Fresh Approaches to the Studies of Maternal Effects on Exceptional Human Longevity

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Approach

To study "success stories" in long-term avoidance of fatal diseases (survival to 100 years) and factors correlated with this remarkable survival success

Centenarians represent the fastest growing age group in the industrialized countries

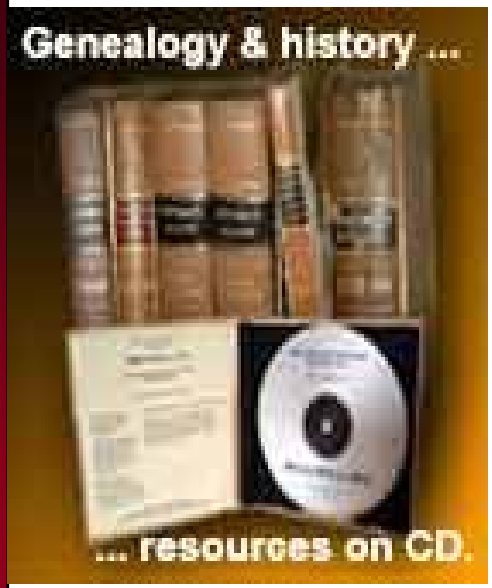
Yet, factors predicting exceptional longevity and its time trends remain to be fully understood

In this study we explored the new opportunities provided by the ongoing revolution in information technology, computer science and Internet expansion to explore early-childhood predictors of exceptional longevity

Jeanne Calment
(1875-1997)

Revolution in Information Technology

What does it mean for longevity studies?



Over 75 millions of computerized genealogical records are available online now!

Computerized genealogies is a promising source of information about potential predictors of exceptional longevity: life-course events, early-life conditions and family history of longevity

Computerized Genealogies as a Resource for Longevity Studies

Pros: provide important information about family and life-course events, which otherwise is difficult to collect (including information about lifespan of parents and other relatives)

Cons: Uncertain data quality
Uncertain validity and generalizability

For longevity studies the genealogies with detailed birth dates and death dates for long-lived individuals (centenarians) and their relatives are of particular interest

In this study 1,001 genealogy records for centenarians born in 1875-1899 were collected and used for further age validation

Edit View Books People Picture/Object Contents Format Tools Internet Help

Parents of William Howard

To be added & To be added

Parents of Florence Ida

John James & Ordelia

Husband

Name	William Howard Hickok
Birth date	13 Apr 1846
Birth place	Wisconsin
Death date	30 May 1930
Death place	Lockeford, California

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Wife

Name	Florence Ida Shoemaker
Birth date	07 Nov 1857
Birth place	Wisconsin
Death date	14 Nov 1911
Death place	San Mateo, California

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Marriage

Date 26 Dec 1874 Place Hollister, San Benito County, California

Children(8)

Name	Sex	Birth date	Birth place	Death date	Death place
Ella Dorinda Hickok	F	14 Jun 1878	Colusa, Colusa County, Californ	10 Nov 1980	Fort Morgon, Morgan County,
Fred Hickok	M	20 Feb 1881	Florence, Douglas County, Ore	12 Apr 1935	San Luis Obispo County, Califc
Ada Penecia Hickok	F	23 Sep 1883	Tres Pinos, San Benito County	05 Jan 1959	California
Stella (Estelle) Hickok	F	03 Apr 1886	Jolan, Monterey County, Califc	17 May 1984	San Francisco, San Francisco C
Laura Leona Hickok	F	30 Aug 1888	Jolan, Monterey County, Califc	28 Dec 1979	Larkspur, Marin County, Califor
Walter Hickok	M	10 Jun 1891	Moss Landing, Monterey Coun	Mar 1993	Bend, Deschutes County, Ore
Olive Viola Hickok	F	14 Aug 1893	Salinas, Monterey County, Cali	09 Dec 1957	

Steps of Centenarian Age Verification

1. Internal consistency checks of dates
2. Verification of death dates – linkage to the Social Security Administration Death Master File (DMF)
3. Verification of birth dates – linkage to early Federal censuses (1900, 1910, 1920, 1930)

Results of Centenarian Age Verification

1001 records consistency checks	990 records used for further verification
990 records were linked to the SSA Death Master File	Linkage success rate 77% (80% for centenarians born after 1890) In 3% of cases centenarian status was not confirmed
548 records found in DMF for persons born in 1890-1899 were then linked to early US censuses	Linkage success rate 80% when using Genealogy.com and 91% after supplementation with Ancestry.com. In 8% of cases a 1-year disagreement between genealogy and census record was observed

