

The Best Predictors of Survival: Do They Vary by Age, Sex, and Race?

**Noreen Goldman
Dana A. Gleit
Maxine Weinstein**

Presented at the NIA-Sponsored
Biomarker Network Meeting
April 26, 2017
Chicago, IL

Modern Day Fortune Telling

HOME

Death Clock: The Internet's friendly reminder that life is slipping away...




The Death Clock™

Welcome to the Death Clock(TM), the Internet's friendly reminder that life is slipping away... second by second. Like the hourglass of the Net, the Death Clock will tell you when you die.



Your Personal Day of Death is...
Sunday, August 6, 2023

This App Predicts When You're Going To Die

Deadline 

42	10	10	6	41	39
Years	Months	Days	Hours	Minutes	Seconds

iTunes



WHEN WILL YOU DIE?

Death Timer will tell you exactly when...

Introduction

- Myriad factors have been linked to human survival: social factors, health conditions, biological markers.
- Prognosis: Strongest predictors of survival of older adults are similar across countries with comparable life expectancy.
- Do the best predictors of survival differ across demographic subgroups?

Data

- 1999-2006 NHANES (U.S.), ages 20+
- Household interview and physical examination
- $N=18,027$ who provided a blood sample & for whom vital status could be verified
- Outcome: Mortality ≤ 5 years post-exam
- Gompertz hazard model with age as the metric for time (age-specific mortality)

Modeling Strategy

- Stratified:
 - By Age group (20-64, 65-79, 80+)*
 - Within each age group
 - By Sex
 - By Race/ethnicity (non-Latino whites, non-Latino blacks, Latinos)*
- 30 predictors, each tested individually
- Non-proportional hazards: if age interaction significant for any subgroups, included for all 8 subgroups

* Controlling for sex

Predictors of Mortality

Demographic

Age (the “clock”)

Sex

Race/ethnicity

Social factors

Marital status

Education

Income

Health behavior

Smoking

Physical activity

Illness-related

History of diabetes

History of cancer

History of stroke

History of heart disease

Hospital stays

5+ medications

Overall health/function

SAH

ADL limitations

IADL limitations

Mobility limitations

Biomarkers

SBP

DBP

Resting pulse

Total cholesterol (TC)

HDL cholesterol

Ratio of TC/HDL

HbA1c

BMI

Waist circumference

CRP

WBC count

Serum creatinine (SCr)

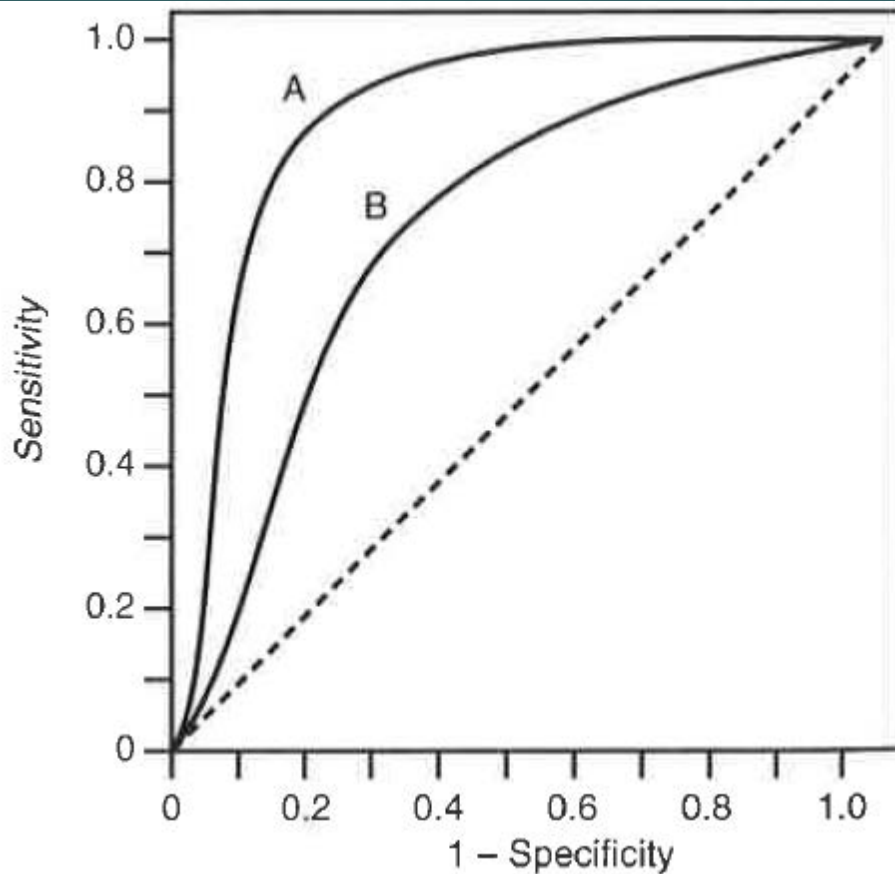
Homocysteine (Hcy)

