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ABSTRACT

This analysis brings "aging with disability" into middle and older ages. We study U.S. adults ages 51+ and ages 65+ with persistent disability (physical, household management, personal care; PLIM, IADL, ADL), using Health and Retirement Study data. Two complementary approaches are used to identify persons with persistent disability, one based directly on observed data, the other on latent classes. Both approaches show that persistent disability is more common for persons ages 65+ than ages 51+, and more common for physical limitations than IADLs and ADLs. People with persistent disability have social and health disadvantages compared to people with other longitudinal experiences. The analysis integrates two research avenues, aging with disability and disability trajectories. It gives empirical heft to government efforts to make aging with disability an age-free (all ages) rather than age-targeted (children and youths) perspective.

INTRODUCTION

"Aging with disability" means a person has persistent functional problems for years, or decades, or even one's whole lifetime. The topic is typically studied for young persons with severe functional problems from birth or acquired in childhood/adolescence. But disability often begins at middle and older ages, and it can persist for many years. This, too, is aging with disability. Yet for these age groups, research emphasis is not disability persistence, but disability change (onset and recovery). This is the first analysis of aging with disability for midlife and older persons using large-scale survey data for the U.S. resident population (community dwellers plus nursing home residents).

LITERATURE REVIEW

Aging with Disability

Research literature on aging with disability focuses on children, adolescents, and young adults. Most studies are about specific conditions (e.g., cerebral palsy, muscular dystrophy, Down syndrome, spinal cord injury), as evidenced in journals such as *Disability and Rehabilitation, Disability and Society, Disability Studies Quarterly*, and *American Journal of Mental Retardation*. The studies typically use patient samples and have modest sample sizes. Population-based data on young adults with persistent disability are rare (exceptions are surveys conducted by the National Center for Health Statistics and National Organization on Disability/ Harris). Research results show that young adults with long-term disability state lost opportunities and blunted achievements, yet also have high resilience and coping abilities. They have "accelerated aging," experiencing secondary conditions, increases in impairment, and more total impairments than age peers without long-term disability (Klingbeil et al, 2004; Pentland et al., 1995; Thompson, 1999; Verbrugge, Yang, 2002). As youths with some disabling conditions survive into their 30s and older, analytic age ranges are stretching to show how they fare in adulthood.

In recent decades, government agencies and scientists have tried to broaden perspectives about aging with disability to include all ages (Ansello, Eustis, 1992; Kennedy, 2002; Putnam, 2007; Torres-Gil, Putnam, 1999). Unexpected resistance has come from many sides, ranging across service agencies, advocacy groups, organizations focused on specific age groups, medical

and rehabilitation staff, and even persons with disabilities. To help alleviate this, several government agencies sponsored the conference Aging with Disability: Demographic, Social, and Policy Considerations (Washington, D.C., May 2012), with presentations from scientists, medical and service professionals, and advocacy representatives (Disability and Health Journal, 2014). Further, the Toronto Declaration on Bridging Knowledge, Policy and Practice in Aging and Disability (Bickenbach et al., 2011) gives strong momentum to an all-ages perspective.

To date, there are few empirical studies of aging with disability for midlife and older persons (Clarke, Latham, 2014; Hardy et al., 2006; Verbrugge, Yang, 2002, 2003). *The analysis here provides prevalence rates of aging with disability in the U.S. resident populations ages 51+ and ages 65+, using two complementary approaches. We identify distinctive social and health features of midlife and older people who are aging with disability, compared to age peers with other disability trajectories.*

Disability Patterns

Aging with disability is persistent disability over a long time period. That is just one of many longitudinal disability patterns.

Research on *disability patterns* has focused on older adults. Katz and colleagues were the first group to study disability patterns (Katz, Akpom, 1976; Katz et al., 1970; Katz et al., 1963). The notion had great appeal because it summarized an individual's whole functional situation. In the 1970's-1980's, analyses were mostly cross-sectional, studying *combinations of disabilities* that people have at a given time and testing the notion of *disability hierarchy*, using community-based or patient-based surveys.

As interest in disability transitions increased and as longitudinal datasets became available, the goal shifted to finding typical *patterns of disability over time* as people age. Longitudinal patterns are identified in two ways. (1) The classic, close-to-data approach is to state specific patterns of interest (e.g., in-hospital functional decline) and find persons with it, or to search broadly for common (high-prevalence) patterns. Whether stated a priori or not, patterns are identified by simple computer algorithms, visual data review, or variability statistics (e.g., standard deviation of repeated measures) (Beckett et al., 1996; Bowling et al., 1994; Carlson et al., 1998; Charlton, 1989; Ferrucci et al., 1996; Fortinsky et al., 1999; Gill et al., 2009; Jette et al.,

1987; Latham, 2012; Maddox, Clark, 1992; Romoren, Blekeseaune, 2003; Verbrugge, Balaban, 1989; Verbrugge, Reoma et al., 1994; Verbrugge, Yang et al., 2004). (2) As sophisticated quantitative techniques advanced, an alternative approach was possible. Statistical techniques that find best-fit trajectories in data-smoothing and probabilistic ways are now popular (Dodge et al., 2006; Gill et al., 2010; Liang et al., 2009; Martin et al., 2016; Slaug et al., 2016; Wickrama et al., 2013; Wolf et al., 2015; Yu et al., 2015; Zimmer et al., 2012, 2014). The trajectories are called latent classes. Classes are named based on visual shapes of trajectories and characteristics of persons in them. Other statistical techniques (cluster analysis, factor analysis, growth modeling, hierarchical linear modeling) are also used to study longitudinal disability patterns over time (Deeg, 2005; Li, 2005; Liang et al., 2003; Nusselder et al., 2005; 2006; Taylor, Lynch 2004).

Analyses of disability patterns to date have used just one approach, either the classic (observed) one or the statistical (trajectory models) one. This analysis applies both approaches and compares the results.

Separated Literatures

The review above shows how ages differ greatly in the aging with disability literature (children and youths) and the disability patterns literature (older adults). There is no intrinsic substantive reason, or objective circumstance, that requires this age difference. Aging with disability occurs for middle-aged and older people, and disability patterns exist for children and youths. A key goal of this analysis is to help alleviate the separation by empirical analysis of aging with disability for midlife and older people.

ANALYSIS DESIGN

We identify persistent disability groups of mid and late life adults in a large longitudinal population-based survey by direct identification in observed data and by latent class modeling. Once groups with, and without, persistent disability are identified, we find sociodemographic and health features associated with aging with disability.

Data Source

The data source is the Health and Retirement Study (HRS), an ongoing longitudinal panel survey of Americans over age 50 (ages 51+) conducted by the Survey Research Center, University of Michigan (hrsonline.isr.umich.edu). HRS started in 1992 with a sample of U.S.

community dwellers ages 51-61 (Heeringa, Connor, 1995). Around the same time (1993), the Study of Asset and Health Dynamics of the Oldest Old (AHEAD) started, with a sample of U.S. community dwellers ages 70+ (Soldo et al., 1997). In 1998, AHEAD was merged with HRS, and HRS coverage is now all ages 51+. The HRS sample is refreshed every six years (1998, 2004, 2010, 2016) by adding new people ages 51-56. HRS respondents are all community dwellers at first interview. If a respondent has a spouse/partner (any age), the spouse is included in HRS. Followup interviews are conducted every 2 years regardless of changes in residence (e.g., move to nursing home) or marital status. We use the RAND HRS data file, a user-friendly file for all waves prepared by the RAND Corporation (www.rand.org/labor/aging/ dataprod.html).

The analysis data are from 7 waves (1998-2010). The 1998-2010 observation period is explained as follows: Although HRS began in 1992, disability questions changed during the 1990's. Questions stabilized in 1998 and have been consistent since then. Our analysis stops with 2010 because it was the latest year of data available when the project started.

Analysis Samples

We study persistent disability for people from midlife onward (Ages 51+), and also from just older ages onward (Ages 65+). There is no upper age bound, so results pertain from the initial age to very advanced ones.

Specifically, the Ages 51+ sample is people who are or become 51+ during 1998-2010. They are respondents already 51+ in 1998, plus others who enter HRS later in refresher samples, and young spouses who become 51+ during 1998-2010. Disability data are assessed from a respondent's first age-eligible interview onward to 2010, or to study dropout or death. The Ages 51+ sample size is 31,879 persons.

The Ages 65+ sample is people who are or become 65+ during 1998-2010. Their disability data are used from first-age-eligible interview onward to 2010 or study departure. The Ages 65+ sample is a subset (64%) of the Ages 51+ sample. Sample size is 20,394 persons.

We hypothesize that aging with disability is more prevalent for older ages onward (Ages 65+) than midlife onward (Ages 51+), but that features of people with persistent disability are the same for both groups.

Measures

Disability. Disability is health-related difficulty doing physical tasks (PLIM, physical limitations), household management (IADL, instrumental activities of daily living), and personal care (ADL, activities of daily living) lasting for 3 months or longer (already or anticipated). (1) PLIM items cover 9 tasks (walk one block, sit about two hours, get up from chair, climb one flight stairs, stoop/kneel/crouch, lift/carry ten pounds, pick up dime from table, reach/extend arms up, push/pull large object). PLIM disability is scored present for a task if the respondent has any difficulty doing it because of a health or physical problem. (2) IADL items cover 5 tasks (prepare hot meal, shop for groceries, make phone calls, take medications, manage own money). IADL disability is scored present for a task if the respondent has health-related difficulty, or personal help for health reason (equipment help for health reasons is not ascertained for IADLs). (3) ADL items cover 6 tasks (dress, bathe/shower, eat, walk across room, get in and out of bed, using the toilet including getting up or down). ADL disability is scored present for a task if the respondent has health-related difficulty, personal help (except people with "no difficulty"), or equipment help. Conceptually, PLIMs are functional limitations rather than disability (Verbrugge, Jette, 1994), but we want to economize prose so call all three outcomes disability.

We created item-specific PLIM, IADL, and ADL variables from raw data in the RAND file, then generated three sums: PLIMs (0-9), IADLs (0-5), and ADLs (0-5). The sums (counts) exist for each wave (1998, 2000, ..., 2010). Specific disabilities can vary wave-by-wave. PLIM counts have broad frequency distributions with moderate percents at 0 (35-40% each wave), whereas IADL and ADL counts are strongly skewed at 0 (81-86%). In the analysis, we collapse the counts and use any (0, 1) disability at each wave.

