

# Healthy Aging in Danish Centenarians

A 29-year follow-up of hospitalizations  
among 40,000 Danes born in 1905

THE DANISH AGING RESEARCH CENTER

**Kaare Christensen**

UNIVERSITY OF SOUTHERN DENMARK

21st REVES Conference  
Copenhagen, May 26-29, 2009

# Background

- Centenarians surpass the current human life expectancy with about 20-25 years.



# Background

- Centenarians surpass the current human life expectancy with about 20-25 years.
- Have centenarians been blessed with a healthier life than contemporaries who died at much younger ages?



# Background

- Centenarians surpass the current human life expectancy with about 20-25 years.
- Have centenarians been blessed with a healthier life than contemporaries who died at much younger ages?
- Centenarians may have reached very advanced age due to a unique capability to postpone disease and disability into their later years of life.

# Aim

## Are centenarians a good model for healthy aging?



**Age: 122 years**  
February 21, 1875 \*  
August 4, 1997 †

**Jeanne Calment**



**Age: 115 years**  
August 16, 1882\*  
April 25, 1998 †

**Chris Mortensen**

# Studying healthy aging in centenarians:

- **Control group?** Centenarians should be compared with members of their own birth cohort.
- **Design?** Longitudinal design with prospectively collected information about relevant markers of health.
- **Population?** A well defined study population with careful ascertainment of each participant to minimize the risk of selection bias.

# Methods

- **The Danish Civil Registration System (CRS).**
- **The unique civil person registration number (CPR number).**
- **The CPR number** serves as the key in all Danish registers and insures accurate linkage between different registers.
- **The Danish National Patient Registry (LPR)** was established in 1977. Since then, all hospital admissions have been recorded and linked to each individuals CPR number.

# Study population

40,355  
persons

```
graph TD; A[40,355 persons] --- B[410 persons]; A --- C[22,264 women]; A --- D[17,681 men];
```

On January 1, 1977, a total of 40,355 persons born in 1905 were still alive and living in Denmark (aged 72-73 years).

410  
persons

A total of 410 persons were excluded from the study population due to migration.

22,264  
women

17,681  
men

The study population consisted of **39,945** individuals.



# Follow-up

39,945 persons

- Hospitalizations
- Number of hospital days

**January 1, 1977**



**December 31, 2004**

**Date at death was available until December 2006.**

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

---

Age at death	N
71-74	5484
75-79	9012
80-84	9494
85-89	8506
90-94	5261
95-99	1829
100+	359

---

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

---

Age at death	N	71-74 %
71-74	5484	19.1
75-79	9012	57.2
80-84	9494	68.4
85-89	8506	74.9
90-94	5261	79.3
95-99	1829	81.7
100+	359	80.5

---

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Not hospitalized at age:	
		71-74 %	75-79 %
71-74	5484	19.1	
75-79	9012	57.2	13.7
80-84	9494	68.4	41.3
85-89	8506	74.9	53.1
90-94	5261	79.3	62.6
95-99	1829	81.7	68.1
100+	359	80.5	68.8

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Not hospitalized at age:		
		71-74 %	75-79 %	80-84 %
71-74	5484	19.1		
75-79	9012	57.2	13.7	
80-84	9494	68.4	41.3	14.4
85-89	8506	74.9	53.1	35.7
90-94	5261	79.3	62.6	49.2
95-99	1829	81.7	68.1	57.5
100+	359	80.5	68.8	60.2

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Not hospitalized at age:			
		71-74 %	75-79 %	80-84 %	85-89 %
71-74	5484	19.1			
75-79	9012	57.2	13.7		
80-84	9494	68.4	41.3	14.4	
85-89	8506	74.9	53.1	35.7	20.1
90-94	5261	79.3	62.6	49.2	34.0
95-99	1829	81.7	68.1	57.5	44.7
100+	359	80.5	68.8	60.2	52.4

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Not hospitalized at age:				
		71-74 %	75-79 %	80-84 %	85-89 %	90-94 %
71-74	5484	19.1				
75-79	9012	57.2	13.7			
80-84	9494	68.4	41.3	14.4		
85-89	8506	74.9	53.1	35.7	20.1	
90-94	5261	79.3	62.6	49.2	34.0	30.2
95-99	1829	81.7	68.1	57.5	44.7	33.6
100+	359	80.5	68.8	60.2	52.4	45.4

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Proportion of non-hospitalized individuals (%) by age period and age at death in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Not hospitalized at age:					
		71-74 %	75-79 %	80-84 %	85-89 %	90-94 %	95-99 %
<b>71-74</b>	5484	19.1					
<b>75-79</b>	9012	57.2	13.7				
<b>80-84</b>	9494	68.4	41.3	14.4			
<b>85-89</b>	8506	74.9	53.1	35.7	20.1		
<b>90-94</b>	5261	79.3	62.6	49.2	34.0	30.2	
<b>95-99</b>	1829	81.7	68.1	57.5	44.7	33.6	38.9
<b>100+</b>	359	80.5	68.8	60.2	52.4	45.4	43.5

