Modeling the effect of disease on functional change in the HRS

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Short Abstract:

Previous research on functional decline has largely focused on the onset of disability or short-term changes in ADLs. The purpose of this paper was to model functional change longitudinally using mixed effects models and to estimate the effect of existing disease and disease onset on functional change. Participants came from five waves (1998-2004) of the combined Health and Retirement Survey (HRS) and Assets and Healthy Dynamics among the Oldest Old (AHEAD) survey, providing a nationally representative longitudinal study of Americans aged 50 and over living in the community (N=17,318). Functional change was nonlinear and varied by sex, race, education, and income. Existing chronic conditions and onset of disease were both related to functional decline; arthritis, heart disease, and lung disease caused the largest drops in function.

Extended Abstract:

Background:

Previous research on functional decline has largely focused on the onset of disability (Anderson et al., 1998; Reynolds & Silverstein, 2003) or on short-term changes in ADLs and IADLs (Choi & Schlichting-Ray, 2001; Hays et al., 2001; Li, 2002; Mehta et al., 2002). However, functional decline is conceptually distinct from disability and is theoretically predicted to precede it (Verbrugge & Jette, 1994). Although some individuals may become disabled as a result of an acute health incident, such as a stroke or hip fracture, many also experience disability as the outcome of a long process of functional change, characterized by the frailty process (Fried et al., 2001; Lunny et al., 2003). Models of functional change that more realistically represent this continuous process could provide new insights on predictors of both frailty and disability in the elderly.

Clearly, the presence of chronic diseases and comorbidity represent important risk factors for disability (Reynolds & Silverstein, 2003; Wray, 2004). However, research has not yet addressed the impact of chronic conditions on functional decline and how this relationship might change with age. The purpose of this paper is to develop mixed effects models of functional change and to determine the effect of prevalent and incident chronic conditions on functional change.

Methods:

Participants came from five waves (1998-2004) of the combined Health and Retirement Survey (HRS) and Assets and Healthy Dynamics among the Oldest Old (AHEAD) survey, providing a nationally representative longitudinal study of Americans aged 50 and over living in the community (N=17,318). These waves were selected because they provided the greatest comparability of both functioning and disease measures across surveys.

A functioning scale was created using 6 ADLs (walking, dressing, bathing, eating, transferring, toileting) and 8 Nagi-Breslauw measures (walking 1 block, sitting for 2 hours, climbing 1 flight of stairs, reaching arms over head, picking up 10 lb object, pushing or pulling large objects, stooping, kneeling, or crouching, getting up from a chair). For each item, participants reported whether they had no difficulty (0), some difficulty (1), or were unable to do the task (2), creating a scale of functional difficulty ranging from 0 (no difficulty) to 28 (unable to perform all tasks). Those who responded that they "don't do" the task were re-coded as unable. We deliberately excluded measures that were heavily dependent upon the physical and social environment, such as ability to climb several flights of stairs, manage money, or prepare a hot meal.

Participants self-reported diagnosis of hypertension, diabetes, cancer, lung disease, heart disease, arthritis, and stroke at the time of each survey. Diseases identified before the first interview included here were modeled as prevalent disease (1=existing diagnosis, 0=no diagnosis). Incident

disease was modeled as a time-varying covariate (1=new diagnosis, 0=never diagnosed). Covariates included age, sex, race, education, logged household income, BMI, and current smoking.

Mixed-effects models assumed a Poisson distribution because of the count nature of the dependent variable (functional impairment scale) and were analyzed using SAS PROC GLIMMIX.

Preliminary Results:

The demographic model in Table 1 indicates that functional limitations increase with age in a cubic specification and are higher in females, nonwhites, and those with less than 12 years of education. Functional limitations are lower in those with more than 12 years of education and higher incomes. Furthermore, the significant negative interaction between age and female suggests that although females have higher functional limitations at a given age relative to males, they accumulate limitations more slowly with age, as illustrated in Figure 1. The same is true of nonwhites.

