Epidemiological predictors of later life health:
Elite Survival in Iowa EPESE cohort

followed to 'extinction'

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Outline

- Background: Why choose the study and Iowa EPESE?
- Aim of the study
- Methods
  - Selection of predictors
  - Modeling
  - Cumulative score
- Results of modeling
- Discussion about the significant predictors

Background

- Extreme longevity: still a rare phenomenon (only 7 out 100,000 survive beyond 100 years)
- But the most rapidly growing segment of the population in the industrialized world and also in emerging economies
- "Healthy and successful aging": "Elite Survivors" mostly healthy and active for longer too
- Elite Survivors may provide clues on how to avoid premature morbidity and mortality: help to design interventions

Background contd..

- Many studies to identify determinants of extreme longevity
  - Okinawa, New England, Honolulu, Sardinian, Danish centenarian studies etc.
- Mostly cross sectional
  - Comparison group from younger population exposed to different diet, lifestyle, health care – "cohort effects"
- Dominated by females

EPESE, Iowa

- Established Population for Epidemiological Study of Elderly
  - Iowa (Iowa and Washington counties)
- All elderly people (>=65 years) dwelling in the community identified: 4601
- Baseline interviews conducted: 3674 (80% response rate, missing members demographically similar to others)
- Baseline interview: Nov 1981 to Jan 1983
- Last death followed up till 2008
- Death ascertained: 3482/3674 (95%)

Aim:

Identification of early life and baseline predictors of extreme longevity in elderly males and females

Methods

Classes of predictors:

1. Demographic
2. Social
3. General health and lifestyle
4. Cognition and mental health
5. Physical function

1. Demographic

- Age at baseline
- Sex
- Birth order among siblings
- Parental age at death

2. Social

- Education
- Family income
- Marital status
- Support from social networks (children, friends and relatives)

3. General Health and Lifestyle

- Smoking
- Chronic diseases
- Self-reported health
- Body Mass Index at 50 years and at baseline
- Blood Pressure
- Sleep

4. Cognition and Mental Health

- Cognitive ability
  - SPMSQ
  - Self-rated memory and word recall
- Attitude towards life
- Depression
- Panic
- Anxiety

5. Physical Function

- Activities of daily living (ADL)
- Gross mobility and physical ability
  - Heavy chores, climbing stairs, walking ½ mile, pull/push heavy objects, stooping, raising arms, writing
- Exercise

Definition and Inclusion Criterion

- Elite survivors:
  - Males: 9.11% = 94+ yrs
  - Females: 8.44% = 97+ yrs
- Included: 65-84 yrs at baseline, people who lived almost 10 years to become elite survivors
- lived for >=3 yrs : to exclude terminally ill individuals

Analysis

- Basic adjusted logistic regression model: individual variables (age, sex and smoking adjusted) and interaction
- Fully adjusted logistic regression model: Multiple variables with significant results ($p<0.05$) in previous analyses
  - Baseline predictors
  - Early-life predictors
- Cumulative Score used for logistic regression and survival analysis

