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Clinical Pathways to Disability

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5.1 Introduction

While disability declined over the course of the 1980s and 1990s (Crimmins, Saito, and Reynolds 1997; Freedman and Martin 1998; Waidmann and Liu 2000; Cutler 2001; Manton and Gu 2001; Schoeni, Freedman, and Wallace 2001; Freedman, Martin, and Schoeni 2002; Freedman, Crimmons et al. 2004; Spillman 2004), the prevalence of disability among the elderly remains high (Waidmann and Liu 2000; Schoeni, Freedman, and Wallace 2001; Manton, Gu, and Lamb 2006). Moreover, disability is associated with poor quality of life (Lamb 1996), high medical spending (Komisar, Hunt-McCool, and Feder 1997; Liu, Wall, and Wissoker 1997; Fried et al. 2001; Guralnik et al. 2002; Chernew et al. 2005), and increased mortality (Manton 1988; Guralnik et al. 1991; Ferrucci et al. 1996). Thus, it is critical to understand the major clinical pathways through which the health of the elderly declines to be able to develop effective interventions to prevent or minimize disability in the elderly population.

In this paper, we analyze data from the National Long Term Care Survey (NLTCS)—a longitudinal survey on a nationally representative sample of Medicare beneficiaries that has been linked to Medicare administrative

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data—to identify the major pathways through which the elderly become disabled. We compare two methods of identifying disabling conditions. First, using administrative billing data, we evaluate thirty-one potentially disabling clinical conditions and estimate the proportion of incident disability attributable to each condition. In order to better understand the association between medical conditions and disability, we consider both simple binary measure of any disability in addition to measures that reflect severity (i.e., the total number of Activities of Daily Living [ADL] and Instrumental Activities of Daily Living [IADL] disabilities) and types of limitations (i.e., mobility-related, cognitive, or self-care). We also examine the relationship between medical conditions and the use of supportive and medical services. We hypothesize that different medical conditions lead to disability of varying severity, type, and need for assistance. Identifying these differences may help to prioritize medical conditions for interventions to prevent or delay disability and to help design appropriate interventions for different types of disability.

In the second part of the chapter, we compare these empirical results to respondents' self-reported causes. We find that an important subset of newly disabled elderly did not report a chronic condition or an acute medical event when asked to identify the cause of their disability; rather, they cited symptoms or simply attributed their disability to old age. We explore whether respondents who attributed their disability to old age or symptoms differed from respondents who cited chronic or acute medical conditions in both patterns of disablement and health care utilization, to better understand whether old age and symptom causes represent pathways to disability independent of diseases and conditions.

Our chapter is structured as follows. First we discuss prior literature relevant to our analyses. We then describe our data and analytic methods and present our results. Finally, we summarize our conclusions and discuss implications of our findings.

5.2 Background

5.2.1 Heterogeneity in the Disablement Process

Disability in an elderly, nonworking population is typically defined as the need for assistance[1] with one or more or self-care tasks (such as bathing or eating) called Activities of Daily Living (ADLs), or tasks required to live independently (such as grocery shopping or preparing meals) called Instrumental Activities of Daily Living (IADLs). National surveys measuring disability in the elderly typically ask respondents about their ability to perform a set of ADL and IADL tasks, and often also ask respondents

1. Some surveys ask respondents about the level of difficulty without assistance.

about physical limitations, such as difficulty walking long distances, going up stairs, or grasping small objects.

Previous research has demonstrated that disability may develop as the result of a catastrophic event such as a stroke or a hip fracture, or as a progressive process associated with chronic and sometimes degenerative conditions such as arthritis or dementia (Ferrucci et al. 1996; Ferrucci et al. 1997; Wolff et al. 2005). Depending on the cause of disability, many elderly may recover from disability (Gill, Robinson, and Tinetti 1997; Gill et al. 2006; Gill et al. 2006) or they may progress to more severe states of disability. Among those who do not recover from disability, both theoretical and empirical work (Katz et al. 1963; Kempen and Suurmeijer 1990; Verbrugge and Jette 1994; Ferrucci et al. 1998) has suggested a hierarchy in physical limitations and ADL and IADL tasks where an elderly person typically progresses from first having physical limitations to needing assistance with complex tasks (such as cooking, grocery shopping, or managing money), progressing to needing assistance with some personal care needs (such as getting out of bed and bathing), and then finally needing assistance with the most basic personal tasks, such as toileting and feeding. However, there is disagreement across studies about the exact nature of the disablement process (Siu, Reuben, and Hays 1990; Lazaridis et al. 1994; Dunlop, Hughes, and Manheim 1997; Jagger et al. 2001), which may be attributable to differing patterns of onset (i.e., catastrophic versus progressive) and likelihood of recovery.