Classification Features. What features distinguish people with persistent disability from those without it? We compare persistent-disability persons with other persons for gender, race/ethnicity, education, age at first observation, birth cohort, marital status, living arrangement, self-rated health, number of chronic conditions, nursing home residence, death, and number of interviews. (Some details: Race/ethnic categories are White non-Hispanic (White),

Black non-Hispanic (Black), Hispanic, and Other. Education is highest level completed. Age at first observation is age at first age-eligible interview (51+ or 65+) in the 1998-2010 period. Age at first observation and birth cohort are not highly correlated due to the HRS design of refresher cohorts; correlations available on request.)

The covariates are used in a classification manner. Bivariate differentials show features that distinguish people with persistent disability from other people in a simple, straightforward way. So, our results are based on bivariate differentials, not multivariate effects. **NOTE 1, NOTE 2**

Initial (first observation) values are often used as covariates, but cumulative values better reflect dis/advantages linked with longitudinal disability experience. Here, "initial" is a person's status at first interview in the 1998-2010 period (e.g., marital status), and "cumulative" is percent of waves in the observation period with a particular status (e.g., % of waves married). We compared results using initial and cumulative versions; they were similar, so we opted for the cumulative ones because of their substantive merit.**NOTE 3**

We hypothesize that female gender, race/ethnic minority, less education, nonmarried status, and living alone are linked with persistent disability, due to social disadvantages that affect adult health. We expect persistent disability is more common for older persons due to higher incidence of disability and lower chances of functional recovery than at younger ages, and also more common for earlier birth cohorts due perhaps to stressful situations in the Depression. Persistent disability is linked with poor health, elevated chances of nursing home residence, and death.

Procedures

From the first interview that a respondent is age 51+ (or 65+) in 1998-2010, his/her data stream is evaluated for longitudinal disability pattern. People aging with disability are identified by 2 procedures, one based directly on the observed data and the other based on latent class models. The first uses a simple algorithm, whereas the second is technically sophisticated. The approaches are complementary. Both yield prevalence of persistent disability and features linked to it. *We hypothesize that observed and latent class approaches produce similar results.*

Observed. The observed approach selects people based directly on their interview responses. People who report having disability (PLIM, or IADL, or ADL) at all their interviews

in the observation period are classified as having persistent disability. This is a strict criterion (100%); it means having disability "all of the time". We also relaxed this and selected people with disability at ≥75% (75+%) of their waves, a more liberal operationalization that allows some variation over waves. The 75+% criterion means having disability "most or all of the time". *Tables show results for both 100% and 75+% criteria*. We also wondered if people with just one interview (with disability) can be scored as having persistent disability, or if they must be scored as not persistent. To find out, we did the full analysis both ways, comparing 1+ (1 interview in the observation period is sufficient) and 2+ (people must have 2 or more interviews). We were amazed to see that results scarcely differ, so we chose the 1+ approach.[NOTE 4]

Latent classes. The latent class approach uses generalized growth mixture modeling (GGMM) to identify groups of individuals according to their latent trajectories of disability. GGMM is an extension of conventional growth modeling that allows different classes of individuals to vary around different mean growth curves (Muthén, 2004; Muthén, Muthén, 2000). GGMM is well-suited to counts, so we use the PLIM count here; it captures both "any" and "high" disability. IADL and ADL variables are dichotomous, being too skewed for counts. Models are estimated in Mplus Version 7.2 using full information maximum likelihood with robust standard errors. Models have quadratic terms, so trajectories can curve. By including variables related to attrition (age, education, marital status, health status), Mplus generates unbiased coefficients (Cnaan et al., 1997; Feng et al., 2006; McArdle, Hamagami, 1992). An appealing aspect of GGMM is its use of all available information to produce trajectories. Single observations (one interview) are not problematic and contribute importantly to trajectory estimation. GGMM solutions assign individuals to the class that best suits their longitudinal pattern; a person is not split probabilistically among classes, but belongs to just one.

Other aspects. (1) Weights take disproportionate sampling and attrition due to dropout into account, and they are necessary for unbiased estimates of population parameters like disability prevalence. The RAND HRS data file has weights for community-dwelling respondents at each wave, but nursing home respondents are assigned weights of 0. We think keeping nursing home residents is crucial for studying persistent disability among American adults. With

statistician advice, we tested several weighting options for nursing home residents (details available on request). Remarkably, all options produce similar prevalences (all higher than estimates excluding nursing home residents by weight = 0). Here, we assign the mean community dweller weight of each wave to nursing home respondents. For the observed approach, this occurs for 2.4% of the 51+ interviews, and 2.8% of the 65+ interviews. For GGMM, Mplus allows only 1 weight for a respondent, so we use a person's first nonzero weight in the observation period. (Only a few people were in nursing home for all their 1998-2010 observations; the mean community-dwellers weight for their first observation was assigned.) (2) Missing data (MD) are negligible for covariates due to RAND's imputation efforts. MD is also small for the disability variables, which we generated. Disability MD cases are dropped for the observed approach (table footnotes show Ns). This is not necessary for GGMM, which uses all available data to best advantage. (3) Both self- and proxy-reported interviews are used.

RESULTS

Sample Descriptives

The Ages 51+ sample is majority female (52.0%) and largely White (76.8%) (Table 1). About half have a high school degree (54.4%). Average age at first observation is 61.8, and the main birth cohorts are 1940-1949 and 1950-1959. People are married the majority of waves (63.1%), and in line with that, they live alone a small percentage of waves (24.7%). Only 30.4% of their waves are rated with fair/poor health, and chronic conditions average 2.2. Few people (10.9%) have a nursing home stay during the observation period, and 22.6% die during it.

By comparison, the Ages 65+ sample is more female and more White, and has less education. Average age at first observation is 71.2, and the main birth cohorts are 1920-1929 and 1930-1939. The Ages 65+ group is married a smaller percentage of the observation period, and lives alone a larger percentage of the time, than the Ages 51+ group. All measures of health problems are higher for Ages 65+ persons, especially nursing home experience (19.8%) and death (37.0%). Both samples have sizable numbers of interviews (4.0 for Ages 51+ and 5.2 for Ages 65+, of 7 total).

Table 1. Characteristics of the Ages 51+ and Ages 65+ Analysis Samples

	Ages 51+	Ages 65+
Sociodemographic		
Gender (female; %)	52.0	56.2
Race/ethnicity (%)		
White non-Hispanic	76.8	81.8
Black non-Hispanic	11.6	9.7
Hispanic	8.9	6.8
Other race/ethnicity	2.7	1.7
Education (%)		
Less than high school	22.4	29.9
High school degree	54.4	52.3
College degree	23.2	17.8
Age at first observation (mean)	61.8	71.2
Birth cohort (%)		
1890-1909	1.5	2.9
1910-1919	7.5	14.7
1920-1929	14.9	29.4
1930-1939	18.9	34.1
1940-1949	26.9	18.9
1950-1959	30.3	--
% of waves married (mean)	63.1	57.4
% of waves live alone (mean)	24.7	30.6
Health		
% of waves fair/poor health (mean)	30.4	34.4
Max no. chronic conditions (0-8; mean)	2.2	2.8
Ever in nursing home (%)	10.9	19.8
Died (%)	22.6	37.0
Other		
No. interviews (1-7; mean)	4.0	5.2

Source: Health and Retirement Study, 1998-2010. N = 31,879 ages 51+; 20,394 ages 65+. Characteristics are at the first age-eligible interview in observation period (gender to birth cohort), cumulative over observation period (% of waves married to max no. chronic conditions; and no. interviews), and event during observation period (ever in nursing home, died). Ranges are 0-1 except age at first observation (51-102 for 51+; 65-100 for 65+), max no. chronic conditions, and no. interviews. Weighted data.

Persistent Disability: Observed

For persons ages 51+, 40.2% report PLIM disability at all observations (100% criterion) (Table 2). Eight percent (8.4%) have persistent IADL disability, and 9.6% have persistent ADL disability. When the criterion is relaxed to 75+% of observations, prevalences of persistent disability increase: 49.0% PLIM, 10.1% IADL, and 11.9% ADL. For persons ages 65+, persistent

disability is more common. Prevalences of persistent disability are 49.6% PLIM, 11.1% IADL, and 12.5% ADL by the 100% criterion, and 59.1%, 13.5%, and 15.5% respectively by the 75+% criterion.[NOTE 5]

Table 2. Rates of Persistent Disability

	Ages 51+ (%)	Ages 65+ (%)
Observed disability (100%)		
PLIM	40.2	49.6
IADL	8.4	11.1
ADL	9.6	12.5
Observed disablity (75+%)		
PLIM	49.0	59.1
IADL	10.1	13.5
ADL	11.9	15.5
Latent Class 1		
PLIM	23.5	30.6
IADL	8.9	11.8
ADL	9.0	14.4

Source: Health and Retirement Study, 1998-2010. N = 31,879 ages 51+; 20,394 ages 65+. PLIM - physical limitation; IADL - instrumental activity of daily living; ADL - activity of daily living. 100% is 100% of observations, and 75+% is 75% or more of observations. Weighted data.

What characteristics are linked with persistent disability? We compare people with persistent disability to people without it (Tables 3 and 4). The differences are consistent for the 2 age groups (51+, 65+) and the 2 criteria (100%, 75+%). People with persistent disability are more likely to be female, Black and Hispanic (also Other for ages 51+), and have low education. People with persistent disability are older on average than those without it, and persistent disability is more common among earlier birth cohorts. People with persistent disability have less time married in the observation period (% of waves) and more time living alone (% of waves), than persons without persistent disability. Health is strongly linked with persistent disability, with much more time in fair/poor health (% of waves), higher number of chronic conditions, and higher percentages with nursing home experience and death, than persons without persistent disability. Persistent disability persons end up with fewer interviews in the observation period.