The disease model in Table 1 includes demographic predictors and interactions between each condition and time for both prevalent and incident conditions. Prevalence and incidence effects are significant for each condition, and incidence effects are smaller in magnitude. Arthritis has the greatest impact on functional impairments, whether the individual entered the study with arthritis or developed arthritis over the course of observation, followed by heart disease and lung disease. Slope effects were observed for heart disease, stroke, lung disease, cancer, and arthritis; in each case, individuals who had or developed the disease declined slower relative to those with no disease.

Discussion:

Mixed effects models of functional change provide a useful way of modeling functional decline as a process. Here, they are used to demonstrate the different impacts of existing and new diseases on functional status. These effects are distinct, and the effect of an incident disease is less than that of an existing disease for each condition examined here. This may reflect time since diagnosis or disease, as those with a disease at study entry are likely to have had the disease for a longer duration than those diagnosed during the study. Additionally, those who developed diseases declined slower than those who did not. This may be due to some recovery of function after diagnosis and treatment. However, these relationships may also reflect the changing dynamic between chronic conditions and functioning with age. At older ages when the majority of older persons are experiencing some decline, the impact of specific conditions may be reduced.

Table 1. Regression estimates associated with level and slope of functional ability in HRS/AHEAD (N=17,318)

	Demographic model			Disease model		
Effect	Estimate	Std Error	Pr > |t|	Estimate	Std Error	Pr > |t|
Intercept	-17.503	1.098	<.001	-6.676	1.218	<.001
Intercept variance	20.031	0.577	<.001	12.231	0.446	<.001
Age	0.719	0.044	<.001	0.264	0.048	<.001
Age variance	0.003	0.0001	<.001	0.002	0.00001	<.001
Age^2	-0.010	0.001	<.001	-0.004	0.001	<.001
Age^3 ($x10^{-2}$)	0.005	0.0003	<.001	0.002	0.0003	<.001
Female	1.278	0.115	<.001	0.906	0.107	<.001
Age*female	-0.012	0.002	<.001	-0.007	0.001	<.001
Nonwhite	0.438	0.141	<.01	0.108	0.132	NS
Age*nonwhite	-0.003	0.002	NS	0.001	0.002	NS
Low education (<12 y)	0.971	0.134	<.001	0.639	0.124	<.001
Age*low education	-0.009	0.002	<.001	-0.006	0.127	<.001
High education (>12 y)	-0.859	0.138	<.001	-0.629	0.127	<.001
Age*high education	0.008	0.002	<.001	0.006	0.002	<.001
Ln(income)	-0.148	0.026	<.001	-0.137	0.029	<.001
Age*ln(income)	0.001	0.0003	<.001	0.001	0.0004	<.05
Prevalent hypertension				0.344	0.107	<.01
Age*prevalent hypertension				-0.003	0.001	NS
Incident hypertension				0.226	0.098	<.05
Age*incident hypertension				-0.002	0.001	NS
Prevalent heart disease				1.147	0.129	<.001
Age*prevalent heart disease				-0.012	0.002	<.001
Incident heart disease				0.476	0.100	<.001
Age*incident heart disease				-0.004	0.001	<.01
Prevalent stroke				1.099	0.203	<.001
Age*prevalent stroke				-0.006	0.003	<.001
Incident stroke				0.368	0.111	<.001
Age*incident stroke				0.001	0.001	NS
Prevalent diabetes				0.652	0.151	<.001
Age* prevalent diabetes				-0.004	0.002	NS
Incident diabetes				0.270	0.130	<.05
Age*incident diabetes				-0.003	0.002	NS
Prevalent lung disease				1.394	0.186	<.001
Age*prevalent lung disease				-0.013	0.003	<.001
Incident lung disease				0.301	0.137	<.05
Age*incident lung disease				-0.001	0.002	NS
Prevalent cancer				0.501	0.175	<.01
Age*prevalent cancer				-0.005	0.002	<.05
Incident cancer				0.500	0.138	<.001
Age*incident cancer				-0.005	0.002	<.05
Prevalent arthritis				2.160	0.106	<.001
Age*prevalent arthritis				-0.020	0.001	<.001
Incident arthritis				0.718	0.093	<.001
Age*incident arthritis				-0.005	0.001	<.001

Figure 1. Estimated mean number of limitations for males and females

Figure 2. Estimated mean number of limitations in those with arthritis, without arthritis, and those who develop arthritis.