Conclusions of the Age Verification Study

Death dates of centenarians recorded in genealogies always require verification because of strong outliers (1.3%, misprints)

Birth dates of centenarians recorded in genealogies are sufficiently accurate - 92% are correct; for the remaining 8% only one-year disagreements

Quality of genealogical data is good enough if these data are pre-selected for high data quality

Study:

Compare centenarians with their siblings (within-family study)

Within-Family Study of Exceptional Longevity

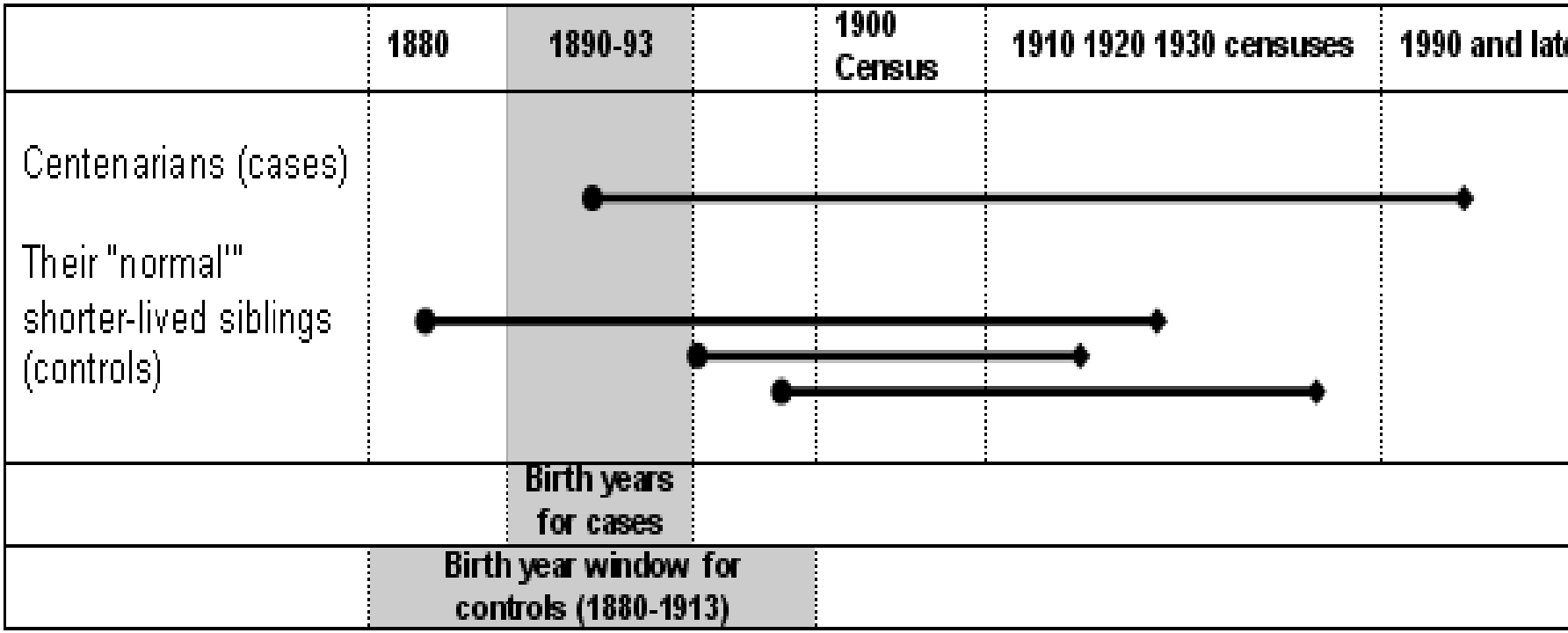
Cases - 198 Centenarians born in U.S. in 1890-1893