Table 3. Classification Features of Observed Persistent Disability for Persons Ages 51+ (Bivariate)

	Persistent Disability (100% or 75+% of Observations)											
	PLIM 100%		PLIM 75+%		IADL 100%		IADL 75+%		ADL 100%		ADL 75+%	
	Pers	NotPers	Pers	NotPers	Pers	NotPers	Pers	NotPers	Pers	NotPers	Pers	NotPers
Gender (female; %)	60.1***	46.5	59.7***	44.6	61.2***	51.2	62.9***	50.8	59.9***	51.2	60.7***	50.8
Race/ethnicity (%)												
White	74.0***	78.6	75.1***	78.4	68.0***	77.5	68.0***	77.7	65.2***	78.0	66.7***	78.1
Black	13.4	10.4	12.8	10.4	17.3	11.1	17.5	11.0	18.4	10.9	18.0	10.8
Hispanic	9.7	8.4	9.4	8.5	11.0	8.8	11.1	8.7	13.0	8.5	12.3	8.5
Other race/ethnicity	2.9	2.6	2.7	2.8	3.8	2.6	3.4	2.6	3.3	2.7	3.1	2.7
Education (%)												
Less than high school	30.0***	17.2	29.3***	15.6	42.5***	20.6	43.5***	20.0	41.1***	20.4	41.2***	19.8
High school degree	54.4	54.3	54.6	54.1	46.9	55.0	46.0	55.3	47.1	55.1	47.1	55.4
College degree	15.5	28.4	16.0	30.2	10.6	24.4	10.4	24.7	11.8	24.5	11.7	24.8
Age at first observation (mean)	64.0***	60.4	63.9***	59.8	69.0***	61.2	68.9***	61.0	67.8***	61.2	67.7***	61.0
Birth cohort (%)												
1890-1909	2.8***	0.6	2.4***	0.5	9.1***	0.8	8.0***	0.8	8.2***	0.8	7.1***	0.7
1910-1919	11.3	4.9	11.0	4.1	23.4	6.0	23.1	5.8	19.9	6.2	19.3	5.9
1920-1929	17.6	13.1	18.4	11.5	16.2	14.8	17.8	14.6	16.0	14.8	18.2	14.5
1930-1939	17.1	20.2	18.4	19.4	8.6	19.8	10.3	19.9	10.6	19.8	12.1	19.8
1940-1949	20.4	31.3	22.4	31.3	10.8	28.4	12.7	28.5	14.3	28.2	16.1	28.4
1950-1959	30.8	30.0	27.4	33.1	31.8	30.2	28.1	30.5	31.0	30.2	27.2	30.7% %
of waves married (mean)	55.5***	68.3	56.6***	69.5	43.0***	65.0	42.4***	65.4	44.1***	65.2	43.6***	65.8
% of waves live alone (mean)	29.0***	21.8	28.6***	20.9	36.3***	23.6	36.7***	23.3	35.8***	23.5	35.8***	23.2
% of waves fair/poor health (mean)	51.1***	16.4	47.5***	13.8	74.8***	26.3	73.9***	25.5	77.0***	25.4	75.2***	24.3
Max no. chronic conditions (mean)	2.9***	1.8	2.9***	1.6	3.2***	2.2	3.3***	2.1	3.3***	2.1	3.4***	2.1
Ever in nursing home (%)	16.5***	7.1	16.4***	5.5	30.9***	9.1	33.0***	8.4	28.6***	9.0	30.0***	8.4
Died (%)	33.4***	15.3	31.5***	13.9	57.1***	19.5	55.8***	18.9	52.4***	19.5	50.6***	18.8
No. interviews (mean)	3.4***	4.4	3.9***	4.2	2.1***	4.2	2.6***	4.2	2.3***	4.2	2.9***	4.2

Source: Health and Retirement Study, 1998-2010. N = 31,816 PLIM; 31,868 IADL; 31,879 ADL. Crosstabulations and chi-squares for categorical variables; means and t-tests for integer and continuous variables. *** is p< .001; ** is p<.01; * is p<.05; ns is nonsignificant (p≥.05). Crosstabulation significance is shown at first category. PLIM - physical limitation; IADL - instrumental activity of daily living; ADL - activity of daily living. Weighted data.

Table 4. Classification Features of Observed Persistent Disability for Persons Ages 65+ (Bivariate)

	Persistent Disability (100% or 75+% of Observations)											
	PLIM 100%		PLIM 75+%		IADL 100%		IADL 75+%		ADL 100%		ADL 75+%	
	Pers	NotPers	Pers	NotPers	Pers	NotPers	Pers	NotPers	Pers	NotPers	Pers	NotPers
Gender (female; %)	62.8***	49.7	62.4***	47.2	65.4***	55.1	66.8***	54.6	65.0***	55.0	66.6***	54.3
Race/ethnicity (%)												
White	81.3*	82.4	81.5*	82.4	78.2***	82.3	77.8***	82.4	76.4***	82.6	76.8***	82.7
Black	10.3	9.2	9.9	9.4	12.8	9.4	13.4	9.2	13.5	9.2	13.3	9.1
Hispanic	6.9	6.6	7.0	6.4	7.2	6.7	7.1	6.7	8.2	6.6	8.2	6.5
Other race/ethnicity	1.5	1.8	1.6	1.9	1.8	1.7	1.7	1.7	1.9	1.6	1.7	1.7
Education (%)												
Less than high school	35.2***	24.6	34.6***	23.0	49.8***	27.4	49.7***	26.8	45.2***	27.7	45.2***	27.1
High school degree	51.8	52.7	51.9	52.9	40.7	53.7	41.3	53.9	43.6	53.5	44.0	53.8
College degree	13.0	22.7	13.6	24.1	9.4	18.9	9.0	19.2	11.2	18.8	10.9	19.1
Age at first observation (mean)	72.2***	70.2	72.1***	69.8	77.6***	70.4	77.1***	70.3	76.3***	70.5	75.9***	70.3
Birth cohort (%)												
1890-1909	4.4***	1.3	3.9***	1.3	13.5***	1.6	11.9***	1.5	12.4***	1.6	10.8***	1.5
1910-1919	18.0	11.4	18.0	10.0	34.7	12.2	34.1	11.7	30.2	12.5	29.2	12.1
1920-1929	28.1	30.6	30.1	28.3	24.0	30.0	26.3	29.8	24.3	30.1	27.6	29.7
1930-1939	28.6	39.6	30.5	39.4	14.2	36.6	16.6	36.8	16.6	36.6	19.1	36.8
1940-1949	20.9	17.0	17.5	21.0	13.5	19.6	11.1	20.1	16.6	19.2	13.4	19.9
1950-1959	--	--	--	--	--	--	--	--	--	--	--	--
% of waves married (mean)	52.3***	62.5	52.7***	64.3	37.3***	59.9	37.4***	60.5	38.5***	60.1	38.3***	60.9
% of waves live alone (mean)	33.5***	27.7	33.5***	26.4	42.4***	29.2	42.3***	28.8	42.0***	29.0	42.0***	28.6
% of waves fair/poor health (mean)	49.3***	19.6	46.5***	16.7	71.9***	29.7	70.4***	28.8	73.4***	28.9	71.3***	27.7
Max no. chronic conditions (mean)	3.2***	2.3	3.2***	2.2	3.4***	2.7	3.4***	2.7	3.4***	2.7	3.5***	2.6
Ever in nursing home (%)	25.2***	14.2	25.2***	11.6	46.7***	16.4	48.1***	15.4	43.7***	16.3	44.6***	15.2
Died (%)	46.0***	27.9	44.0***	26.6	78.0***	31.9	75.4***	31.1	72.1***	32.0	69.1***	31.1
No. interviews (mean)	4.7***	5.7	5.0***	5.6	3.1***	5.5	3.5***	5.5	3.4***	5.5	3.8***	5.5

Source: Health and Retirement Study, 1998-2010. N = 20,327 PLIM; 20,383 IADL; 20,386 ADL. Crosstabulations and chi-squares for categorical variables; means and t-tests for integer and continuous variables. *** is p< .001; ** is p<.01; * is p<.05; ns is nonsignificant (p≥.05). Crosstabulation significance is shown at first category. PLIM - physical limitation; IADL - instrumental activity of daily living; ADL - activity of daily living. Weighted data.

Persistent Disability: Latent Classes

Latent class models find that 3 classes provide the best fit for all disabilities and both age groups (Figures 1-3). The classes have similar shapes, regardless of disability type and age.

Figure 1. Predicted Number of PLIMs over Mid and Late Adulthood (HRS, 1998-2010)

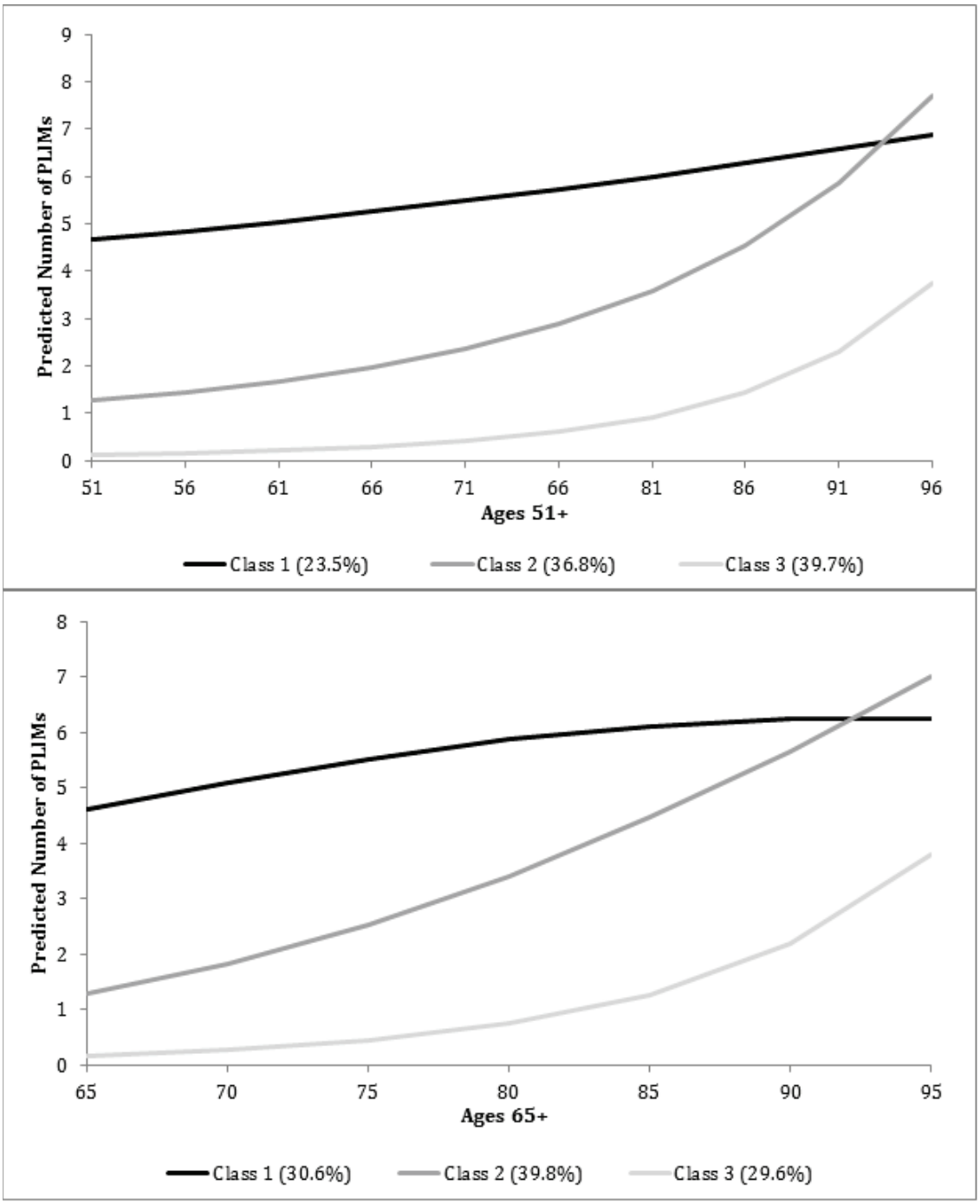


Figure 2. Predicted Probability of Any IADLs over Mid and Late Adulthood (HRS, 1998-2010)

