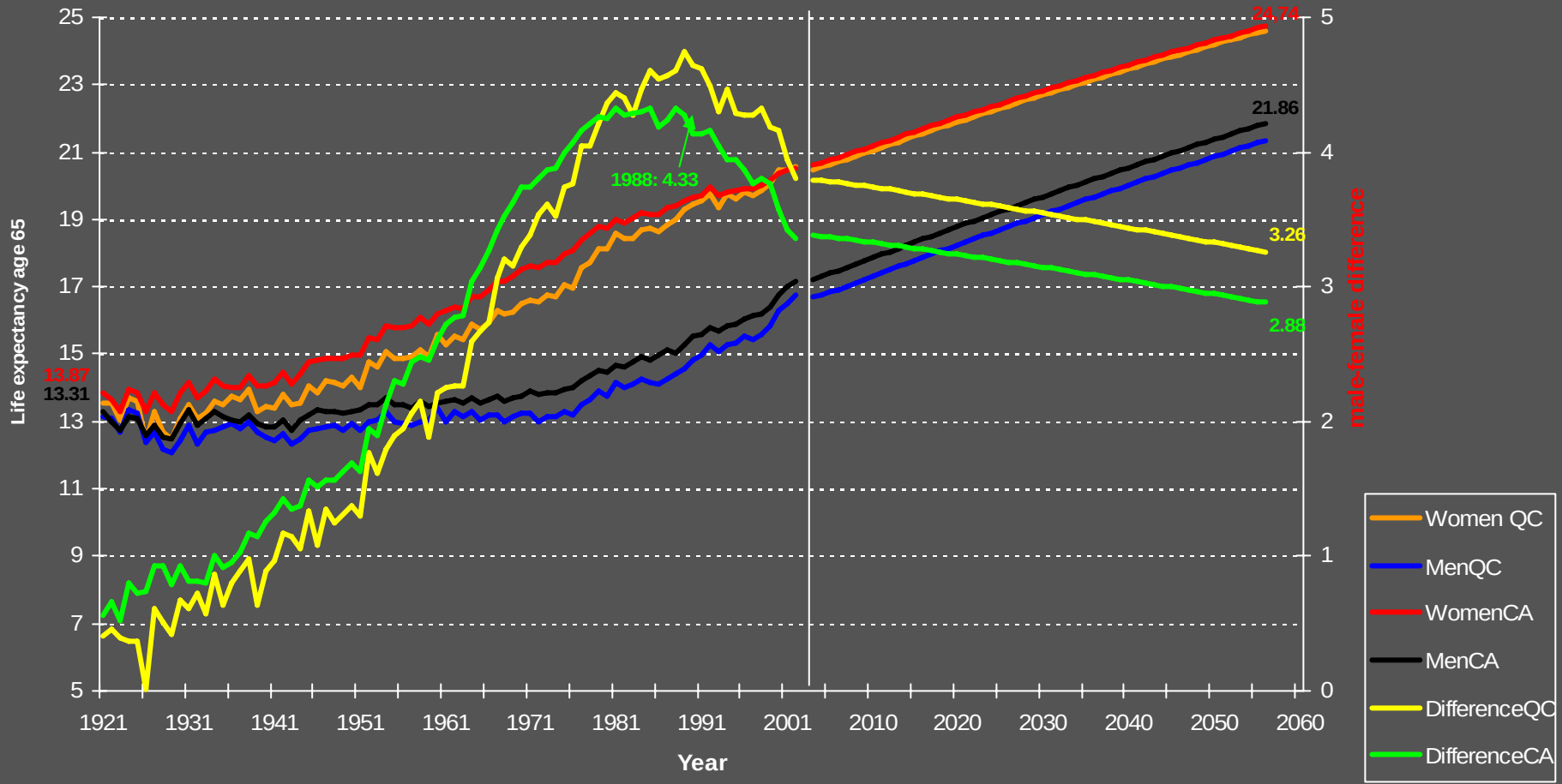
Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada; 2003-2050:ISQ

Life expectancy at age 65 (e_{65}) and male-female difference, 1921-2002 (observations), 2003-2056 (Statistics Canada projections), 2003-2050 (ISQ projections), Quebec



Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada; 2003-2050:ISQ

Life expectancy at age 65 (e_{65}) and male-female difference , Quebec and Canada, 1921-2002 (observations), 2003-2056 (projections)