Researchers have also demonstrated that disability, regardless of its cause, may be characterized as a continuum of difficulty and dependency (Fried et al. 1991; Fried et al. 1996; Gill, Robinson, and Tinetti 1998; Fried et al. 2000; Fried et al. 2001). For example, Gill, Robinson, and Tinetti (1998) examined the relationship between difficulty and dependence in specific tasks and demonstrated that separate questions about the use of assistance and difficulty could be used to classify respondents into three ordered categories: independent without difficulty, independent with difficulty, and dependent. Similarly, the work by L.P. Fried et al. (2000, 2001) identified a state of preclinical disability where respondents denied difficulty with a task, but nevertheless reported having modified their performance of the task because of health or physical problems. Respondents with preclinical disability were found to have intermediate levels of physical functioning between that of respondents who reported difficulty with tasks and those who reported neither difficulty nor modification, suggesting that modification without reported difficulty represents early manifestations of functional declines and a less severe form of disability.

Other empirical studies have conducted factor analyses to identify the number and types of underlying dimensions of disability (Fried et al. 1994; Spector and Fleishman 1998). For example, Spector and Fleishman (1998) found a great deal of correlation among seven ADL and nine IADL mea-

sures in approximately 3,000 disabled respondents to the 1989 National Long Term Care Survey, so that a single factor that combined fifteen of the sixteen items adequately described the observed patterns. Fried et al. (1994) examined seventeen physical limitations, ADL and IADL items, in 5,201 community-based elderly adults living in one of four U.S. communities; they found that self-reported difficulty with these seventeen items could be partitioned into four factors representing mobility problems, difficulty with complex tasks, difficulty with self-care, and upper extremity limitations. These four factors explained 48 percent of the total variance in the seventeen items. Researchers have also used grade-of-membership models, an extension of latent class models that hypothesize different underlying types of respondents with different patterns of disability, to examine profiles of disability (Lamb 1996; Manton, Stallard, and Corder 1998).

Prior research has also documented specificity in the associations between conditions and specific types of limitations. Arthritis has generally been found to be strongly associated with functional limitations and moderate ADL limitations (Verbrugge, Lepkowski, and Konkol 1991; Fried et al. 1994; Guccione et al. 1994; Manton, Stallard, and Corder 1998) while stroke and dementia have been consistently linked with both IADL limitations and more severe disability in self-care tasks (Fried et al. 1994; Guccione et al. 1994; Manton, Stallard, and Corder 1998). Similar patterns are found in respondents' self-reports of the causes of their limitations (Ford et al. 1988; Ettinger et al. 1994; Valderrama-Gama et al. 2002). Arthritis was most often cited as the cause of limitations in mobility-related tasks, including getting out of bed and getting around inside. Heart and lung diseases were the most often cited causes for aerobic tasks, such as walking half a mile, while stroke and dementia were most often associated with cognitive and self-care tasks.

In this chapter, we evaluate the association of specific diseases and conditions with varying types and severity of disability to better understand the association between medical conditions and the disablement process. We also use the total number of limitations as a proxy for severity of disability, and evaluate whether severity varies across conditions. We further examine reported medical care and assistive services used by disabled respondents, hypothesizing that greater use of medical care and assistive services may reflect more severe disability.

5.2.2 Chronic Conditions Leading to Disability

A large body of research has demonstrated the importance of chronic disease as the primary contributor to disability (Kosorok et al. 1992; Guccione et al. 1994; Boult et al. 1996; Ferrucci et al. 1997; Aguero-Torres et al. 1998; Dunlop et al. 2002; Wolff et al. 2005; Song Chang, and Dunlop 2006). However, these studies often limit attention to the noninstitutionalized elderly population—thus omitting important conditions such as de-

mentia—or focus on a small number of conditions. Further, studies were often conducted on nonrepresentative samples. In this chapter, we extend these prior results by examining the share of disability attributable to a wide range of clinical conditions in a nationally representative sample.