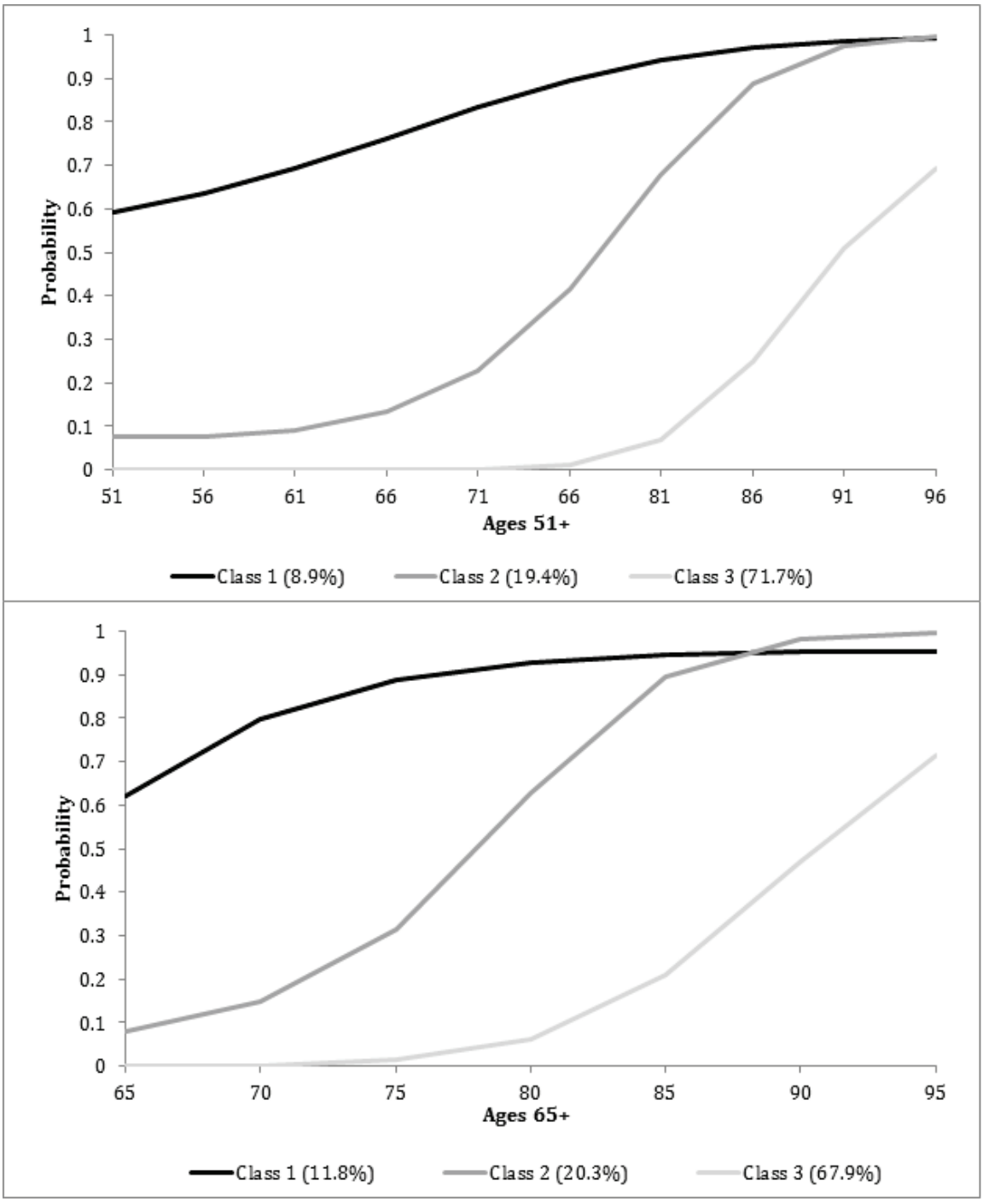
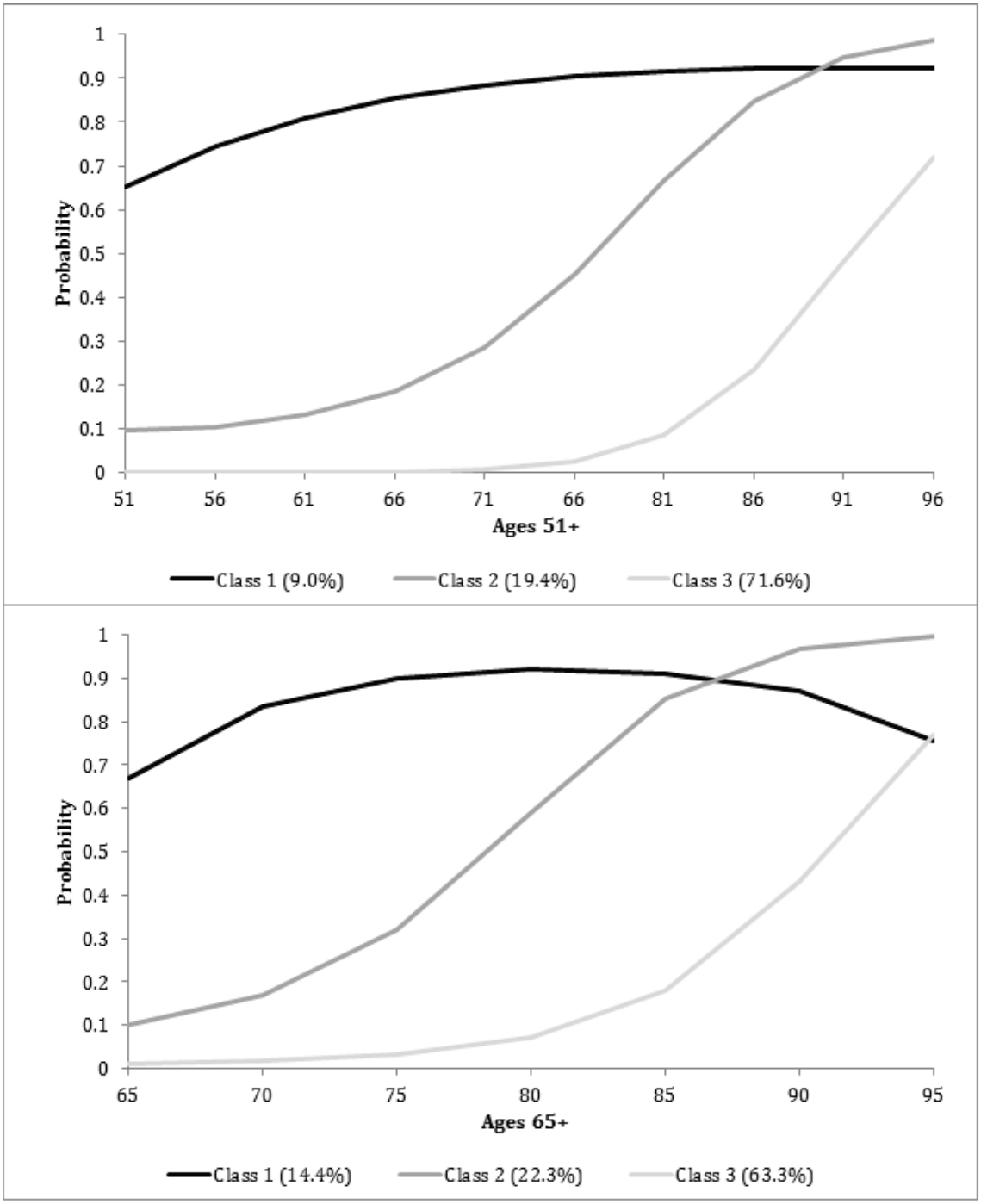


Figure 3. Predicted Probability of Any ADLs over Mid and Late Adulthood (HRS, 1998-2010)



Class 1 shows high initial then gradually increasing disability with age. This means high number of PLIMs at first observation (age 51 or 65), and high probability of any IADL or any ADL at first observation. *Class 2* has low initial disability, with rising prevalence in one's 70's and steep rise at old ages. *Class 3* has very low initial chances of disability, a situation maintained into one's early 80's, then gradual increases and steepening at old ages. *Simple labels for the three trajectories are persistent disability, delay disability, and avoid disability.* Class 1 (persistent disability) is least prevalent, Class 2 (delay disability) ranks second, and Class 3 (avoid disability) is most prevalent.[NOTE 6]

Persistent disability (class 1). There was no guarantee of a persistent disability class in the GGMM solutions, but the results consistently produce it. *Class 1 (persistent disability) fits the notion of aging with disability, with high initial and steadily increasing disability as people age onward*. For ages 51+, prevalence rates of Class 1 are 23.5% PLIM, 8.9% IADL, and 9.0% ADL. Simply put, 23% of persons 51+ follow the persistent PLIMs trajectory as they age, 9% follow it for IADLs, and 9% for ADLs. For ages 65+, percents with the persistent disability trajectory are higher: 30.6% PLIM, 11.8% IADL, and 14.4% ADL. (Prevalences are on Figures 1-3, and also in Table 2. The GGMM values are really probabilities, not typical prevalences.)

Several Class 1 trajectories show slight declines (lower probabilities) at very old ages. The reasons are substantive and technical, due to selective survival (survivors have less disability than those who die), and relatively small --but still several hundred persons-- sample sizes at advanced ages (imprecise estimates).

Other trajectories (classes 2 and 3). Classes 2 and 3 are persons who do not have persistent disability as they age into late life. Prevalences are as follows: *Class 2* (delay disability; low initial disability that rises sharply in one's 70's) percents for ages 51+ are 36.8% PLIM, 19.4% IADL, and 19.4% ADL. For ages 65+, Class 2 percents increase: 39.8% PLIM, 20.3% IADL, and 22.3% ADL. *Class 3* (avoid disability; disability only at very elderly ages) percents for ages 51+ are 39.7% PLIM, 71.7% IADL, and 71.6% ADL. For ages 65+, percents are lower than that: 29.6% PLIM, 67.9% IADL, and 63.3% ADL. This reflects how older persons move into classes with more disability (Classes 1 and 2).