Serum albumin

Area Under the Receiver Operating Characteristic Curve (AUC)

- Objective: assess predictive ability rather than magnitude of the associations
- AUC summarizes ability to discriminate between decedents and survivors.
- Range:
 - 0.5 = no better than chance and
 - 1.0 = perfect accuracy
- $\Delta\text{AUC} > 0.01$ considered meaningful

Evaluating discrimination with the area under the ROC curve (AUC)



Sensitivity: predict death if R died

Specificity: predict survival if R survived

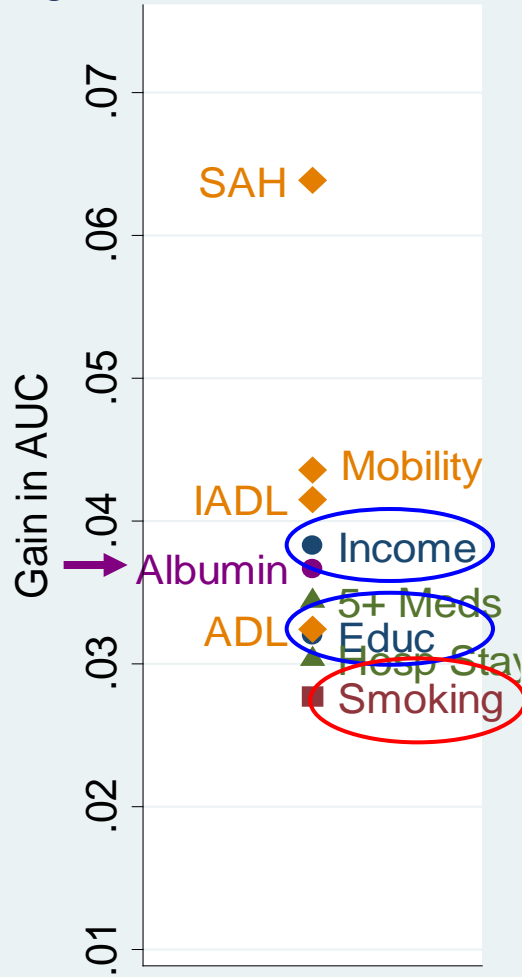
— A Strong model

— B Weak model