Controls – Their own siblings

Method: Conditional logistic regression

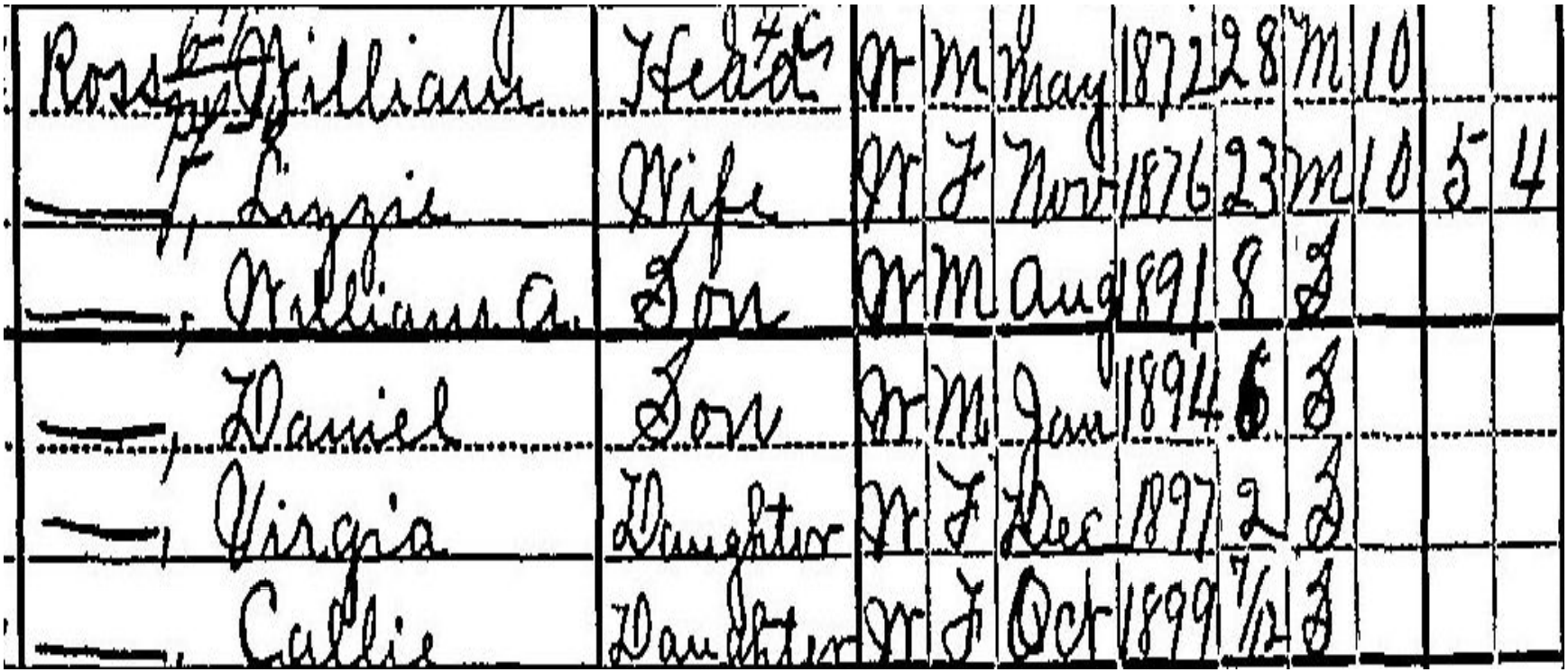
Advantage: Allows researchers to eliminate confounding effects of between-family variation

Design of the Study



Circles indicate birth, diamonds indicate death.