What characteristics are linked with persistent disability? We compare features of Class 1 members with Classes 2&3 combined, thus contrasting people aging with disability to those without it (Table 5). Differences are very consistent for the two age groups (51+, 65+). People in Class 1 are more likely to be female, Black/Hispanic/Other, and have low education than those in the other classes. The group with persistent disability is a little younger when first observed, and they come from more recent birth cohorts. (These age and birth cohort bivariates differ from the observed results. This turns out to have great importance; see Discussion section on the two analysis approaches.) Persons with persistent disability are less steadily married in the observation period, and in line with that, more often living alone. Class 1 people have more time in fair/poor health (% of waves) and more chronic conditions, and they are more likely to have nursing home residence and die in the observation period. They contribute fewer interviews on average than the other classes.

Overlap of Observed and Latent Class Results

Do the same people have persistent disability in the observed and latent class approaches? We hope so! *Overlap is very high for PLIMs*: For people ages 51+ who are in Class 1 PLIMs (persistent disability), 88.0 - 95.5% also have observed persistent PLIM disability; for ages 65+, overlap is 88.5 - 94.5% (Table 6). The ranges are based on the 100% and 75+% criteria; 100% has less overlap. *Overlap is moderately high for IADLs and ADLs*: For IADLs, 57.8 - 68.1% of Class 1 members ages 51+ also have observed persistent IADL disability; for ages 65+, overlap is 56.0 - 66.1%. For ADLs, overlap is 64.0 - 76.6% for ages 51+, and 56.1 - 68.2% for ages 65+. *All in all, the results show that the two approaches routinely identify the same people as having persistent disability*.[NOTE 7]

Remarkably, persistent disability tends to occur across disabilities, even if they are not the same type! Class 1 people have higher percents of persistent disability of all sorts, compared to Classes 2&3 people. This is evident by looking at "off-diagonal" results in Table 6. For example, compare percents of latent IADL with observed ADL for Class 1 versus Classes 2&3. Most of these overlaps for Class 1 are modest, but one is very high: People with persistent IADL or ADL disability (latent) almost always have persistent PLIM disability (observed) as well. The overlaps are 80.3 - 96.5% for ages 51+, and 80.1 - 93.8% for ages 65+. We return to this in the Discussion.

Table 5. Classification Features of Persistent Disability Latent Class (C1) vs. Other Latent Classes (C2&3) (Bivariate)

	Ages 51+						Ages 65+					
	PLIM		IADL		ADL		PLIM		IADL		ADL	
	C1	C2&3	C1	C2&3	C1	C2&3	C1	C2&3	C1	C2&3	C1	C2&3
Gender (female; %)	62.6	48.8	57.0	51.5	55.5	51.6	65.5	52.1	59.6	55.8	60.6	55.5
Race/ethnicity (%)												
White	68.8	79.2	62.5	78.1	59.6	78.5	77.6	83.7	73.8	82.9	73.6	83.2
Black	16.3	10.2	19.8	10.8	20.5	10.7	12.4	8.5	14.6	9.1	14.3	9.0
Hispanic	11.8	8.1	13.7	8.5	15.9	8.2	8.1	6.2	9.3	6.4	10.0	6.2
Other race/ethnicity	3.1	2.6	4.0	2.6	4.1	2.6	1.8	1.6	2.3	1.6	2.1	1.6
Education (%)												
Less than high school	34.2	18.8	35.7	21.1	36.6	21.0	37.9	26.3	43.6	28.1	39.9	28.2
High school degree	54.0	54.5	51.8	54.6	51.1	54.7	50.3	53.1	44.9	53.2	47.3	53.1
College degree	11.9	26.7	12.5	24.3	13.3	24.3	11.7	20.6	11.5	18.7	12.8	18.7
Age at first observation (mean)	61.1	62.0	58.9	62.1	58.9	62.1	70.5	71.5	69.9	71.4	69.8	71.4
Birth cohort (%)												
1890-1909	0.4	1.8	0.0	1.6	0.0	1.6	1.5	3.5	0.0	3.3	0.1	3.4
1910-1919	6.8	7.6	0.0	8.2	0.0	8.3	14.2	14.9	9.3	15.5	8.9	15.7
1920-1929	13.6	15.3	13.2	15.1	11.7	15.3	27.2	30.3	35.6	28.5	35.5	28.3
1930-1939	19.2	18.8	19.4	18.8	20.7	18.7	36.0	33.3	34.4	34.0	34.1	34.1
1940-1949	29.0	26.3	28.4	26.7	31.9	26.4	21.1	18.0	20.7	18.7	21.4	18.5
1950-1959	30.9	30.1	39.0	29.4	35.8	29.7	--	--	--	--	--	--
% of waves married (mean)	55.1	65.6	54.1	64.0	53.8	64.1	51.8	60.0	50.8	58.3	49.3	58.8
% of waves live alone (mean)	27.7	23.7	26.4*	24.5	26.7**	24.5	32.5	29.8	31.0^{ns}	30.6	33.3	30.2
% waves fair/poor hlth (mean)	65.0	19.9	72.0	26.3	73.6	25.9	59.4	23.3	68.4	29.9	67.8	28.8
Max no. chron.cond. (mean)	3.3	1.9	3.4	2.1	3.4	2.1	3.5	2.4	3.6	2.6	3.6	2.6
Ever in nursing home (%)	17.7	8.8	17.3	10.3	17.2	10.3	29.6	15.3	36.6	17.5	35.2	17.2
Died (%)	30.1	20.3	29.2	22.0	26.9	22.2	45.0	33.3	55.5	34.6	50.9	34.7
No. interviews (mean)	3.8	4.1	3.3	4.1	3.5	4.1	3.6	4.1	3.3	4.0	3.5	4.0

Source: Health and Retirement Study, 1998-2010. For Ages 51+, N = 31,816 PLIM; 31,868 IADL; 31,879 ADL. For Ages 65+, N = 20,327 PLIM; 20,383 IADL; 20,386 ADL. Results are based on generalized growth mixture modeling (GGMM). C1 is latent class 1 (persistent disability); C2&3 is latent classes 2 and 3 combined. Crosstabulations and chi-squares for categorical variables; means and t-tests for integer and continuous variables. All differences C1 vs C2&3 are statistically significant at $p < .001$ except as indicated (** $p<.01$; * $p<.05$; ^{ns} nonsignificant, $p \geq .05$). PLIM - physical limitation; IADL - instrumental activity of daily living; ADL - activity of daily living. Weighted data.

Table 6. Overlap of Latent Classes with Observed Persistent Disability

	Ages 51+						Ages 65+					
	PLIM		IADL		ADL		PLIM		IADL		ADL	
	C1	C2&3	C1	C2&3	C1	C2&3	C1	C2&3	C1	C2&3	C1	C2&3
	(Percent in latent class who have observed persistent disability)											
Observed persistent disability												
PLIM 100% of observations	88.0	25.8	80.3	36.2	90.6	34.9	88.5	32.4	80.1	45.5	87.7	43.1
PLIM 75+% of obs.	95.5	35.1	87.2	45.3	96.5	44.1	94.5	43.5	86.3	55.4	93.8	53.2
IADL 100% of observations	23.3	3.8	57.8	3.6	34.8	5.6	24.0	5.2	56.0	5.2	32.7	7.5
IADL 75+% of obs.	28.2	4.5	68.1	4.4	41.1	6.9	28.8	6.5	66.1	6.5	39.4	9.1
ADL 100% of observations	31.6	2.9	43.3	6.4	64.0	4.0	30.3	4.4	42.6	8.5	56.1	5.2
ADL 75+% of obs.	38.6	3.8	51.5	8.1	76.6	5.2	37.4	5.6	50.1	10.9	68.2	6.7

Source: Health and Retirement Study, 1998-2010. Latent class results are based on generalized growth mixture modeling (GGMM). C1 is latent class 1 (persistent disability); C2&3 is latent classes 2 and 3 combined. All differences C1 vs C2&3 are statistically significant at $p<.001$. PLIM - physical limitation; IADL - instrumental activity of daily living; ADL - activity of daily living. Weighted data.

DISCUSSION

This analysis reports prevalence and correlates of aging with disability for U.S. adults in midlife and older ages. We reflect here on (1) how our results join and extend contemporary research on disability trajectories, (2) whether observed and latent class approaches reach the same conclusions about persistent disability, (3) how age groups do, or do not, differ for persistent disability, (4) how types of disability do, or do not, differ for persistent disability, and (5) how aging with disability can be studied with existing longitudinal surveys.

Aging-with-Disability Is A Typical Pattern

This analysis started from interest in aging with disability, with an open mind about whether a latent class reflecting it would be found, or not. The trajectory of "high initial then gradually increasing disability with age" is indeed "aging with disability". Persistent disability is a typical, although not high prevalence, pattern for midlife and older persons as they age onward into late life.

Contemporary *longitudinal disability analyses often find 3 trajectories* (Dodge et al., 2006: Liang et al., 2003; Martin et al., 2016; Slaug et al., 2016; Wickrama et al., 2013; Wolf et al., 2015; Yu et al., 2015; Zimmer et al., 2012; 2014). The patterns are usually similar across analyses, distinguishing groups with high and rising disability, low disability that rises gradually as age increases, and near-zero disability for many years that gradually rises at later ages. The similar number and shapes occur regardless of variation in disability items, coding of disability variables, and statistical techniques. Importantly, *other topics produce different routine numbers and shapes* of trajectories (e.g., obesity, Clarke et al., 2010; substance abuse, Muthén, Muthén, 2000; criminal profiles, Kreuter, Muthén 2008). All in all, there must be a deep-down substantive reason for the consistency in number and shape of disability patterns. It stems, we think, from some limited heterogeneity in the fundamental nature of aging and death for contemporary populations. **NOTE 8**

The literatures on aging with disability and disability trajectories join together. This union has not been perceived previously by either trajectories or aging-with-disability researchers. There is evident opportunity to use both literatures to advantage for hypotheses and interpretations to understand aging with disability for midlife and older adults.

The Observed and Latent Class Approaches Are Both Good

Do the observed and latent class approaches yield similar results about persistent disability, as we hypothesized? Yes.

