Disability in an Elderly Cohort
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TOPIC. As a cohort of elderly persons ages, do disability rates rise sharply as they acquire and retain functional problems? Or are rates quite steady because the most disabled members die? In short, "fit or frail" in late life?

We answer this by studying a cohort of older persons, who were born before 1924. We look at disability trends among them for the time period 1993-2010, when they are ages 70+ (1993) to 87+ (2010). This is hypothesis-driven descriptive analysis.

THEORETICAL FOCUS AND BACKGROUND. "Fit or frail" is a common contemporary theme of empirical research, health care discussions, and advocacy statements for older persons. The scientific issue relates to multiple fields in demography and gerontology: fitness/successful aging; frailty; last years of life/end of life; centenarians; compression of disability/morbidity; mortality selection; population heterogeneity; cohort and cross-cohort studies; population trends in disability; individual-level analyses (transitions in disability, predictors of mortality, disability trajectories). All of these fields are mature, with ample literature. They offer distinctive, but complementary, views of elderly persons. In our literature review, we will state findings from each field that are directly pertinent to this project.

The question of "fit or frail" for a cohort is simple, and interesting, but there is only one prior study in the literature (Christensen et al., 2008). Christensen et al. studied the cohort of Danish persons born in 1905, who had assessments between 1998 and 2005 (4 waves). Cohort members were ages 92 to 100 in that time period. The analyses are about independence (obverse of disability), plus several aspects of physical function and depression. Independence was steady, or even rose a bit, over the seven years. The other function items showed little change as well. The interpretation is that the most disabled persons exited by mortality. With respect to design, the Christensen et al. analysis tracks disability rates over time among living persons at each wave, and rates for subgroups of survivors who get to each wave. It does not present explicit results for decedents. By contrast, our analysis tracks disability for living persons, decedent groups, and survivor groups; this is clarified below.

ANALYSIS DESIGN AND HYPOTHESES. Our analysis is uncommon, so it is crucial that readers understand its design and purpose. It concerns over-time changes in a specific cohort. It is not about individual-level trajectories of disability over time. It is not about population trends (repeated cross-sections). Both of those topics have large literatures, so it is easy for readers to "fall back" into their styles of thinking when interpreting the cohort results. We follow a specific cohort as it ages, asking about disability status of living members every two years.

We study trends for persons alive at nine biennial waves (*living cohort*), decedent groups (*decedents*), and survivor groups (*survivors*). Decedent groups are defined by when they die (early waves versus later waves). Survivor groups are defined by how long they are alive (alive only early waves, or alive all waves). Decedent groups are mutually exclusive (e.g., those who die between waves 3 and 4 are entirely different people than those who die between waves 4 and 5). Survivor groups are not mutually exclusive (e.g., those who are alive at wave 5 are included in those who are alive at wave 4). We focus on living and decedent results, and include survivor results to replicate Christensen et al. material.

Three types of disability are studied: personal care (ADL), household management (IADL), and physical limitations (PLIM).

We posit that an elderly cohort is both "fit and frail" as it ages into its eighties and nineties. (1) For *living* cohort members, disability rises over time. PLIMs rise more than ADLs and IADLs over time. (2) Earlier *decedents* (die in early waves) have more baseline disability than later decedents (die in later waves), and this initial difference is maintained across waves. Disability rises over time for all decedent groups, but less rapidly for later decedents than earlier ones. (3) Longer-*survivors* have less baseline

disability than shorter-survivors, and this initial difference is maintained across waves. Disability rises over time for all survivor groups, but less rapidly for longer-survivors than shorter-survivors.

DATA AND METHODS. The data source is the Study of Assets and Health Dynamics Among the Oldest-Old Cohort (AHEAD) (Soldo, Hurd, Rodgers, Wallace, 1997). The baseline sample in 1993 was U.S. community dwellers ages 70+ (born 1923 or before). Initial interviewed sample size was 7,447. AHEAD respondents were interviewed at two-year intervals thereafter regardless of residence status (community dwelling or nursing home). AHEAD was merged with the Health and Retirement Study in 1998. Our analysis covers 9 waves of data (1993, 1995, 1998, ... 2010). As of 2010, living cohort members were ages 87+. We use AHEAD data in the RAND HRS file, a user-friendly version of HRS data prepared by the RAND Corporation (Chien, Campbell, Hayden, Hurd, et al., 2013).