A typical image of 'centenarian' family in 1900 census

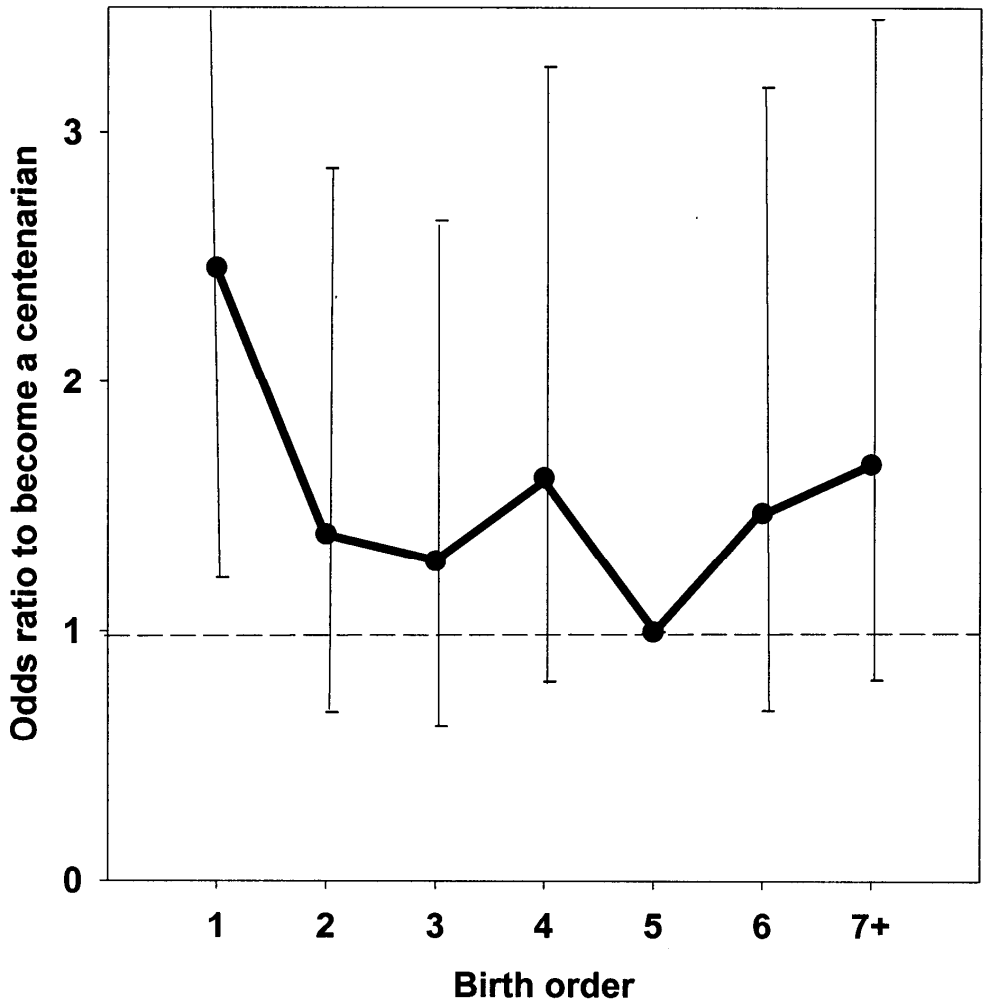


Ross [illegible] Gilliam	Head	W	M	May	1872	28	M	10		
" Lizzie	Wife	W	F	Nov	1876	23	M	10	5	4
" William A.	Son	W	M	Aug	1891	8	S			
" Daniel	Son	W	M	Jan	1894	6	S			
" Virgie	Daughter	W	F	Dec	1897	2	S			
" Callie	Daughter	W	F	Oct	1899	7/12	S			

First-born siblings are more likely to become centenarians (odds = 1.8)

Conditional (fixed-effects) logistic regression N=950, Prob > chi2=0.0000			
Variable	**Odds ratio**	**95% CI**	**P-value**
First-born status	**1.77**	1.18-2.66	**0.006**
Male sex	0.40	0.28-0.58	<0.001

Birth Order and Odds to Become a Centenarian



Can the birth-order effect be a result of selective child mortality, thus not applicable to adults?

Approach:

To compare centenarians with those siblings only who survived to adulthood (age 20)

First-born adult siblings (20+years) are more likely to become centenarians (odds = 1.95)

Conditional (fixed-effects) logistic regression
N=797, Prob > chi2=0.0000

Variable	Odds ratio	95% CI	P-value
First-born status	1.95	1.26-3.01	0.003
Male sex	0.46	0.32-0.66	<0.001

Are young fathers responsible for birth order effect?

Conditional (fixed-effects) logistic regression N=950, Prob > chi2=0.0000			
Variable	**Odds ratio**	**95% CI**	**P-value**
Born to young father	**1.86**	**0.99-3.50**	**0.056**
Male sex	**0.42**	**0.29-0.59**	**<0.001**