Both approaches generate *very similar prevalences* of persistent disability for IADLs, and also for ADLs. For PLIMs, prevalences of observed persistent disability exceed latent class probabilities; this is because the first are based on "any" (persistent presence) and the second on "count" (persistent any or high). *For population reporting, persistent I/ADL disability exists for 8-10% of persons ages 51+ and 11-45% for ages 65+* (observed 100% and latent class 1 criteria). *Persistent PLIM disability exists for 40% of persons ages 51+ and 50% for ages 65+* (observed 100%; latent class are 17-19% lower).

Both approaches find the *same social and health features* linked with persistent disability. *As hypothesized, people with persistent disability have social and health disadvantages, compared to people without it*. The standout features are protracted health problems, and elevated risks of nursing home stays and death, for those with persistent disability. The sole inconsistency between approaches is for age and birth cohort, and we explain shortly why that difference happens.

This overall similarity between the two approaches is remarkable, given striking differences between them.

For the observed approach, persistent disability is based on 12 years (maximum) data for respondents, which is not especially long. Nevertheless, our evaluations of several criteria for persistent disability (100% versus 75+% of observations; and 1+ versus 2+ interviews) show robust identification of persistent disability. These evaluations are not just technical sensitivity tests, but have important substantive meaning. First, allowing variation (disability at 75+% of observations) does as good a job as not allowing it (disability at 100% of observations). Thus, *persistence can be legitimately viewed as "most or all"*. Second, counting people with just 1 interview (with disability) as having persistent disability is a brave step, but it does as good a job as scoring persistence only for people with 2 or more interviews. *People with disability at just one wave have elevated chances of disability at later ones; their one-wave results are a quite-good prognosis of the future, not yet recorded in interviews*. **NOTE 9**

The latent class approach is more flexible and population-oriented. Although a person contributes only 12 years (maximum) data, the technique pools data to produce typical patterns for everyone Ages 51+ (65+) onward. The approach smooths individual variation and utilizes all information, including single interviews, to find best-fit patterns. But we discovered it has some trouble for very advanced ages due to competing classes at that point (Classes 1 and 2 both have high disability at those ages). The technique runs into uncertainty about class assignment. That, in turn, causes unusual differentials. We noted age and birth cohort, but some others become shallow compared to the observed results. Remarkably, prevalence rates are not affected as the technique struggles to assign people to classes. I/ADL pevalences are similar to the observed approach. Finding and understanding this estimation feature took a great deal of detective work on our part. We think it may be common for latent class techniques; that is, imprecise assignment at ages where disability levels become similar for previously differentiated subgroups. We welcome comments on this important point.

Do we recommend one approach over the other? No. Both are appropriate for large-scale survey data with longitudinal information for individuals. Researchers accustomed to the aging-with-disability literature may be more comfortable with the observed approach. Researchers with strong statistical savvy may be more comfortable with the latent class approach. Neither one is intrinsically better. The latent class approach does have the advantage of pooling individuals' data even when sparse, in contrast to the observed approach staying stolidly within individual data streams to determine persistent disability.

Trajectories are Similar for Midlife and Older Ages Onward [NOTE 10]

Persistent disability is less common from midlife ages onward (51+) than from older ages onward (65+), as hypothesized. Lower prevalence of persistent disability for Ages 51+ signals that functional recovery and episodic disability are more common at middle ages 51-64 than at older ages.

The same trajectories of disability occur whether we start watching at midlife ages or older ones. There are 3 patterns, their shapes are the same, and a persistent disability group exists for both age spans. *The trajectories literature has focused on older persons. Our analysis shows that starting at midlife extends the patterns, but does not fundamentally change them.* [NOTE 11]

Persistent Disability is Especially Common for PLIMs

PLIMs have distinctive results that reflect their early onset and tendency to accumulate over time, compared to IADLs and ADLs.

First, *prevalence of persistent disability is much higher* for PLIMs than I/ADLs. This aligns with scientific and clinical evidence that physical limitations accumulate for people, prompting increasing troubles in daily life but little increased risk of death. By contrast, I/ADL disabilities signal trouble for maintaining one's residence and life itself, and they are more strongly linked to residential care and death (Bernard et al, 1997; Bo et al., 2003; Keller, Potter, 1994; Mayo et al., 2005; Nybo et al., 2003; Sonn et al., 1996; Tianen et al., 2013). Second, although the same social and health disadvantages for persons with persistent disability occur for all disability types, *differentials are smaller* for PLIMs than I/ADLs. Differentials are especially shallow for health, nursing home, and death, reflecting the fact that physical limitations are not highly predictive for poor outcomes. By contrast, people with persistent I/ADLs differ strongly from those with nonpersistent experiences, particularly for adverse health. Third, people with persistent I/ADL disability very often have persistent PLIMs as well. All other overlaps across disability types are less common. This aligns with scientific evidence on *disability hierarchy and progression* (Dunlop et al., 1997; Ferrucci et al., 1998; Fieo et al., 2011; Kempen, Suurmeijer, 1990; Verbrugge et al., 2004). In people's longrun disability experience, PLIMs tend to come earliest, and ADLs tend to come latest. When people acquire IADLs and especially ADLs, they usually already have PLIMs. *All in all, PLIMs are so common as people age, their presence and persistence do not distinguish people and their prospects very well compared to IADLs and ADLs.*

Existing Longitudinal Data Have Potential to Study Aging with Disability

A simple, but apt, definition of aging with disability is "persistent disability over a long time period". The definition is not contingent on onset timing (birth, childhood, adulthood) or on severity.

This definition can be operationalized in various sorts of data containing repeated disability measures over years. All such data sets have strengths and limitations. We chose HRS because of its large sample scope, data quality, and longitudinal length. But it has some limitations for studying persistent disability, the main one being disability onset/duration. HRS does not have

onset dates for current disabilities, episodes before HRS entry, and changes during the intervals between interviews. Those limitations are typical for large-scale surveys with disability information; we found no better alternative to HRS. Onset information requires a retrospective query for each current disability about "age when disability first started" or "how long ago did disability start". This is rare but highly valuable and to be recommended, with some validation assessments.[NOTE 12]

In short, to study *persistent disability* over a long time, "age at onset" is desirable but not requisite. This analysis yields plenty of information without it. However, if the research goal is to study *lifetime experience of disability*, then "age at onset" is requisite.

Researchers who study aging with disability for children and youths are accustomed to more ample data that include disability onset time and subsequent episodic experiences. Their samples are often children/youths with severe disability, which also makes for clear onset times and high chances of continuation. Being used to such data, the researchers may complain about data sets like HRS. Our stance is to use large-scale survey data as best as possible, attentive to limitations and using adroit techniques.

CONCLUSION

Aging with disability is persistent disability over a long time -- many years, or decades, or one's whole lifetime.

This analysis has focused on prevalence and correlates of aging with disability, not its psychosocial consequences. Whether persistent disability starts early or late in the life course, the consequences for individuals are large and protracted. People face enduring problems in accomplishing goals, they must adapt daily life and attitudes, and they can feel angry or depressed. These are common topics for youth with early-onset disabilities. They are just as germane for midlife and older adults who age with disability. We posit that social and emotional consequences are similar for all age groups, no matter when persistent disability begins. Specific goals and problems will vary by age, but overarching life issues are the same.

This analysis helps stretch the notion of aging with disability from children and youths toward all ages. Eventually, as research on aging with disability for middle and older ages increases, an integrated corpus of knowledge across all ages will emerge, and programs and policies that are age-free rather than age-targeted will be possible.

NOTES

NOTE 1 From a causal standpoint, sociodemographic and health characteristics are disability precursors or reciprocal relationships, and nursing home, death, and time in study are disability outcomes.

NOTE 2 We generated multivariate results, namely, logistic regressions predicting persistent disability with the sociodemographic and health covariates. Differentials are sometimes weaker and inconsistent compared to bivariates, and the models do not suit a classification approach. Still, tables with odd ratios are available on request.

NOTE 3 Four "initial" features are: % married, live alone, fair/poor health, and number of chronic conditions. Their "cumulative" versions are: % of waves married, % of waves live alone, % of waves with fair/poor health and highest number of chronic conditions. (1) "Initial" percentages/means are a bit higher than "cumulative" ones for married, and lower for live alone, fair/poor health, and chronic conditions. This makes sense since as time goes on, midlife and older people can become widowed or separated/divorced, and then live alone, and also their health generally worsens. (2) Differentials with persistent disability are the same for the two versions; that is, we find that initial and cumulative versions do equally good jobs of distinguishing persistent versus other disability. This similarity holds for both observed and latent class results. Tables with initial-version results are available on request.

NOTE 4 This evaluation is for the 100% criterion (not germane for 75+%). Scoring "one interview with disability" people 1, or 0, for persistent disability occurs for 9-14% of respondents for PLIMs, and 4-5% for I/ADLs. Prevalence rates for the 1+ approach are higher than for 2+, but covariate relationships are the same. Exception: death is more common for persistent disability based on 2+ interviews than 1+ interviews. Tables with the 2+ results are available on request.

NOTE 5 Prevalence of persistent ADL disability exceeds prevalence of persistent IADL disability (ADL > IADL). This mirrors a result often found in HRS disability analyses: ADL rates exceed IADL rates (Bowen, 2009; Fonda, Herzog, 2004; Freedman et al., 2008; St. Clair et al., 2011). Most disability research shows the opposite (IADL > ADL). Why does this occur? Surveys vary in specific items used in I/ADL counts (Freedman et al., 2004; Freedman et al., 2013). The HRS items likely drive this difference (ADL > IADL), and HRS staff could investigate this issue since so many researchers utilize the data set.

NOTE 6 One exception: For ages 65+ PLIMs, prevalences vary only a little across the 3 classes. Ranks are 2, 1, 3 instead of the usual 3, 2, 1.

NOTE 7 Higher overlap for PLIMs is likely due to a technical feature. For PLIMs, overlap percents compare "any" for the observed approach and "count" for the latent class approach (highly likely to capture "any" in its hunt for "count"). By contrast, for IADLs and ADLs, the observed and latent class approaches both use "any". This is a demanding criterion for a probabilistic approach, and latent class models sometimes miss it, so lower overlap appears.