Disability is defined as health-related difficulty in specific tasks. Personal help (ADL) and equipment help (ADL, IADL) for health reasons is considered disability. The variables are counts of component items with disability (ADL 0-5, IADL 0-5, PLIM 0-9). We study mean values of ADL, IADL, and PLIM counts at each wave. RAND recode rules yield very little missing data [state amounts in paper].

Graphs show mean values over time for living cohort members, decedents groups, and survivor groups. Regressions of disability means are run with time as covariate: Disability = $f\{t, t^2\}$, where t is the wave interval (0, 2, 4, ...).

The analysis is performed for the total cohort, then repeated for gender (men, women) and for two age strata (baseline ages 70-79, 80+). Gender differences in disability are well-studied, and our work offers a special view of how men and women in a cohort follow similar, or different, paths as they become very elderly. Age strata are studied because the AHEAD cohort has diverse ages. (This contrasts with the Christensen et al. analysis, which uses a single birthyear cohort.) Plenty of advice was sought about how to handle the AHEAD age diversity, and we implement the strongest recommendation, namely, to study and compare age strata. Hypotheses about gender and age strata (living, decedents, survivors) have been prepared and will be stated in the full paper.

Several technical features are noted [in full paper]: trimming the initial sample to age-eligibles with unambiguous data streams (final initial N is 7,227); preparation of nonzero weights for nursing home residents (the data file has weight=0 for them, and we tested options for assigning nonzero weights, then chose a conditional-mean weights approach); how item missing data are handled; and complex variances.

FINDINGS. [At abstract submission (09/14), analyses have been completed for total cohort, men, and women. Weights proved a big hurdle; nursing home residents are given weight=0 in the data file, but these people are crucial to keep. Several weighting options were tested, and we opted for a conditional-mean weights approach; nursing home people receive the community dweller weights for same gender, marital status, and race/ethnicity. Weighted analyses for total cohort will be run soon, using the file respondent weights for community dwellers and conditional-mean ones for nursing home residents. Then we repeat the analysis for gender and age strata, and do regressions for everything.]

Initial results are compact and follow the hypotheses.

- Living Cohort: Over time, disability rises for the living cohort. Physical limitations (PLIMs) rise more than ADLs and IADLs.

[See Figure 1]

- Decedent groups have sharply rising disability over time. Early decedents are much more disabled at baseline, than later decedents are. Yet at time of death, decedent groups have quite similar levels of disability.

[See Figure 2]

- Survivor groups show similar patterns, but less striking (nb: recall that survivor disability paths come upward to form the mean at each wave). Survivors who reach the last wave (longer survivors) start with lower baseline disability than shorter survivors (who include people who will die later in observation). Longer survivors' disability "speeds up" (nonlinear rise) as they age, compared to shorter survivors; their early fitness advantage erodes over time. (This is the sole result contrary to hypothesis, to date.)

- Men and women show same results as the total cohort. Women have higher disability rates at all points, but patterns for living persons, decedents, and survivors are the same.

In sum, as a cohort ages, disability among living members rises only moderately, compared to decedents' disability.

DISCUSSION AND CONCLUSION. [to be written] Implications for health care are clear and striking: Very elderly persons typically do have disability, but far less than if all cohort members were still present.

REFERENCES

Chien S, Campbell N, Hayden O, Hurd M, Main R, Mallett J, Martin C, Meijer E, Miu A, Moldoff M, Rohwedder S, St. Clair P. RAND HRS Data Documentation, Version M. Santa Monica, CA: RAND Center for the Study of Aging, RAND Corporation. August 2013.

Soldo BJ, Hurd MD, Rodgers WL, Wallace RB. Asset and Health Dynamics Among the Oldest Old: An overview of the AHEAD Study. Journals of Gerontology, Series B, 52B (Special Issue): 1-20, 1997.