5.2.3 Characteristics of Disabled Respondents Attributing Disability to Symptoms or Old Age

The prior literature provides conflicting evidence on whether chronic disease is responsible for the majority of disability attributed to old age or symptoms by elderly respondents, or whether these respondents are identifying a pathway to disability that is largely independent of chronic disease. Research supporting the idea that the elderly may attribute declines in health related to chronic conditions to old age or symptoms include a study of 230 community-dwelling elderly that found that those who attributed their disability to old age were similar to those not reporting old age as the cause of their disability in terms of age, gender, and race, but were more likely to have chronic conditions, such as arthritis, heart disease, or hearing difficulties (Williamson and Fried 1996). In addition, several regional studies (Ettinger et al. 1994; Williamson and Fried 1996; Leveille, Fried, and Guralnik 2002; Leveille et al. 2004) demonstrated strong relationships between specific diseases and symptoms. For example, elderly who cited pain as a primary cause of their disability were also likely to cite arthritis when asked for a condition cause, and they had a high prevalence of arthritis confirmed by clinical examination; disability attributed to fatigue and shortness of breath was associated with lung and heart disease.

In contrast, Leveille, Fried, and Guralnik (2002) found that women who were unable to cite specific chronic conditions causing their disability were often better able to name symptom causes. They also found little association between certain symptoms, such as fear of falling and general weakness, and chronic conditions, suggesting that at least some of the disability attributed to symptoms or old age is not directly related to common disabling chronic conditions. The literature on frailty generally supports the notion of a pathway to disability that is not a direct result of chronic disease, but instead is associated with age-related loss of physical condition and reserve. For example, Guralnik et al. (1995) found that objective measures of physical functioning among nondisabled elderly predicted subsequent disability even after controlling for chronic conditions (Guralnik et al. 1995). Other authors have argued for the importance of frailty as a separate concept from comorbidity and have found that frailty is associated with disability independently of chronic disease (Ferrucci et al. 1996; Lunney et al. 2003; Fried et al. 2004).

In this chapter, we seek to resolve some of this conflict by further analyzing the characteristics of respondents who attribute disability to either old age or symptom causes as opposed to chronic or acute medical condi-

tions. In particular, we compare severity of disability and use of medical and assistive services to identify systematic differences across these populations that may suggest a pathway to disability independent of diseases and conditions.

5.3 Data and Methods

We used data from the National Long Term Care Survey (NLTCS). The NLTCS is a longitudinal, nationally representative survey of the Medicare population that was designed to study changes in the health and functional status of elderly Americans. Starting in 1982, a random sample of approximately 20,000 Medicare beneficiaries completed a screening interview. Those found to have a chronic disability[2] were then asked to complete a detailed survey. Follow-up surveys were conducted in 1984, 1989, 1994, and 1999. Chronically disabled respondents who survived until the next survey were automatically contacted for detailed follow-up surveys. In addition, at each subsequent wave of the survey, a subsample of nondisabled respondents from the previous wave were contacted for a new screener interview and those found to be chronically disabled were asked to complete the detailed survey. Finally, at each wave a random sample of approximately 5,000 Medicare beneficiaries who reached age sixty-five between waves of the survey were screened in order to maintain a nationally representative sample of the Medicare population. Over the 5 waves of the survey, more than 90,000 screening interviews were performed, leading to over 32,000 detailed interviews (Manton and Gu 2001). Approximately 20 percent of 1994 and 1999 surveys were completed by proxy respondents (Freedman et al. 2004).

The NLTCS has several important strengths. First, the longitudinal design with age-in cohorts allows us to obtain national estimates. Second, response rates for both screener interviews and detailed surveys were over 95 percent in each wave. In addition, survey data has been linked to Medicare administrative data, providing detailed information on the existence of clinical conditions for which respondents were receiving care.

5.3.1 Study Cohorts

Our analyses are based on nondisabled respondents from the 1994 survey whose disability and vital status is known in 1999. From the cohort of 12,366 participants in the 1994 survey who were not chronically disabled,

2. Defined as residence in a long-term care facility, the inability to perform one of nine ADLs (eating, getting in or out of bed, getting in or out of chairs, walking around inside, going outside, dressing, bathing, getting to the bathroom, or using the toilet, and controlling bowel movements or urination) without personal assistance or special equipment, or one of seven IADLs (preparing meals, laundry, light housework, shop for groceries, manage money, take medicines, and use the telephone) without help because of disability or health problem for at least ninety days.

we excluded (a) 1,568 participants who were not sixty-five years old on January 1, 1992, in order to assure complete claims data in the baseline period prior to 1994, (b) ten participants who could not be matched to Medicare data, (c) 1,231 respondents whose disability status was unknown in 1999 because they were not resampled ($n = 752$) or lost to follow-up ($n = 479$), and (d) 1,830 participants enrolled in an HMO for six months or longer, leaving an analytic cohort of 7,727 participants.