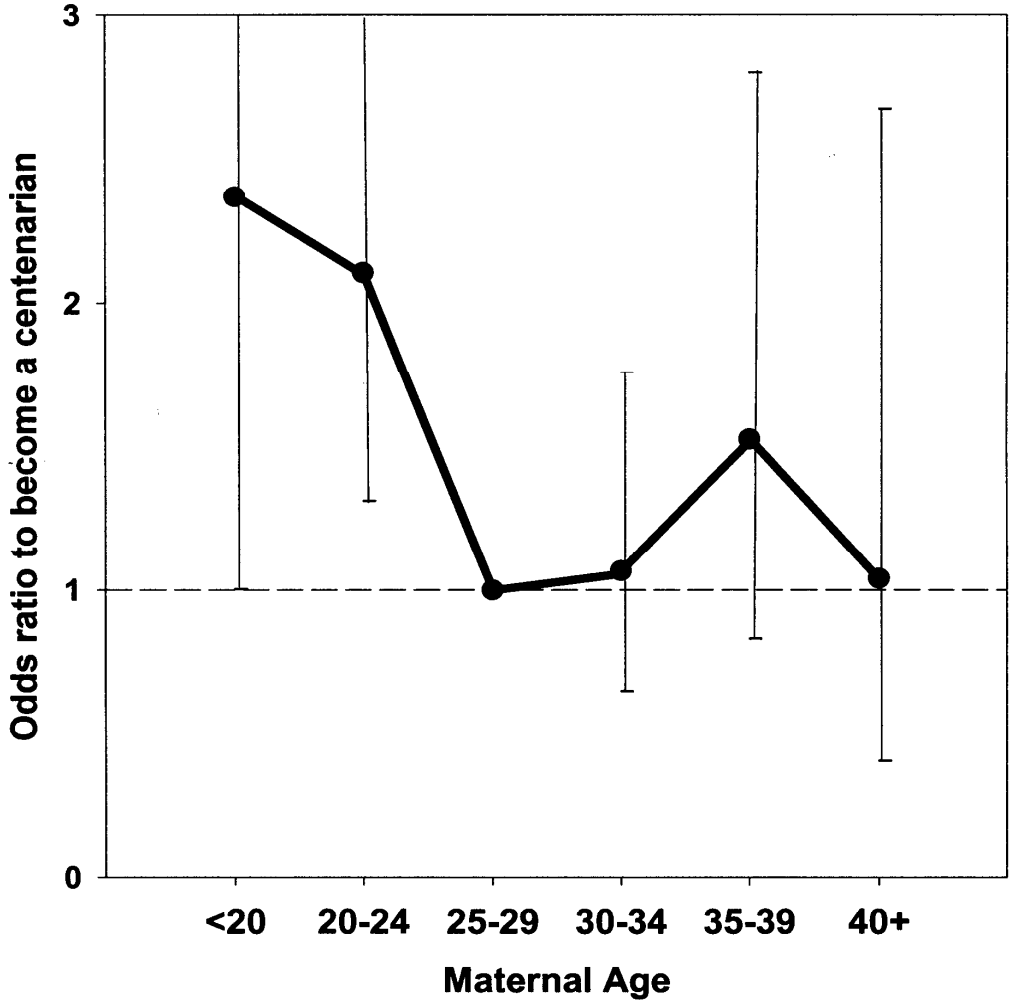
Birth order is more important than paternal age for chances to become a centenarian

Conditional (fixed-effects) logistic regression N=950, Prob > chi2=0.0000			
Variable	**Odds ratio**	**95% CI**	**P-value**
First-born status	**1.64**	**1.03-2.61**	**0.039**
Born to young father	**1.29**	**0.63-2.67**	**0.484**
Male sex	**0.41**	**0.29-0.58**	**<0.001**

Are young mothers responsible for the birth order effect?

Conditional (fixed-effects) logistic regression N=950, Prob > chi2=0.0000			
Variable	**Odds ratio**	**95% CI**	**P-value**
Born to young mother	**2.03**	**1.33-3.11**	**0.001**
Male sex	**0.41**	**0.29-0.59**	**<0.001**

Maternal Age at Person's Birth and Odds to Become a Centenarian



Birth order effect explained: Being born to young mother!

Conditional (fixed-effects) logistic regression N=950, Prob > chi2=0.0000			
Variable	**Odds ratio**	**95% CI**	**P-value**
First-born status	**1.36**	**0.86-2.15**	**0.189**
Born to young mother	**1.76**	**1.09-2.85**	**0.021**
Male sex	**0.41**	**0.29-0.58**	**<0.001**

Even at age 75 it still helps to be born to young mother (age <25) (odds = 1.9)

Conditional (fixed-effects) logistic regression N=557, Prob > chi2=0.0000			
Variable	**Odds ratio**	**95% CI**	**P-value**
Born to young mother	**1.86**	**1.15-3.05**	**0.012**
Male sex	**0.46**	**0.31-0.69**	**<0.001**

Question

Families were quite large in the past, particularly those covered by genealogical records (large family size bias).

Is the "young mother effect" robust to the family size, and is it observed in smaller families too?

Or is it confined to extremely large families only?

Approach:

To split data in two equal parts by median family size (9 children) and re-analyze the data in each group separately.