Source: CHMD; 2001-2002: ISQ; 2003-2056: Statistics Canada

Life expectancy at birth (e_0), projections for Quebec, 2030 and 2050, and Canada, 2050

	2030		2050	
	Men	Women	Men	Women
RRQ (2003)	79.70	84.00	81.70*	85.70*
ISQ (2003)	81.66	86.31	84.50	88.57
Statistics Canada (2006) (Li and Lee method)	81.14	85.71	83.78	87.85
CPP (2003) - Canada				
With improvements			85.50	88.60
Without improvements			82.00	85.30

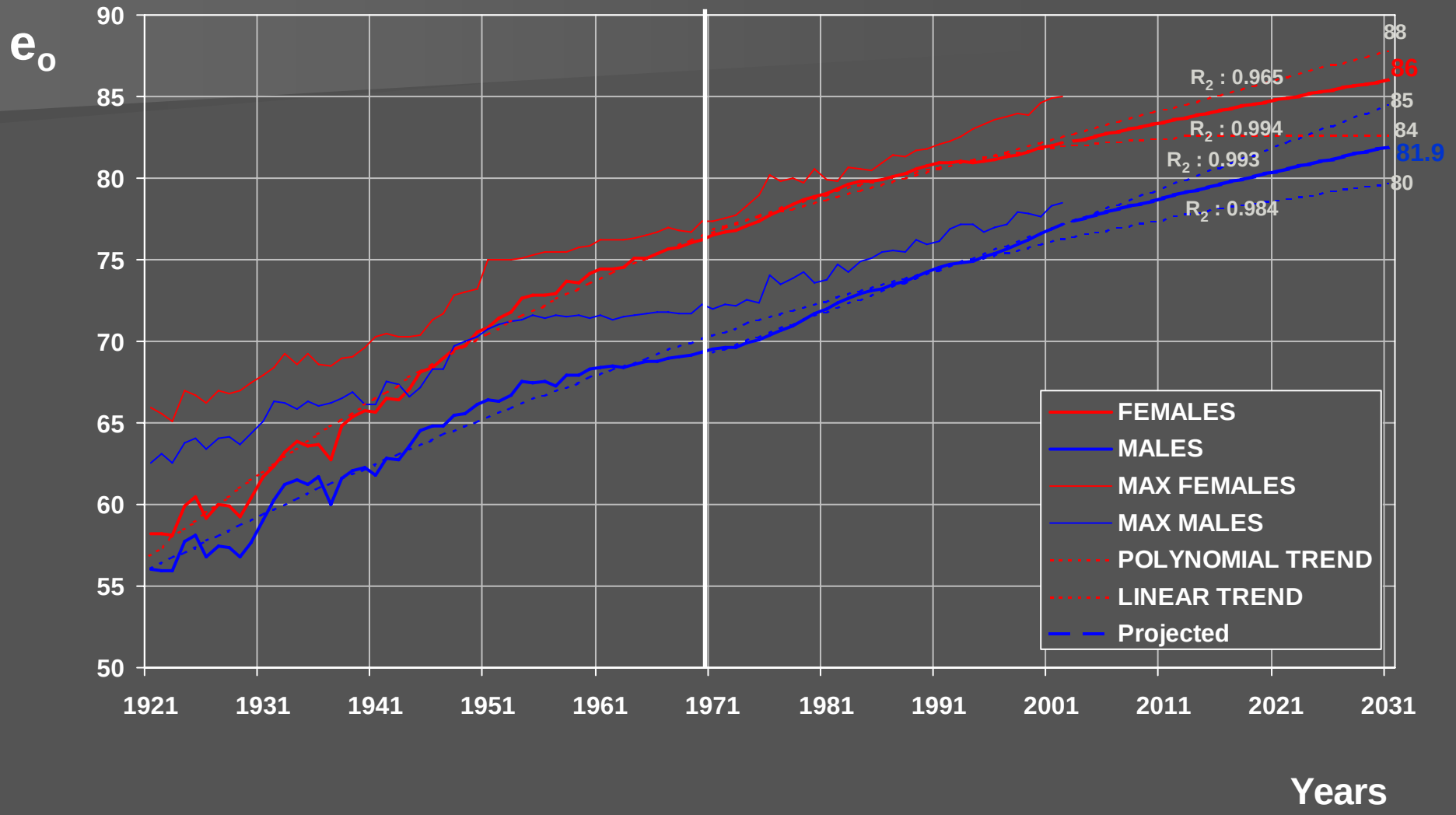
* Projections for 2055

Life expectancy at 65 years (e_{65}), projections for Quebec, 2030 and Canada, 2050