5.3.2 Disability Measures

Subjects were considered newly disabled if they reported any ADL or IADL limitations in the 1999 detailed survey[3] or if they were institutionalized at the time of the 1999 survey. Limitations on six specific ADL tasks (eating, getting in and out of bed, getting around inside, dressing, bathing, and toileting) were obtained from the detailed interviews of both community-based and institutionalized respondents. Limitations on eight specific IADL tasks (light housework, laundry, preparing meals, shopping for groceries, getting around outside, managing money, taking medications, and using the telephone) and nine functional limitations (difficulty climbing a flight of stairs, walking across a room, bending to put on socks, lifting a ten pound object, reaching above the head, using fingers to grasp and handle small objects, seeing well enough to read newsprint, speaking, and hearing) were also obtained from the detailed interviews with community-based respondents.

We grouped the fourteen individual ADL and IADL tasks into categories for several analyses. To explore the empirical relationships between the specific tasks, we fit a principal component model to the 5,787 nondisabled respondents in the 1994 NLTCS who survived to 1999 and completed a screener interview. We found that three factors could explain 85 percent of the total variance in the fourteen items. Similar to Fried et al. (1994), one of these factors was strongly associated with more complex IADL tasks requiring cognitive abilities (cooking, laundry, light housekeeping, grocery shopping, managing money, and using the telephone). Also as in the Fried et al. analysis, difficulty getting around outside (typically considered an IADL) was more strongly related to mobility-related ADL tasks than the other IADL tasks. Thus, we used the aggregation of tasks employed by Fried et al. (1994) to summarize our fourteen ADL and IADL measures into three major types of disability: (1) mobility disability (getting out of bed, walking inside and walking outside the home), (2) disability in complex tasks (cooking, laundry, light housework, grocery shopping, managing money, and using the telephone) and (3) disability in self-care tasks

3. Respondents were classified as disabled on an ADL task if they reported that someone helped them perform the task, if someone stayed nearby in case they needed help, or if they used special equipment to perform the task. Respondents were classified as disabled on an IADL task if they report that they cannot do the task because of disability or health problem.

(eating, dressing, toileting, and bathing). Following theoretical and empirical work suggesting hierarchies in the disablement process, we consider disability in basic self-care tasks to represent the most severe type of disability, and mobility disability to represent early manifestations of loss of functional abilities.

Detailed interviews of the community-based disabled also asked respondents to report the heath conditions they believed were the cause of their disability. Respondents were able to list up to ten conditions, and 89 percent of the community-based respondents ($n = 892$) provided at least one response. We developed a coding scheme that summarized free-text responses into: (a) chronic conditions, (b) acute events, (c) physical symptoms that were not directly linked to a clinical condition (such as weakness, lack of balance, or pain), or (d) old age. These categories were not mutually exclusive, as respondents often reported multiple causes. We also coded a set of binary indicators of specific chronic conditions and acute events and modified a recently validated taxonomy of self-reported symptom causes to classify symptom causes as pain, balance, weakness, endurance, or other symptoms, (Leveille et al. 2004). Both authors independently coded the free-text responses. Agreement was high, with kappas ranging from 0.7 to 1.0 for chronic and acute conditions. Agreement was slightly lower for symptom causes (ranging from 0.3 for upper extremity pain to 1.0 for hearing). Final coding was based on consensus when there was disagreement.

5.3.3 Other Variables

Mortality and information about the existence of thirty-one chronic conditions[4] were obtained from Medicare administrative data. We examined the prevalence of chronic conditions over two time frames. Participants were coded as having the clinical condition at baseline if there was at least one inpatient claim or two nonhospital claims (outpatient, home health, SNF, or hospice) with a primary or secondary diagnosis of interest between January 1, 1992, and December 31, 1994[5]. Similarly, participants were coded as developing the condition between surveys if they had at least

4. These mutually exclusive categories were previously defined on the basis of prevalence of ICD-9 diagnosis and their observed relationship with disability (McClellan and Yan 2000; Cutler 2005). See table 5.A1 in the Appendix for list of clinical conditions and associated ICD-9 codes.