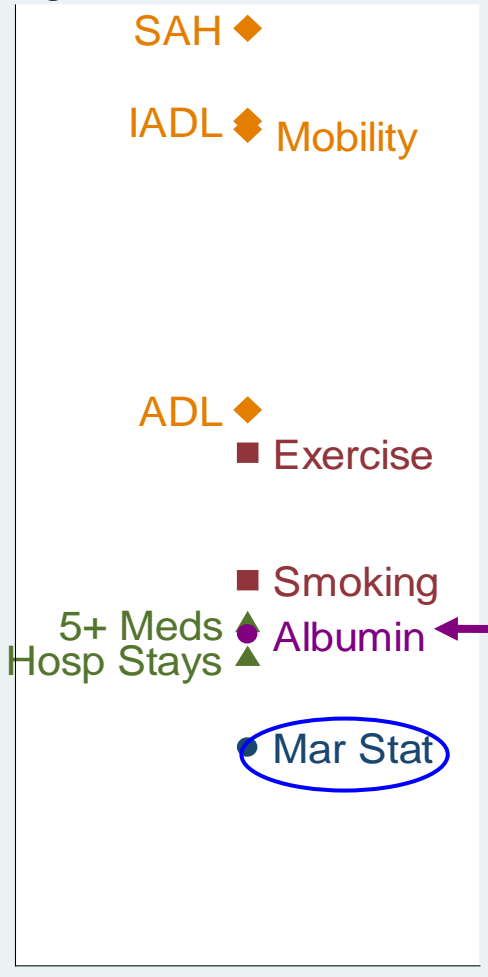
- - - Random coin toss

Top 10 Predictors by Age Group

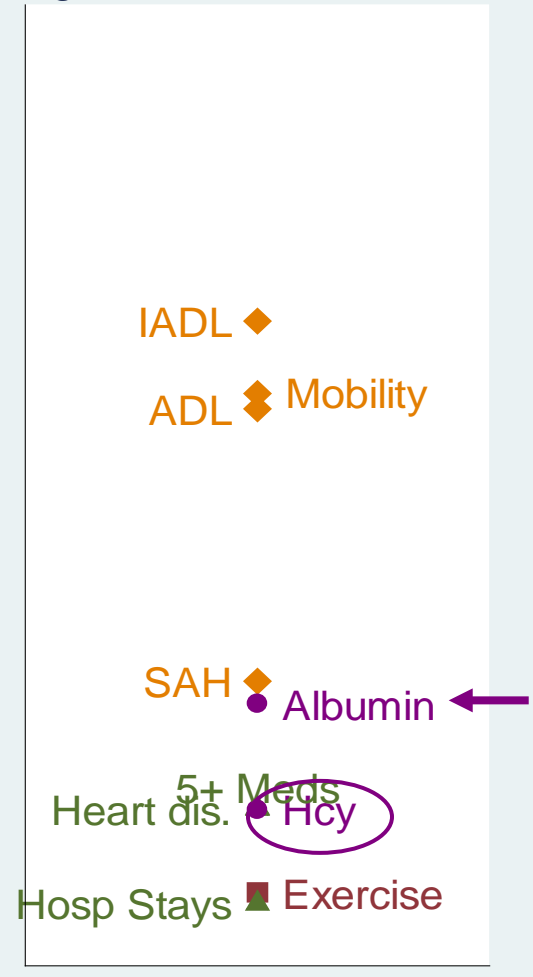
Ages 20-64



Ages 65-79



Ages 80+

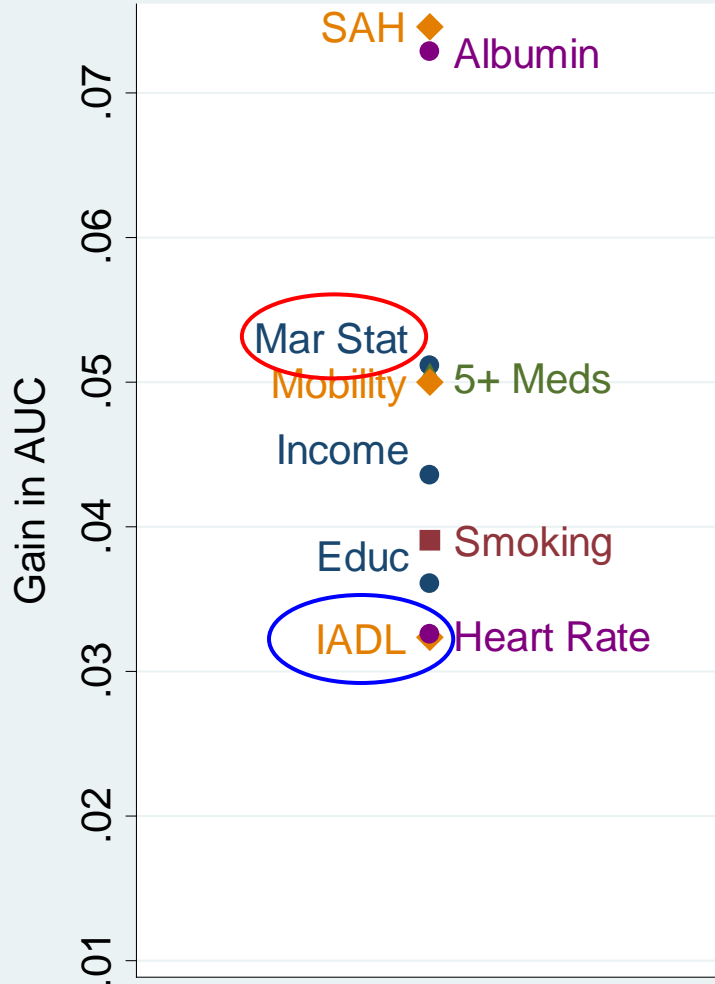


Differences by Age Group

- SAH and physical function among strongest predictors in all age groups
- Importance declines with age:
 - Social factors (education, income, marital status)
 - Smoking (selective survival?)
- Biomarkers:
 - Albumin is a top predictor in all age groups
 - Homocysteine emerges among the top 10 only for the oldest age group