NOTE 8 Based on an extensive review of trajectories analyses, we offer these comments: (1) *Numbers of trajectories* found in other contemporary analyses are 3 (see main text), 4 (Romoren, Blekeseaune, 2003; Gill et al., 2009), 5 (Gill et al., 2010; Liang et al., 2009; Taylor, Lynch, 2011, 6 (Nusselder et al., 2006), 8 (Deeg, 2005), and 10 (Nusselder et al., 2005). (2) *For U.S. analyses*, HRS data are often used. Many operational and statistical differences exist among the analyses, yet they often yield similar number and shapes of trajectories. Is there perhaps an "uber" data structure that drives such similarity? Maybe not. U.S. analyses using other data sets tend to arrive at the same overall outcome

of 3 trajectories and same shapes. (3) *Latent variables analyses* of multivariate relationships among social characteristics, health, and disability are not reviewed here (e.g., Brown et al., 2012; Haas, Rohlfsen, 2010; Taylor, 2011; Taylor, Lynch, 2004). Their focus is relationships among constructs, not identification and description of latent classes.

NOTE 9 A reviewer suggested using wave-to-wave variations to study "disability episodes". We think finer-grained data documenting the timepoints of onset and recovery are needed to study episodes, and large-scale data sets like HRS are not well-suited.

NOTE 10 A reviewer suggested separating the age samples entirely by studying Ages 51-64 and Ages 65+. The Ages 51-64 group ages to 63-76 in the observation period, so we see aging with disability for a truncated range of ages, namely, 51-76. We prefer Ages 51+ because it goes onward to advanced ages.

NOTE 11 Patterns for Ages 51+ and Ages 65+ appear to coincide from ages 65 onward, but in fact, they are not identical. Both samples contribute information for ages 65-76, but only the 65+ sample does for ages 77+.

NOTE 12 A recent review confirms the paucity of suitable data sets for studying aging with disability for middle and older ages (Putnam et al., 2016). The authors evaluate data sets for onset information, but do not distinguish between "onset of diagnosis" and "onset of disability" (Table 1 and text top p.8 in Putnam et al.). A rare instance of disability onset data is the 1994-1995 National Health Interview Survey Disability Supplement (NHIS-D), which asked "age at first onset" for current disabilities. The data are analyzed in Verbrugge, Yang, 2002, 2003; Verbrugge et al., 2004. We welcome information about other analyses of the NHIS-D onset data, or of other large-scale datasets with disability onset items.

REFERENCES

Ansello EF, Eustis NN (Eds.). 1992. Aging and Disabilities: Seeking Common Ground. Amityville, NY: Baywood.

Beckett LA, Brock DB, Lemke JH, Mendes de Leon CF, Guralnik JM, Fillenbaum GG, Branch LG, Wetle TT, Evans DA. 1996. Analysis of change in self-reported physical function among older persons in four population studies. American Journal of Epidemiology, 143(8), 766-778. doi:10.1093/oxfordjournals.aje.a008814

Bernard SL, Kincade JE, Konrad TR, Arcury TA, Rabiner DJ, Woomert A, DeFriese GH, Ory GM. 1997. Predicting mortality from community surveys of older adults: The importance of self-rated functional ability. Journal of Gerontology: Social Sciences, 52B(3), S155-S163. doi:10.1093/geronb/52B.3.S155

Bickenbach J, Bigby C, Salvador-Carulla L, Heller T, Leonardi M, LeRoy B, Mendez J, Putnam M, Spindel A. 2011. The Toronto Declaration on Bridging Knowledge, Policy and Practice in Aging and Disability. Growing Older with a Disability (GOWD) Conference, Festival of International Conferences on Caregiving, Disability, Aging and Technology (FICCDAT), Toronto, Canada, June 2011. (Available at www.ficcdat.ca.)

Bo M, Massaia M, Raspo S, Bosco F, Cena P, Molaschi M, Fabris F. 2003. Predictive factors of in-hospital mortality in older patients admitted to a medical intensive care unit. Journal of the American Geriatrics Society, 51, 529-533. doi:10.1046/j.1532-5415.2003.51163.x

Bowen ME. 2009. Childhood socioeconomic status and racial differences in disability: Evidence from the Health and Retirement Study (1998-2006). Social Science & Medicine, 69, 433-441. doi:10.1016/j.socscimed.2009.06.006

Bowling S, Farquhar M, Grundy E. 1994. Associations with changes in level of functional ability. Results from a follow-up survey at two and a half years of people ages 85 years and over at baseline interview. Ageing & Society, 14(1), 53-73. doi:10.1017/S0144686X00000052

Brown TH, O'Rand AM, Adkins DE. 2012. Race-ethnicity and health trajectories: Tests of three hypotheses across multiple groups and health outcomes. Journal of Health and Social Behavior, 53(3), 359-377. doi:10.1177/0022146512455333

Carlson JE, Zocchi KA, Bettencourt DM, Gambrell ML, Freeman JL, Zhang D, Goodwin JS. 1998. Measuring frailty in the hospitalized elderly: Concept of functional homeostasis. American Journal of Physical Medicine & Rehabilitation, 77(3), 252-257. doi:10.1097/00002060-199805000-00012

Charlton JRH. 1989. Measuring disability in a longitudinal survey. Pp. 62-80 in Patrick DL, Peach H (Eds.), Disablement in the Community. Oxford: Oxford University Press.

Clarke P, Latham K. 2014. Life course health and socioeconomic profiles of Americans aging with disability. Disability and Health Journal, 7, S15-S23. doi:10.1016/j.dhjo.2013.08.008

Clarke PJ, O'Malley PM, Schulenberg JE, Johnston LD. 2010. Midlife health and socioeconomic consequences of persistent overweight across early adulthood: Findings from a national survey of American adults (1986-2008). American Journal of Epidemiology, 172(5), 540-548. doi:10.1093/aje/kwq156

Cnaan A, Laird NM, Slasor P. 1997. Using the general linear mixed model to analyse unbalanced repeated measures and longitudinal data. Statistics in Medicine, 16(20), 2349-2380. doi:10.1002/(SICI)1097-0258(19971030)16:20<2349::AID-SIM667>3.0.CO;2-E

Deeg DJH. 2005. Longitudinal characterization of course types of functional limitations. Disability and Rehabilitation, 27(3), 253-261. doi:10.1080/09638280400006507

Disability and Health Journal. 2014. Special issue for Aging with Disability: Demographic, Social, and Policy Considerations (Washington, D.C., May 2012), 7(Suppl. Issue 1).

Dodge HH, Du Y, Saxton JA, Ganguli M. 2006. Cognitive domains and trajectories of functional independence in nondemented elderly persons. Journal of Gerontology: Medical Sciences, 61A(12), 1330-1337. doi:10.1093/gerona/61.12.1330

Dunlop DD, Hughes SL, & Manheim LM. 1997. Disability in activities of daily living: Patterns of change and a hierarchy of disability. American Journal of Public Health, 87(3), 378-383. doi:10.2105/AJPH.87.3.378

Feng D, Silverstein M, Giarrusso R, McArdle JJ, Bengtson VL. 2006. Attrition of older adults in longitudinal surveys: Detection and correction of sample selection bias using multigenerational data. Journals of Gerontology: Psychological and Social Sciences, 61B(6), S323-S328. doi:10.1093/geronb/61.6.S323

Ferrucci L, Gurlanik JM, Cecchi F, Marchionni N, Salani B, Kasper J, Celli R, Giardini S, Heikkinen E, Jylha M, & Baroni A. 1998. Constant hierarchic patterns of physical functioning across seven populations in five countries. The Gerontologist, 38(3), 286-294. doi:10.1093/geront/38.3.286

Ferrucci L, Guralnik JM, Simonsick E, Salive ME, Corti C, Langlois J. 1996. Progressive versus catastrophic disability: A longitudinal view of the disablement process. Journal of Gerontology: Medical Sciences, 51A(3), M123-M130. doi:10.1093/gerona/51A.3.M123

Fieo RA, Austin EJ, Starr JM, & Deary IJ. 2011. Calibrating ADL-IADL scales to improve measurement accuracy and to extend the disability construct into the preclinical range: A systematic review. BMC Geriatrics, 11, 42. doi:10.1186/1471-2318-11-42

Fonda A, Herzog AR. 2004. Documentation of Physical Functioning Measures in the Health and Retirement Study and the Asset and Health Dynamics among the Oldest Old Study. HRS Documentation Report DR-008. Ann Arbor, Michigan: Survey Research Center, University of Michigan. (Available at hrsonline.isr.umich.edu)

Fortinsky RH, Covinsky KE, Palmer RM, Landefeld CS. 1999. Effects of functional status changes before and during hospitalization on nursing home admission of older adults. Journal of Gerontology: Medical Sciences, 54A(10), M521-M526. doi:10.1093/gerona/54.10.M521

Freedman VA, Crimmins E, Schoeni RF, Spillman BC, Aykan H, Kramarow E, Land K, Lubitz J, Manton K, Martin LG, Shinberg D, Waidmann T. 2004. Resolving inconsistencies in trends in old-age disability: Report from a technical working group. Demography, 41(3), 417-441. doi:10.1353/dem.2004.0022

Freedman VA, Martin LG, Schoeni RF, Cornman JC. 2008. Declines in late-life disability: The role of early- and mid-life factors. Social Science & Medicine, 66, 1588-1602. doi:10.1016/j.socscimed.2007.11.037

Freedman VA, Spillman BC, Andreski PM, Cornman JC, Crimmins EM, Kramarow E, Lubitz J, Martin LG, Merkin SS, Schoeni RF, Seeman TE, Waidmann TA. 2013. Trends in late-life activity limitations in the United States: An update from five national surveys. Demography, 50(2), 661-671. doi:10.1007/s13524-012-0167-z

Gill TM, Gahbauer EA, Han L, Allore HG. 2009. Functional trajectories in older persons admitted to a nursing home with disability after an acute hospitalization. Journal of the American Geriatrics Society, 57, 195-201. doi:10.1111/j.1532-5415.2008.02107.x

Gill TM, Gahbauer EA, Han L, Allore HG. 2010. Trajectories of disability in the last year of life. New England Journal of Medicine, 362(13), 1173-1180. doi:10.1056/NEJMoa0909087

Haas S, Rohlfsen L. 2010. Life course determinants of racial and ethnic disparities in functional health trajectories. Social Science & Medicine, 70, 240-250. doi:10.1016/j.socscimed.2009.10.003

Hardy SE, Allore HG, Guo Z, Dubin JA, Gill TM. 2006. The effect of prior disability history on subsequent functional transitions. Journal of Gerontology: Medical Sciences, 61A(3): 272-277. doi:10.1093/gerona/61.3.272

Heeringa SG, Connor JH. 1995. Technical Description of the Health and Retirement Survey Sample Design. Ann Arbor, Michigan: Sampling Section, Institute for Social Research, University of Michigan. (//hrsonline.isr.umich.edu; Publications/Documentation Reports) doi:10.7826/ISR-UM.06.585031.001.05.0001.1995

Jette AM, Harris BA, Cleary PD, Campion EW. 1987. Functional recovery after hip fracture. Archives of Physical Medicine and Rehabilitation, 68, 735-740.