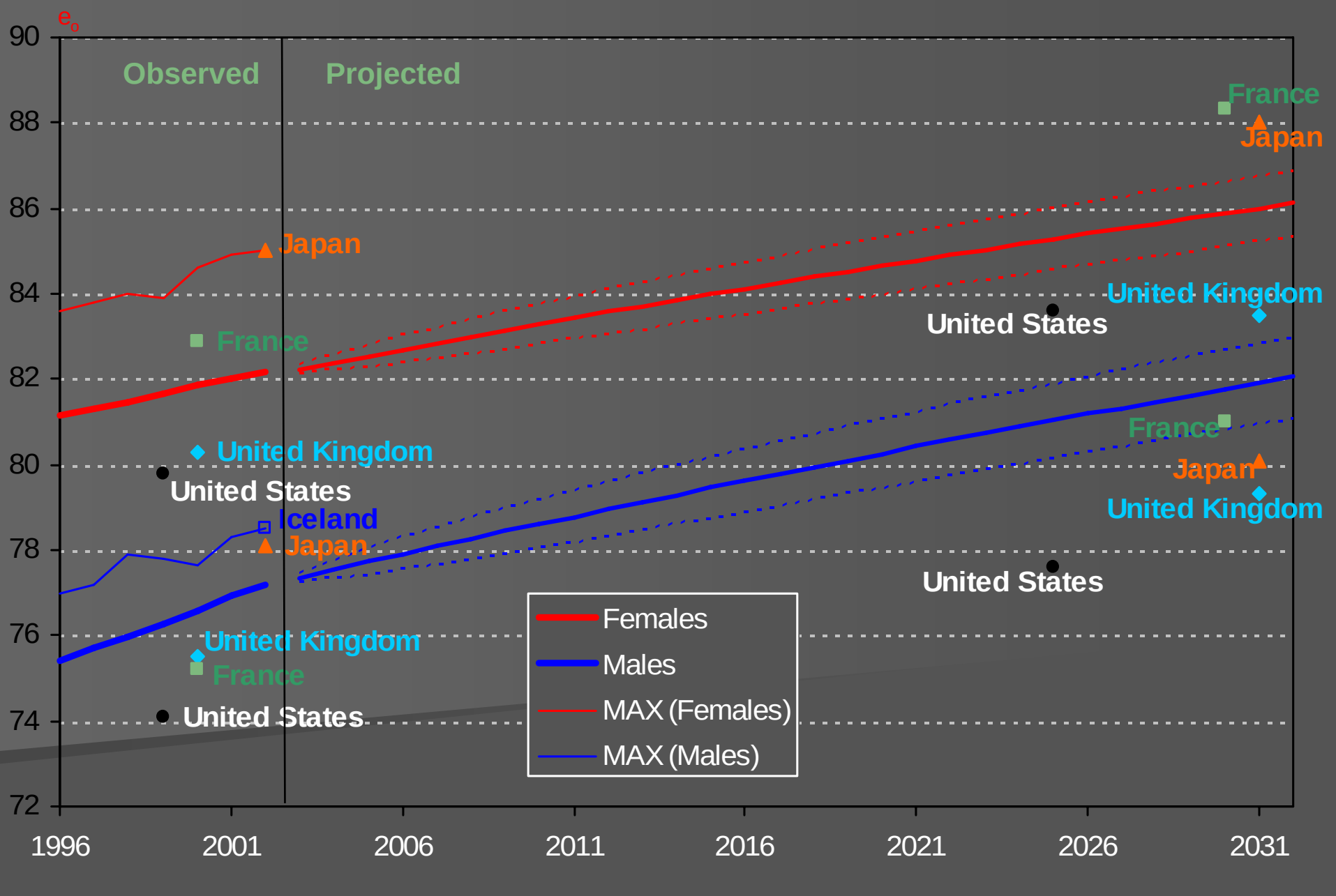
	2030		2050	
	Men	Women	Men	Women
RRQ (2003)				
With improvements	19.40	22.70	21.00*	24.10*
Without improvements	18.60	21.80	20.10*	23.20*
ISQ (2003)	19.17	22.62	21.15	24.33
Statistics Canada (2006) Li and Lee method	19.15	22.69	21.28	24.55
CPP (2003) - Canada				
With improvements			20.50	23.20
Without improvements			20.00	22.60