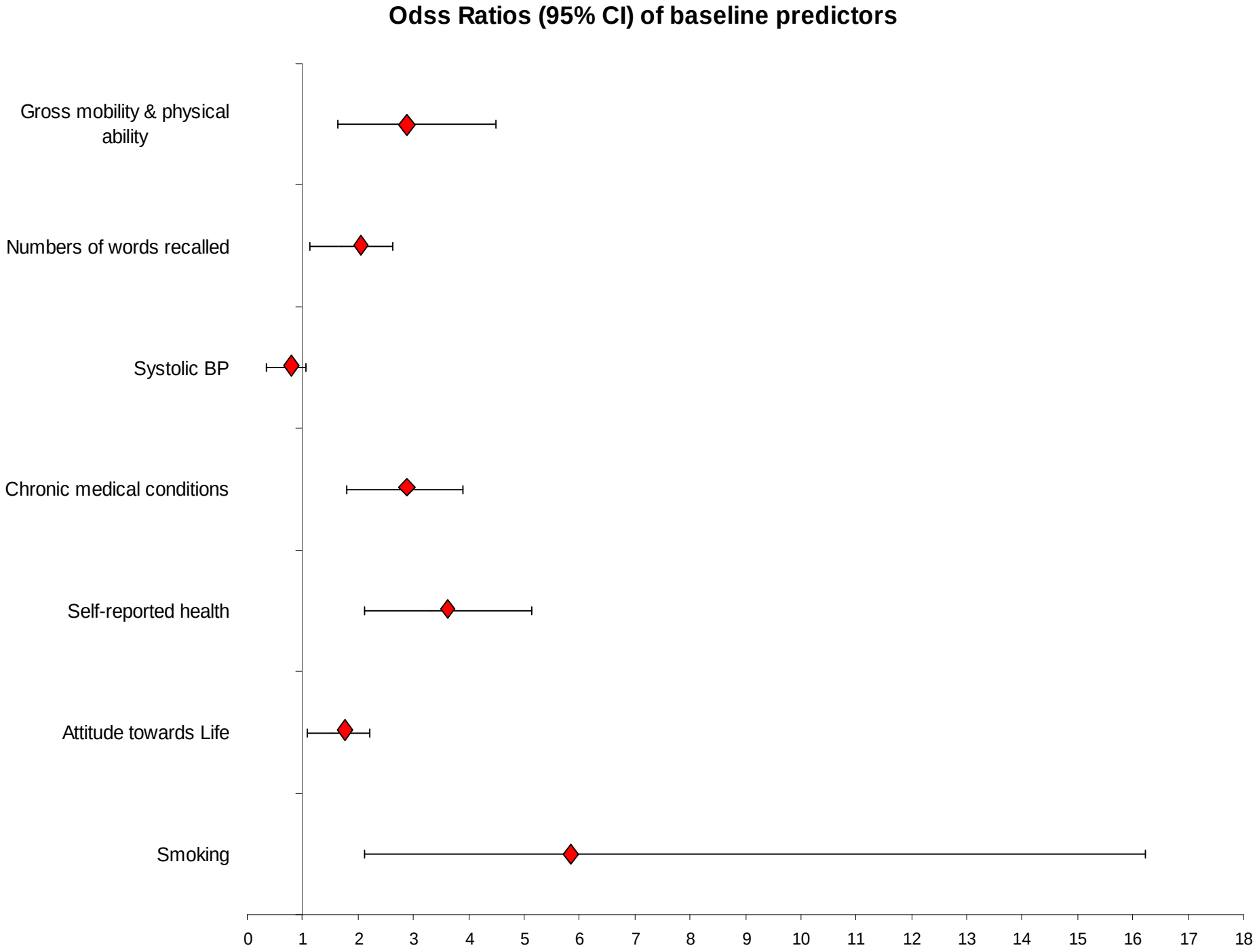
Results

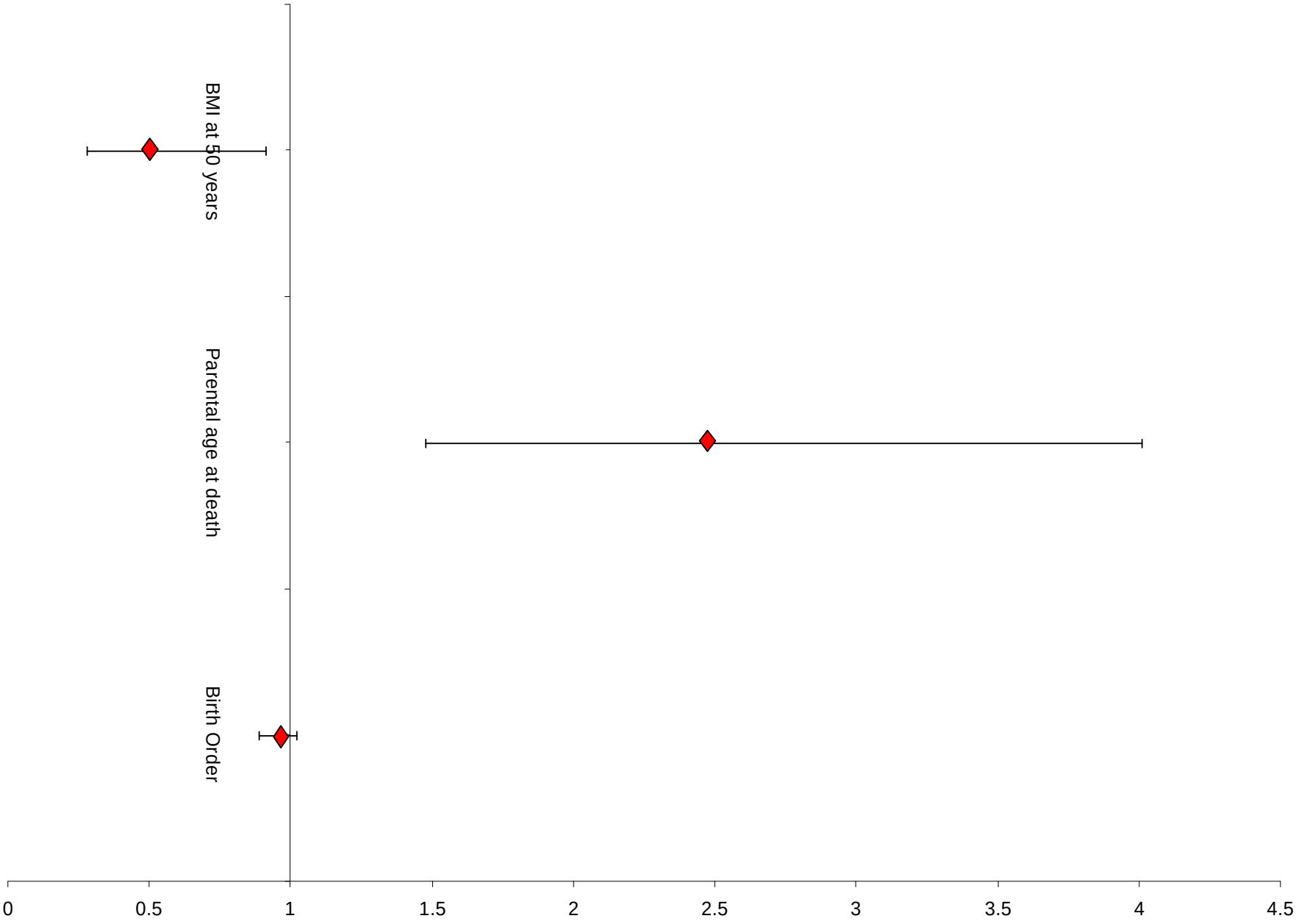
Table 1a. Basic characteristics of participants* in Established Population for the Epidemiological Study of the Elderly (EPESE), Iowa

	Male	Female
Longevity		
Age at baseline		
Median age at baseline (inter-quartile range)	72 (8)	74 (8)
Longevity beyond baseline		
Median years lived beyond baseline (inter-quartile range)	11 (10)	14 (11)
Age at death		
Median age at death (Inter-quartile range)	85 (9)	89 (9)
Elite survival (approximately top 10% longest-lived members in respective groups)		
Numbers of elite survivors (cut-off age for elite survival)	99 (94 yrs)	154 (97 yrs)
Demographic characteristics		
Birth order of participants among siblings		
Median birth order (inter-quartile range)	3 (2)	3 (2)
Minimum-Maximum birth order of participants	1 to 19	1 to 15
Parents' age at death		
Both parents living >= 85 yrs (%)	57 (7%)	95 (7%)
One parent living >= 85 yrs (%)	285 (35%)	483 (35%)
Pregnancy		
At least one pregnancy (%)	NA	1319 (85%)
Social characteristics		
Marital status		
Never Married (%)	45 (4%)	104 (6%)
Spouse support		
Living with spouse (%)	783 (71%)	667 (39%)
Educational Status		
Less than 9 years (%)	499 (46%)	574 (34%)
9-12 years (%)	438 (40%)	759 (45%)
More than 12 years	154 (14%)	370 (22%)
Annual income (1981-83)		
< $ 5,000 (%)	102 (12%)	339 (26%)
$ 5000 - $ 9999 (%)	277 (32%)	513 (39%)
> $ 10, 000 (%)	488 (56%)	472 (36%)
Social network support from children, friends or relatives		
No support (%)	18 (2%)	16 (1%)
1 to 2 sources of support (%)	578 (66%)	1001 (69%)
3 sources of support (%)	279 (32%)	420 (29%)
Attitude towards life		
Negative attitude (%)	330 (37%)	563 (38%)
Intermediate attitude (%)	255 (29%)	433 (29%)
Positive attitude (%)	306 (34%)	474 (32%)