Results

In smaller families (less than 9 children) the effect of young mother is even larger:

Odds ratio = **2.23**, P=0.004; 95%CI = 1.30 - 3.98

Compare to larger families (more than 9 children):

Odds ratio = **1.72**, P=0.11; 95%CI = 0.88 - 3.34

Conclusion:

"Young mother effect" is not confined to extremely large family size

New Striking Findings: Invitation for discussion and brain-storming!

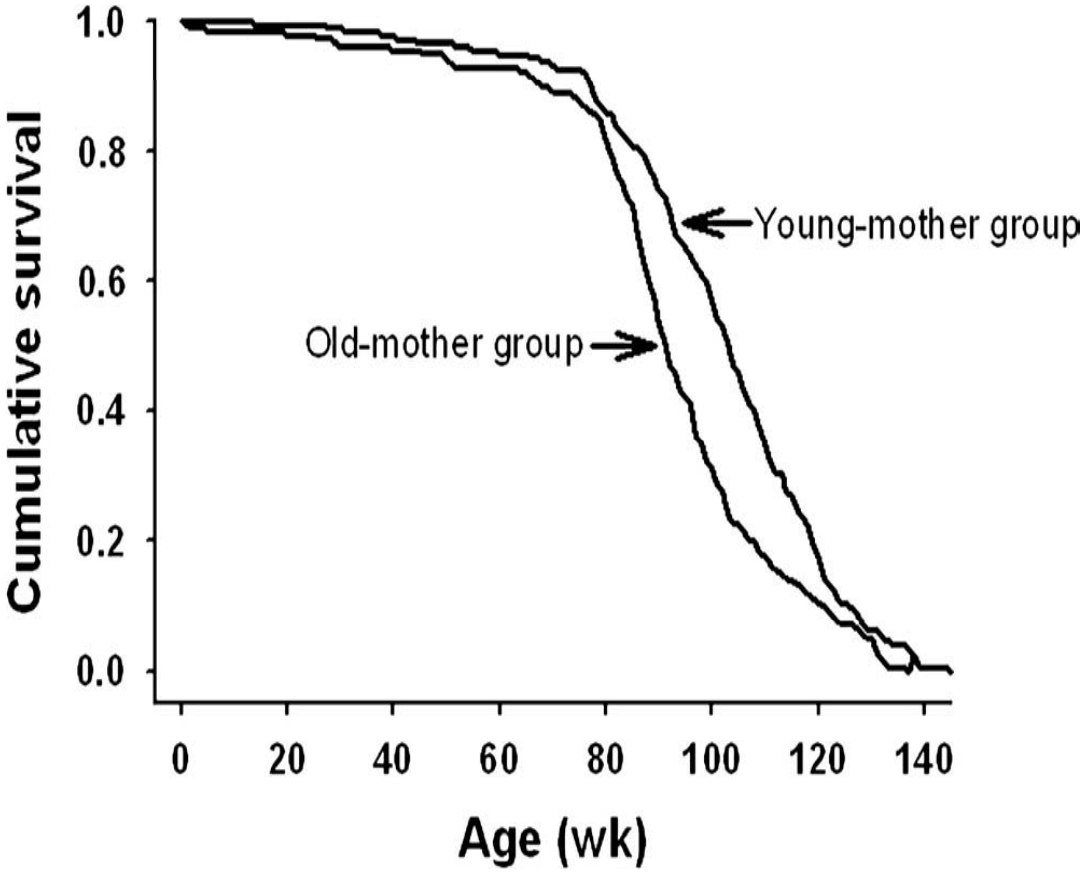
The favorable "Young Mother Effect" is particularly strong when parents have particularly large differences in their lifespan

Odds Ratio to live to 100 years if born to young mother as a function of maternal and paternal lifespans (tertiles)

MOTHER	FATHER		
	Shorter-lived	Medium-lived	Longer-lived
Shorter-lived	**0.93**	**1.29**	**4.04***
Medium-lived	**3.49***	**3.01**	**1.50**
Longer-lived	**11.62***	**1.21**	**0.36**

*** p<0.05**

Being born to Young Mother Helps Laboratory Mice to Live Longer



Source:

Tarin et al., Delayed Motherhood Decreases Life Expectancy of Mouse Offspring. ***Biology of Reproduction*** **2005 72: 1336-1343.**

Conclusions

- Centenarians are more likely to be first-born
- The effect of first-born status is driven mostly by young maternal age (<25) at person's birth
- Being born to young mother is an important predictor of human longevity even at age 75

Acknowledgments

This study was made possible thanks to:

generous support from the National Institute on Aging and the Society of Actuaries

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