* Projections for 2055

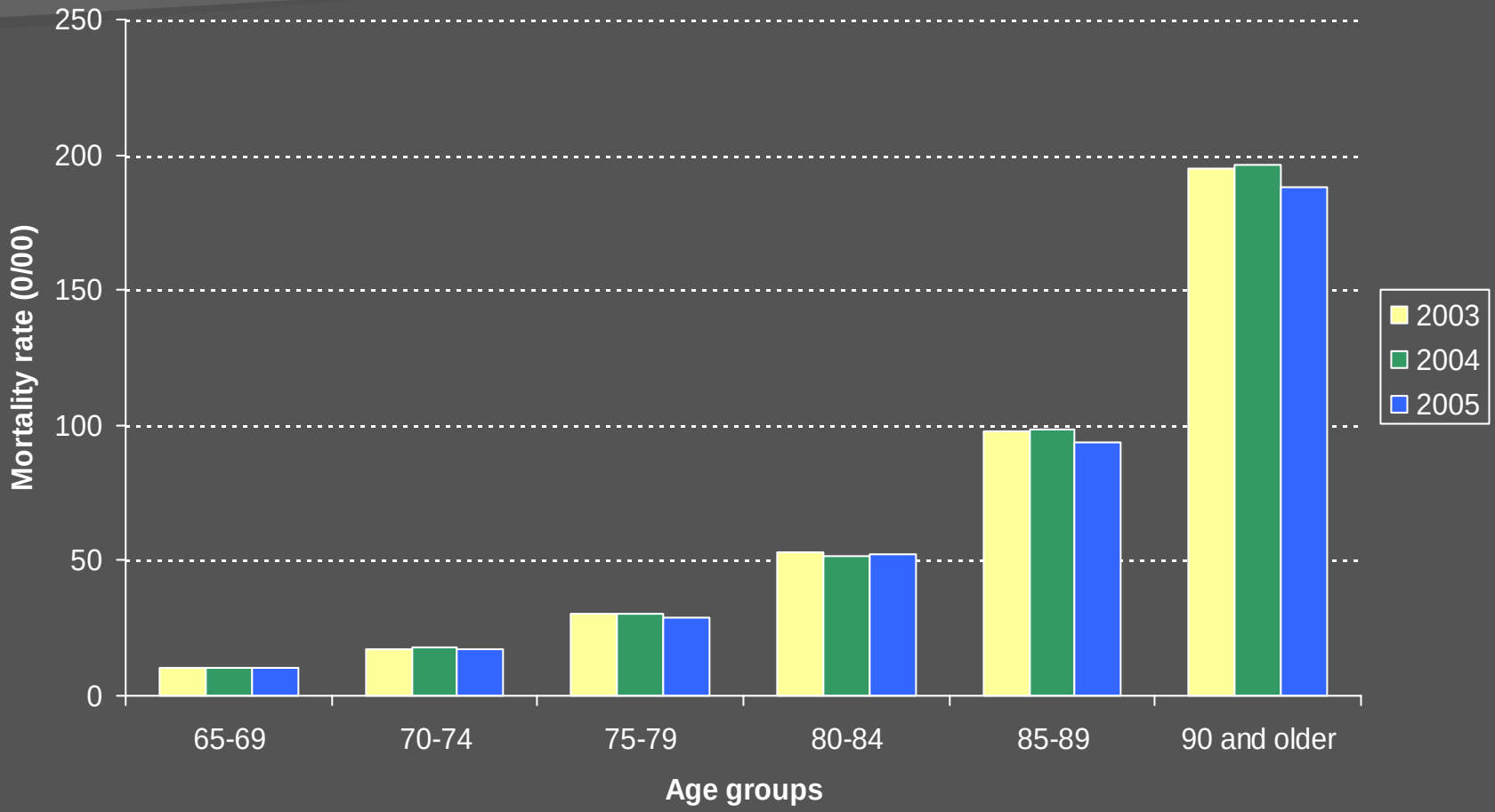
Life expectancy at birth (e_0) observed (1921-2002) and projected (2003-2031) in Canada and maximum life expectancy observed (1921-2002) in the world



International comparisons of projected life expectancy at birth (e_0), Canada (Statistics Canada) and various industrialized countries, 2001-2031