Top 10 Predictors by Sex, Ages 20-64

Men

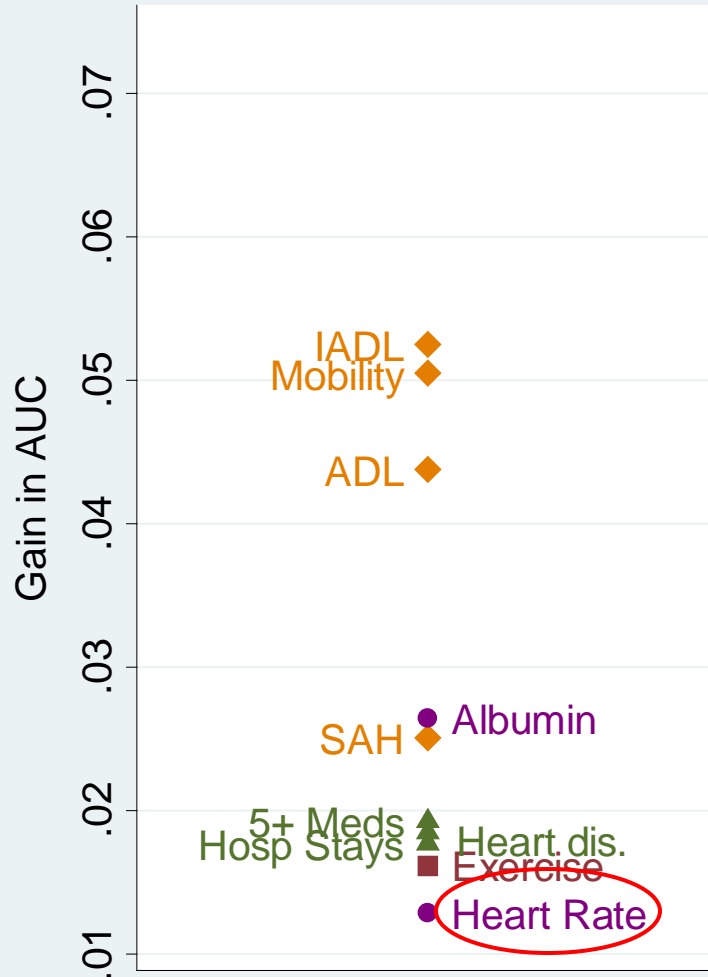


Women

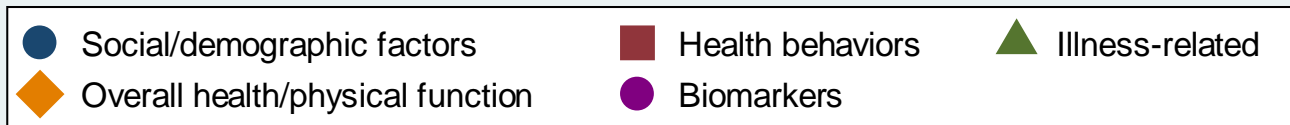
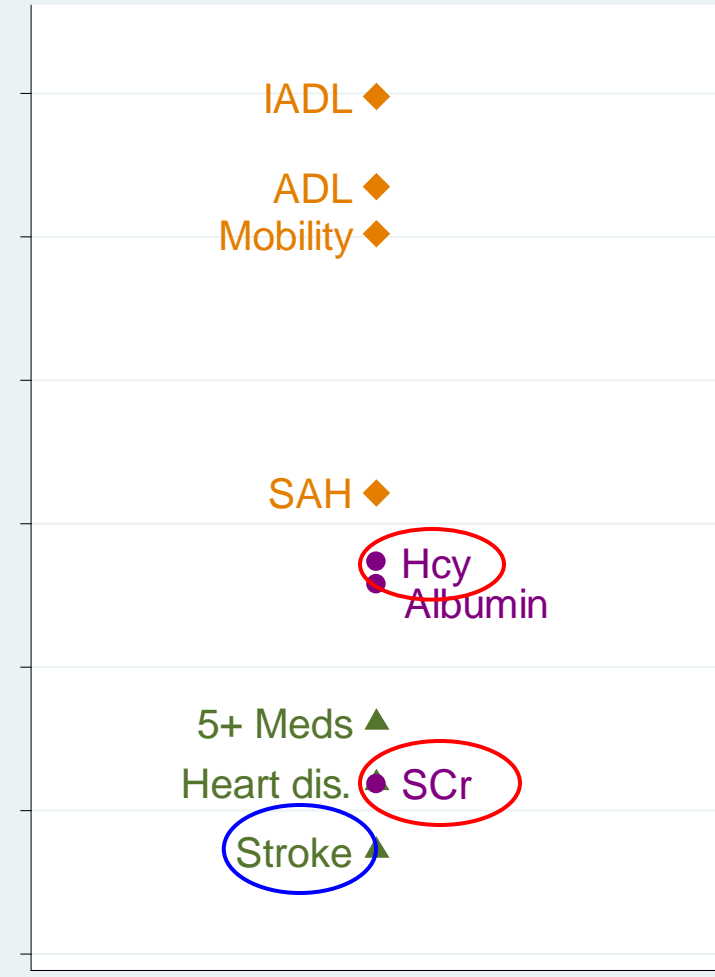


Top 10 Predictors by Sex, Ages 80+

Men



Women



Differences by Race/Ethnicity

- Disability measures are weaker predictors for younger blacks
- Disease diagnosis: at ages 65-79, heart disease is strongest for whites, cancer for blacks, and stroke for Latinos
- Number of hospitalizations ranks particularly high among blacks younger than 80.

How Do Biomarkers Fare?

- Serum albumin top predictor in most subgroups
 - More likely to be a marker of morbidity and survival risk than a causal, modifiable factor
- Standard clinical markers (hypertension, cholesterol, and obesity) are generally weak discriminators
- More important: Serum creatinine, homocysteine, & CRP (but again, not necessarily causal)

Conclusions

- Self-reported health & physical function among the best predictors in all subgroups
 - More proximate than social/behavioral factors
 - Integrates an accumulation of biological processes over a lifetime not easily captured in one-time measurement of a biomarker
- Although most of the strongest predictors perform well across subgroups, prognostic indexes may need to be optimized for specific demographic groups

Funding

This work was supported by:

- Eunice Kennedy Shriver National Institute of Child Health and Human Development [P2CHD047879]; and
- Graduate School of Arts and Sciences, Georgetown University.