\* Individuals with a migration status were excluded from the study population, n = 410



# Results

## Mean number of hospital days per individual per year by age at death (years) in the 1905 Cohort\*

Total sample - men and women (n=39,945)

---

Age at death

N

---

71-74	5484
75-79	9012
80-84	9494
85-89	8506
90-94	5261
95-99	1829
100+	359

---

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Mean number of hospital days per individual per year by age at death (years) in the 1905 Cohort\*

Total sample - men and women (n=39,945)

---

Age at death	N	71-74 Mean
71-74	5484	17.2
75-79	9012	5.5
80-84	9494	3.1
85-89	8506	2.0
90-94	5261	1.4
95-99	1829	1.3
100+	359	1.0

---

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Mean number of hospital days per individual per year by age at death (years) in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Hospitalized at age:		
		71-74 Mean	SE	75-79 Mean
71-74	5484	17.2	0.3	
75-79	9012	5.5	0.1	15.1
80-84	9494	3.1	0.1	5.6
85-89	8506	2.0	0.1	3.2
90-94	5261	1.4	0.1	2.1
95-99	1829	1.3	0.1	1.3
100+	359	1.0	0.2	1.5

\* Individuals with a migration status were excluded from the study population, n = 410

# Results

## Mean number of hospital days per individual per year by age at death (years) in the 1905 Cohort\*

Total sample - men and women (n=39,945)

Age at death	N	Hospitalized at age:											
		71-74		75-79		80-84		85-89		90-94		95-99	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
<b>71-74</b>	5484	17.2	0.3										
<b>75-79</b>	9012	5.5	0.1	15.1	0.2								
<b>80-84</b>	9494	3.1	0.1	5.6	0.1	14.0	0.2						
<b>85-89</b>	8506	2.0	0.1	3.2	0.1	5.5	0.1	11.5	0.2				
<b>90-94</b>	5261	1.4	0.1	2.1	0.1	3.1	0.1	5.1	0.1	7.2	0.2		
<b>95-99</b>	1829	1.3	0.1	1.3	0.1	1.7	0.1	2.9	0.1	3.8	0.2	4.8	0.2
<b>100+</b>	359	1.0	0.2	1.5	0.2	1.4	0.2	1.6	0.2	2.7	0.3	2.8	0.3

\* Individuals with a migration status were excluded from the study population, n = 410

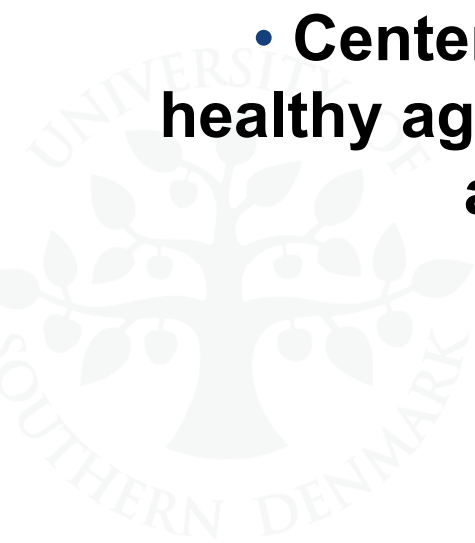
# Conclusion

- **An inverse relationship between age at death and being hospitalized and length of stay in hospital at earlier ages.**



# Conclusion

- **An inverse relationship between age at death and being hospitalized and length of stay in hospital at earlier ages.**
- **Centenarians represent a useful model for healthy aging as measured using hospitalizations and length of stay in hospital.**



# Conclusion

- **An inverse relationship between age at death and being hospitalized and length of stay in hospital at earlier ages.**
- **Centenarians represent a useful model for healthy aging as measured using hospitalizations and length of stay in hospital.**
- **Fixed traits**

# Paper:

**Centenarians - a useful model for healthy aging? A 29-year follow-up of hospitalizations among 40,000 Danes born in 1905.** Aging Cell (forthcoming).

Henriette Engberg<sup>1</sup>, Anna Oksuzyan<sup>2</sup>, Bernard Jeune<sup>1</sup>, James W. Vaupel<sup>2</sup> and Kaare Christensen<sup>1</sup>

<sup>1</sup> The Danish Aging Research Center, University of Southern Denmark, Odense, DK.

<sup>2</sup> Max Planck Institute for Demographic Research, Rostock, Germany.