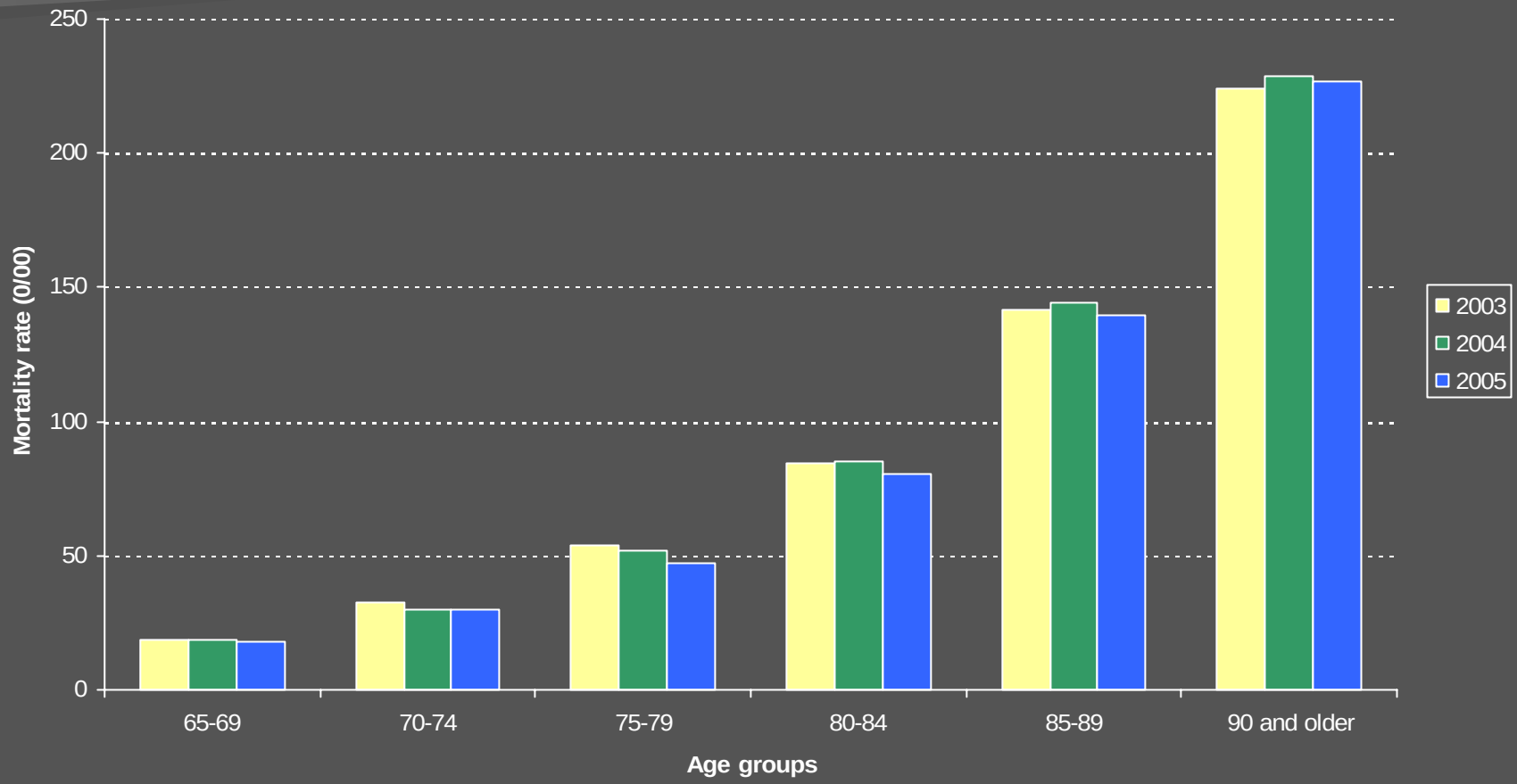


Female mortality rate by age group, Quebec, 2003-2005



Source: ISQ

Male mortality rate by age group, Quebec, 2003-2005



Source: ISQ

Three theories on the evolution in morbidity

- *The rising pandemic of mental disorders and associated chronic diseases and disabilities* (Gruenberg and Kramer 1980): the time of the appearance of diseases remains stable, but the length of survival with the disease is increasing. We will therefore see more severe conditions appear.

- *The compression of morbidity* (Fries 1980): the average age for the appearance of diseases is delayed, while life expectancy is relatively constant. Morbidity is therefore compressed in a short period of time.

- *The dynamic equilibrium* (Manton 1992): the rise in life expectancy is in part explained by the slowdown in the development of chronic diseases. The prevalence of diseases is increasing, but they are, on average, less severe.