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Figure 1. ADL, IADL, and PLIM Distributions for Living Members of the AHEAD Cohort by Interview Wave (Unweighted Means)

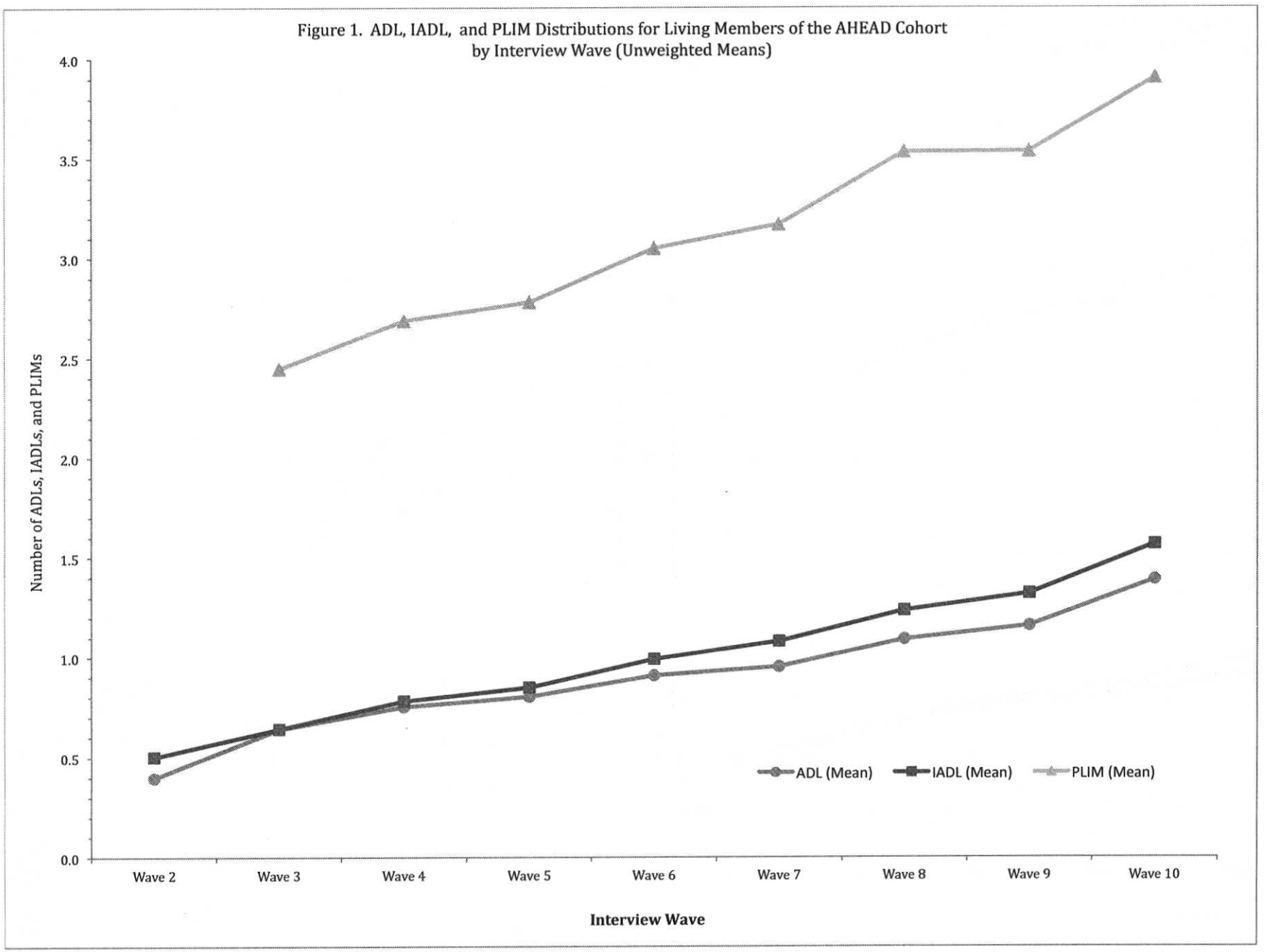

Figure 2. ADL Means in Prior Waves for AHEAD Decedent Groups
by Interview Wave of Death (Unweighted)