Table 1b. Basic characteristics of participants in Established Population for the Epidemiological Study of the Elderly (EPESE), Iowa

	Male	Female
General health and lifestyle characteristics		
Self-reported health		
Excellent (%)	208 (19%)	324 (19%)
Good (%)	580 (53%)	910 (54%)
Poor to very poor (%)	298 (27%)	465 (27%)
Systolic BP		
< 120 (%)	153 (17%)	252 (17%)
120 – 139 (%)	357 (42%)	565 (38%)
140 – 159 (%)	272 (30%)	464 (31%)
>159 (%)	117 (13%)	215 (14%)
Diastolic BP		
<80 (%)	608 (6%)	1056 (71%)
80 - 119 (%)	210 (23%)	326 (22%)
>119 (%)	81 (9%)	114(8%)
Sleep scores		
Maximum sleep difficulty (%)	365 (40%)	727 (48%)
Intermediate sleep difficulty (%)	366 40%)	530 (35%)
Minimum sleep difficulty (%)	185 (20%)	267 (17%)
Smoking		
Never smoked (%)	437 (40%)	1462 (86%)
Ex-smokers (%)	503 (46%)	121 (7%)
Current smokers (%)	152 (14%)	115 (7%)
Cognition and Mental health		
Short Portable Mental Status Questionnaire		
Number (%) with less than full score	695 (47%)	786 (53%)
Self Assessed Memory Score		
Minimum memory score (%)	270 (33%)	458 (33%)
Intermediate memory score (%)	336 (41%)	611 (44%)
Maximum memory score (%)	219 (26%)	328 (23%)
Numbers of words recalled		
Minimum numbers (%)	374 (46%)	592 (33%)
Intermediate numbers (%)	316 (39%)	612 (39%)
Maximum numbers (%)	134 (16%)	442 (29%)
Physical Functional Assessment		
Activities of Daily Living (ADL)		
Numbers (%) with some difficulty	59 (6%)	152 (10%)
Gross mobility and physical ability		
Numbers (%) with difficulty in < 2/7 activities	208 (23%)	387 (27%)
Numbers (%) with difficulty in > 2/7 activities	80 (9%)	233 (16%)
Exercise score		
Minimum exercise (%)	368 (33%)	643 (36%)
Moderate exercise (%)	598 (54%)	998 (56%)
Maximum exercise (%)	144 (13%)	149 (8%)


Odss Ratios (95% CI) of baseline predictors
Gross mobility & physical ability
Numbers of words recalled
Systolic BP
Chronic medical conditions
Self-reported health
Attitude towards Life
Smoking
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18


Odds Ratios (95% CI), Early Life Predictors
BMI at 50 years
Parental age at death
Birth Order
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5

Results (gender difference)

- All predictors significant for females

- Three predictors significant for females only:

  Significant sex interaction terms for these three variables

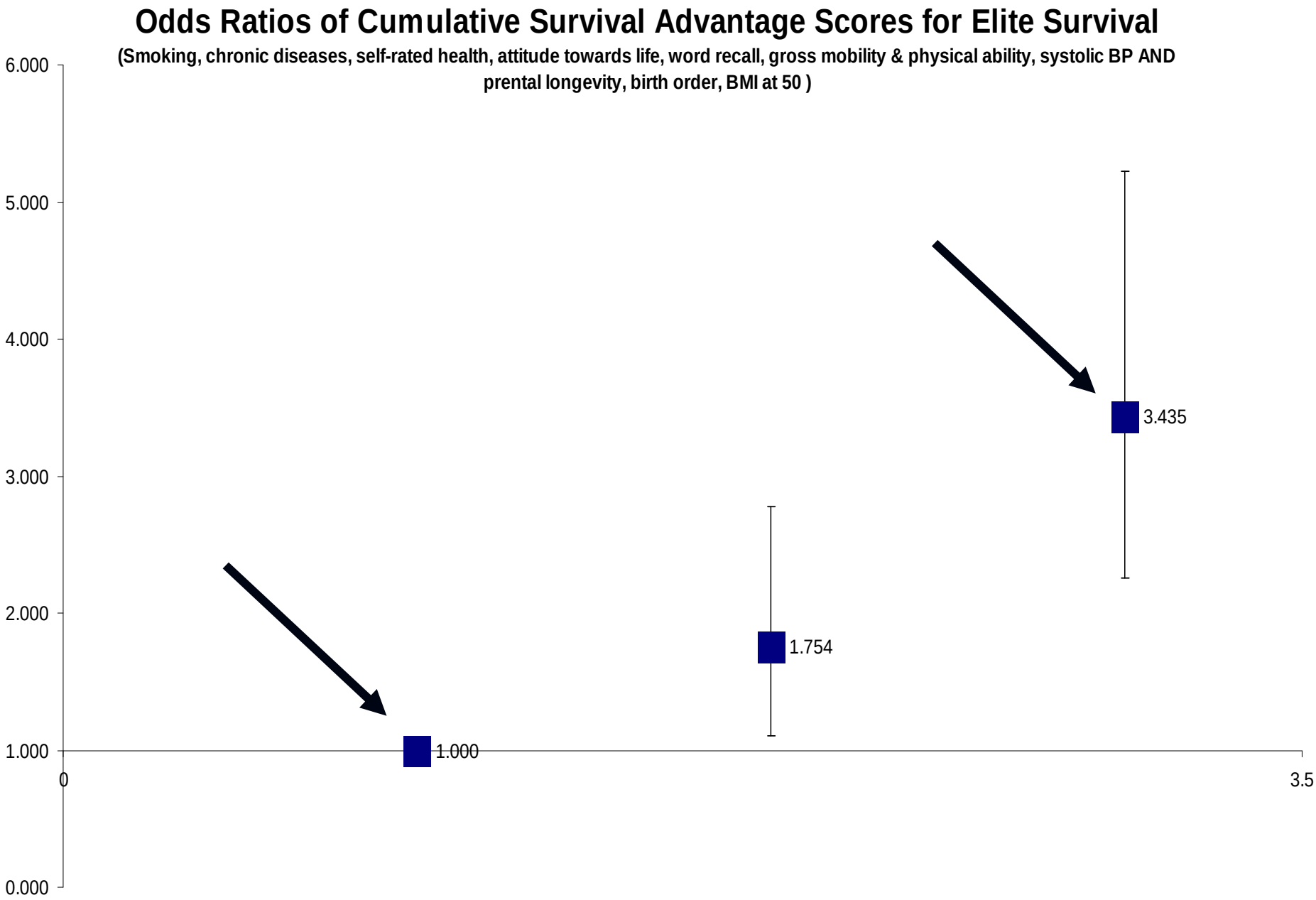
  - Parental longevity (both parents >85 yrs): p=0.05
  - Birth order: p=0.02
  - Systolic BP: p=0.04