Katz S, Akpom CA. 1976. A measure of primary sociobiological functions. International Journal of Health Services, 6(3), 493-508. doi:10.2190/UURL-2RYU-WRYD-EY3K

Katz S, Downs TD, Cash HR, Grotz RC. 1970. Progress in development of the index of ADL. The Gerontologist, 10(1), 20-30. doi:10.1093/geront/10.1_Part_1.20

Katz S, Ford AB, Moskowitz RW, Jackson BA, & Jaffe MW. 1963. Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. Journal of the American Medical Association, 185(12), 914-919. doi:10.1001/jama.1963.03060120024016

Keller BK, Potter JF. 1994. Predictors of mortality in outpatient geriatric evaluation and management clinic patients. Journal of Gerontology: Medical Sciences, 49(6), M246-M251. doi:10.1093/geronj/49.6.M246

Kempen GIJM & Suurmeijer TPBM. 1990. The development of a hierarchical polychotomous ADL-IADL scale for noninstitutionalized elders. The Gerontologist, 30(4), 497-502. doi:10.1093/geront/30.4.497

Kennedy J (Ed.). 2002. Special Issue: Disability and Aging. Journal of Disability Policy Studies, 12(4), Spring 2002.

Klingbeil H, Baer HR, Wilson PE. 2004. Aging with a disability. Archives of Physical Medicine and Rehabilitation, 85, 68-73. doi:10.1016/j.apmr.2004.03.014

Kreuter F, Muthén B. 2008. Analyzing criminal trajectory profiles: Bridging multilevel and group-based approaches using growth mixture modeling. Journal of Quantitative Criminology, 24(1), 1-31. doi:10.1007/s10940-007-9036-0

Latham K. 2012. Progressive and accelerated disability onset by race/ethnicity and education among late midlife and older adults. Journal of Aging and Health, 24(8), 1320-1345. doi:10.1177/0898264312459345

Li LW. 2005. Trajectories of ADL disability among community-dwelling frail older persons. Research on Aging, 27(1), 56-79. doi:10.1177/0164027504271348

Liang J, Shaw BA, Krause NM, Bennett JM, Blaum C, Kobayashi E, Fukaya T, Sugihara Y, Sugisawa H. 2003. Changes in functional status among older adults in Japan: Successful and usual aging. Psychology and Aging, 18(4), 684-695. doi:10.1037/0882-7974.18.4.684

Liang J, Xu X, Bennett JM, Ye W, Quiñones. 2009. Ethnicity and changing functional health in middle and late life: A person-centered approach. Journal of Gerontology: Social Sciences, 65B(4), 470-481. doi:10.1093/geronb/gbp114

Maddox GL, Clark DO. 1992. Trajectories of functional impairment in later life. Journal of Health and Social Behavior, 33, 114-125. doi:10.2307/2137250

Martin LG, Zimmer Z, Lee J. 2016. Foundations of activity of daily living trajectories of older Americans. Journals of Gerontology, Series B: Psychological and Social Sciences, online 2 September 2015, forthcoming. doi:10.1093//geronb/gbv074 [same status 19 June 2016]

Mayo NE, Nadeau L, Levesque L, Miller S, Poissant L, Ramblyn R. 2005. Does the addition of functional status indicators to case-mix adjustment indices improve prediction of hospitalization, institutionalization, and death in the elderly? Medical Care, 43(12), 1194-1202. doi:10.1097/01.mlr.0000185749.04875.cb

McArdle JJ, Hamagami F. 1992. Modeling incomplete longitudinal and cross-sectional data using latent growth structural models. Experimental Aging Research, 18(3), 145-166. doi:10.1080/03610739208253917

Muthén B. 2004. Latent variable analysis. Growth mixture modeling and related techniques for longitudinal data. Pp. 345-368 (Chapter 19) in Kaplan D (Ed.), The Sage Handbook of Quantitative Methodology for the Social Sciences. Thousand Oaks, CA: Sage.

Muthén B, Muthén LK. 2000. Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. Alcoholism: Clinical and Experimental Research, 24(6), 882-891. doi:10.1080/03610739208253917

Nusselder WJ, Looman CWN, Mackenbach JP. 2005. Nondisease factors affected trajectories of disability in a prospective study. Journal of Clinical Epidemiology, 58, 484-494. doi:10.1016/j.jclinepi.2004.09.009

Nusselder WJ, Looman CWN, Mackenbach JP. 2006. The level and time course of disability: Trajectories of disability in adults and young elderly. Disability and Rehabilitation, 28(16), 1015-1026. doi:10.1080/09638280500493803

Nybo H, Petersen HC, Gaist D, Jeune B, Andersen K, McGue M, Vaupel JW, Christensen K. 2003. Predictors of mortality in 2,249 nonagenarians - The Danish 1905-Cohort Survey. Journal of the American Geriatrics Society, 51(10), 1365-1373. doi:10.1046/j.1532-5415.2003.51453.x

Pentland W, McColl MA, Rosenthal C. 1995. The effect of aging and duration of disability on long term health outcomes following spinal cord injury. Spinal Cord, 33(7), 367-373. doi:10.1038/sc.1995.84

Putnam M (Ed.). 2007. Aging and Disability: Crossing Network Lines. New York: Springer.

Putnam M, Molton IR, Truitt AR, Smith AE, Jensen MP. 2016. Measures of aging with disability in U.S. secondary data sets: Results of a scoping review, Disability and Health Journal, 9(1), 5-10. doi:10.1016/j.dhjo.2015.07.002

Romoren TI, Blekeseaune M. 2003. Trajectories of disability among the oldest old. Journal of Aging and Health, 15(3), 548-566. doi:10.1177/0898264303253633

Slaug B, Schilling O, Haak M, Rantakokko M. 2016. Patterns of functional decline in very old age: An application of latent transition analysis. Aging Clinical and Experimental Research, online 17 June 2015, forthcoming. doi:10.1007/s40520-015-0394-4

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

Sonn U, Grimby G, Svanborg A. 1996. Activities of daily living studied longitudinally between 70 and 76 years of age. Disability and Rehabilitation, 18(2), 91-100. doi:10.3109/09638289609166023

St. Clair P, Bugliari D, Campbell N, Chien S, Hayden O, Hurd M, Main R, Miu A, Moldoff M, Panis C, Pantoja P, Rastegar A, Rohwedder S, Oshiro M, Zissimopoulos J. 2011. RAND HRS Data Documentation, Version L. Santa Monica, CA: RAND Center for the Study of Aging. (Available at www.rand.org)

Taylor MG. 2011. The causal pathway from socioeconomic status to disability trajectories in later life: The importance of mediating mechanisms for onset and accumulation. Research on Aging, 33(1), 84-108. doi:10.1177/0164027510385011

Taylor MG, Lynch SM. 2004. Trajectories of impairment, social support, and depressive symptoms in later life. Journals of Gerontology: Psychological Sciences & Social Sciences, 59B(4), S238-S246. doi:10.1093/geronb/59.4.S238

Taylor MG, Lynch SM. 2011. Cohort differences and chronic disease profiles of differential disability trajectories. The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences, 66(6), 729-738. doi:10.1093/geronb/gbr104

Thompson L. 1999. Functional changes in persons aging with spinal cord injury. Assistive Technology, 11(2), 123-129. doi:10.1080/10400435.1999.10131996

Tianen K, Luukkaala T, Hervonen A, Jylha M. 2013. Predictors of mortality in men and women aged 90 and older: A nine-year follow-up study in the Vitality 90+ study. Age and Ageing, 42, 468-475. doi:10.1093/ageing/aft030

Torres-Gil F, Putnam M. 1999. The growing pains of aging: Disability, aging and Baby Boomers. Pp. 261-283 (Chapter 18) in Dychtwald K (Ed.). Healthy Aging: Challenges and Solutions. Gaithersburg, MD: Aspen Publishers Inc.

Verbrugge LM, Balaban DJ. 1989. Patterns of change in disability and well-being. Medical Care, 27(3, Supplement), S128-S147. doi:10.1097/00005650-198903001-00011

Verbrugge LM, Jette AM. 1994. The disablement process. Social Science & Medicine, 38(1), 1-14. doi:10.1097/00005650-198903001-00011

Verbrugge LM, Reoma JM, Gruber-Baldini AL. 1994. Short-term dynamics of disability and well-being. Journal of Health and Social Behavior, 35, 97-117. doi:10.2307/2137359

Verbrugge LM, Yang LS. 2002. Aging with disability and disability with aging. Journal of Disability Policy Studies, 12(4), 253-267. doi:10.1177/104420730201200405

Verbrugge LM, Yang L. 2003. Duration of disability and timing of onset. Pp. 275-298 in Altman BM, Barnartt SN, Hendershot GE, Larson SA (Eds.). Using Survey Data to Study Disability: Results from the National Health Interview Survey on Disability. Research on Social Science and Disability, Vol. 3. Amsterdam: Elsevier Science Ltd. doi:10.1016/S1479-3547(03)03014-8

Verbrugge LM, Yang L, Juarez L. 2004. Severity, timing, and structure of disability. Social and Preventive Medicine. 49(2), 110-121. doi:10.1007/s00038-004-3058-2

Wickrama KAS, Mancini JA, Kwag K, Kwon J. 2013. Heterogeneity in multidimensional health trajectories of late old years and socioeconomic stratification: A latent trajectory class analysis. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 68(2), 290-297. doi:10.1093/geronb/gbs111

Wolf DA, Freedman VA, Ondrich JI, Seplaki CL, Spillman BC. 2015. Disability trajectories at the end of life: A “countdown” model. Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 70(5), 745-752. doi:10.1093/geronb/gbu182

Yu H-W, Chen D-R, Chiang T-L, Tu Y-K, Chen Y-M. 2015. Disability trajectories and associated disablement process factors among older adults in Taiwan. Archives of Gerontology and Geriatrics, 60, 272-280. doi:10.1016/j.archger.2014.12.005

Zimmer Z, Martin LG, Nagin DS, Jones BL. 2012. Modeling disability trajectories and mortality of the oldest-old in China. Demography, 49, 291-314. doi:10.1007/s13524-011-0075-7

Zimmer Z, Martin LG, Jones BL, Nagin DS. 2014. Examining late-life functional limitation trajectories and their associations with underlying onset, recovery, and mortality. Journals of Gerontology, Series B: Psychological and Social Sciences, 69(2), 275-286. doi:10.1093/geronb/gbt099

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