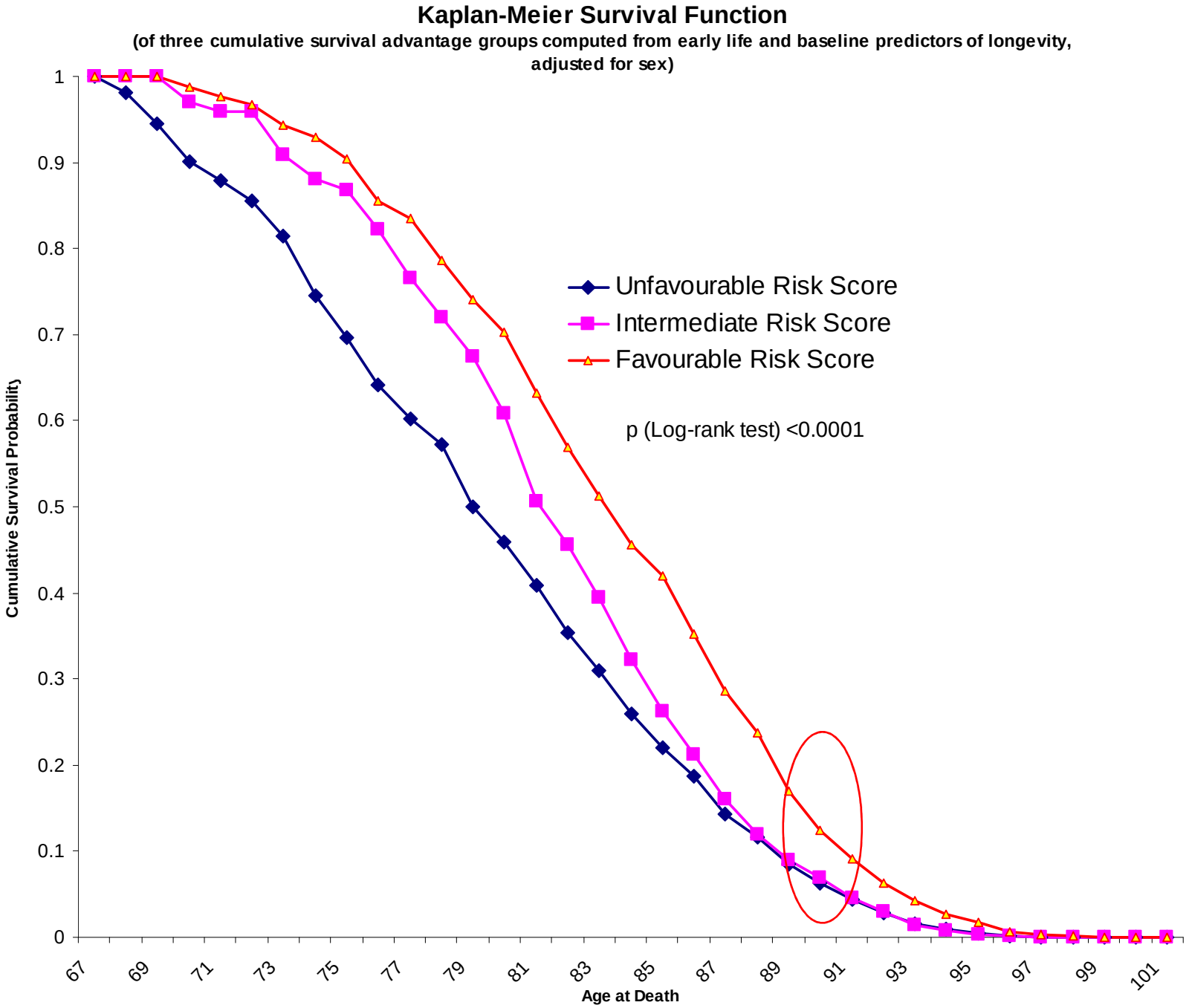
Results: multi-variable models

Two multi-variable models

- First: Adjusted for age, sex, smoking and with early life predictors
- Second: Adjusted for age, sex, smoking and baseline predictors

- All predictors maintain significant association in fully-adjusted models
  - except positive attitude towards life
- Explain 19% of variability in longevity


Odds Ratios of Cumulative Survival Advantage Scores for Elite Survival
(Smoking, chronic diseases, self-rated health, attitude towards life, word recall, gross mobility & physical ability, systolic BP AND prental longevity, birth order, BMI at 50)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0
3.5
1.000
1.754
3.435


Kaplan-Meier Survival Function
(of three cumulative survival advantage groups computed from early life and baseline predictors of longevity, adjusted for sex)
Cumulative Survival Probability
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
67
69
71
73
75
77
79
81
83
85
87
89
91
93
95
97
99
101
Age at Death
Unfavourable Risk Score
Intermediate Risk Score
Favourable Risk Score
p (Log-rank test) <0.0001

Discussion

Discussion

- Parental longevity
  - Strong association with elite survival of women (OR 3.55, 95% CI 1.93-6.53, $p<0.0001$)
  - but not with men (OR 1.16, 95% CI 0.45 – 2.98, $p=0.75$)
- Birth order among siblings
  - Significant association in women (OR 0.89, 95% CI 0.81 – 0.98, $p=0.02$) with significant sex interaction
- Heredity or environmental influence? Heritable component overshadowed by male lifestyle-related predictors?
- Attitude towards life shaped mainly by presence/absence of chronic medical diseases and one's subjective perception of it: loss of significant association in adjusted model

Discussion contd….

- Social support, education and income: showed no association with extreme longevity in this dataset
- BMI at baseline was not predictive
- Word recall and heavy chores: predictive tests than SPMSQ/self-rated memory and ADL scores for community-dwelling elderly citizens

Conclusion

- Contemporaneous control followed up to "extinction" (26 years)
- Predictors of extreme longevity from Iowa EPESE validates many previous findings
- Parental longevity and birth order among siblings: associated with females with significant sex interaction
- Some prominent social and psycho-social variables lack association with elite survival
- Limitation:
  - range restriction
  - Homogenous population and limited generalizability

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