5. We examined several alternative coding schemes for clinical conditions. First we considered rules that considered a respondent to have the condition if there were any claims for the condition (inpatient, outpatient, SNF, home health, or hospice). In addition, we examined a two-year window (January 1, 1993–December 31, 1994) for conditions existing prior to baseline. Based on examination of the prevalence of conditions, the persistence of conditions across time frames, and the association with self-reported conditions, in addition to an examination of prior literature, we determined that a three-year look-back for the baseline period and the requirement of at least two noninpatient diagnoses provided the best compromise between sensitivity and specificity for a majority of the conditions.

one inpatient claim or two nonhospital claims with a primary or secondary diagnosis of interest between January 1, 1995, and December 31, 1999. We then combined these two time frames and examined the impact of having the condition either at baseline or developing the condition between the surveys on the likelihood of developing disability[6].

Demographic variables (age, gender, race, and marital status) were obtained from the screener surveys. Detailed interviews with community-based disabled respondents provided information on the use of health care and assistive services: this includes any nursing home stays; hospitalizations in the past year; visits in the past month to the emergency room; physicians; physical, occupational, speech, or hearing therapists; home health services in the past month; and the number of prescription medications obtained in the previous month. The detailed survey also asked respondents about their living arrangements, including whether they were living in an assistive living setting with board and/or personal care services available.

5.4 Analyses

5.4.1 Empirical Pathways to Disability

We fit multinational regression models to estimate the relative importance of the thirty-one clinical factors in explaining any disability and differing types of disability. We fit four separate models for any disability, mobility disability, disability in complex tasks, and disability in self-care tasks. In each case, the dependent variable was a categorical variable with three levels: disabled in at least one specific task in the group, alive and not disabled in at least one task in the group, or died before the 1999 survey. All regression models included age (in five-year categories), gender, marital status in 1994, race (coded as white, black, or other), the set of thirty-one indicators variables for each of the clinical conditions and a binary variable equal to 1 if the respondent did not have any medical claims during the study period. In addition, we examined interaction terms to understand the extent to which combinations of diseases have synergistic effects on disability. To focus the exploration of interactive effects, we included all pairwise interactions of conditions that were each estimated to cause at least 5 percent of incident of any type disability as measured by the adjusted attributable fraction.

6. We included conditions developed between the surveys in order to study conditions such as dementia that may be disabling over a short time frame. The associations between conditions and disability should be interpreted cautiously, as we do not know when the participant became disabled and thus some of the new conditions may follow or even be a result of declining functional status (for example, a fracture may be the result of weakness and/or loss of balance). However, for a majority of these conditions, the more likely scenario is that the condition led to functional limitations and resulting disability.

We used results from the multinomial regression models to compute adjusted attributable fractions (Greenland and Drescher 1993). Attributable fractions estimate the importance of the condition from a population perspective by combining the prevalence of the factor with the strength of the association between the factor and future disability status. Specifically, for each condition we estimated the reduction in each type of disability that could be achieved by preventing the condition as the average predicted probability of becoming disabled if none of the participants had the condition, holding all other covariates at their observed values. A few clinical conditions were found to be protective for mortality, disability, or both. As these effects are likely markers for either improved access to treatments or relative health that allows for treatment of milder chronic conditions (Jencks, Williams, and Kay 1988; Iezzoni et al. 1992), we did not estimate attributable fractions for conditions that were protective of both disability and death. In cases where a condition was estimated to be protective for death but positively associated with disability, we computed attributable fractions for disability by setting all negative mortality coefficients equal to zero and rescaling the intercept terms to match observed overall proportions in our data.

5.4.2 Characteristics of Pathways

We examined how the empirical pathways differed in terms of number of limitations and use of medical and assistive services to understand whether various pathways are associated with more intensive medical and social service needs. We focused on the conditions that were each responsible for at least 5 percent of incident disability. Note these groups are not mutually exclusive, and in fact, there is a great deal of co-occurrence of disabling diseases in this population. In these descriptive analyses, for each of the major pathways, we compared disabled respondents with the condition to those without evidence of the condition in their medical claims.

5.4.3 Self-Reported Causes of Disability

Our second set of analyses describes self-reported causes of disability in the newly disabled community-dwelling cohort (institutionalized respondents were not asked to report the cause of their disability). We also examined the distribution of the number of functional limitations and limitations in IADL and ADL tasks, and described reported use of medical and assistive services. In all analyses, we compared newly disabled community-dwelling respondents reporting old age or symptom causes to those who reported only medical conditions as the cause of their disability.

Analytic weights that account for complex sampling scheme were used in all analyses to provide estimates that reflect the national population of nondisabled Medicare beneficiaries aged sixty-seven and older in 1994. Specifically, cross-sectional weights that accounted for complex sampling

scheme and nonresponse to the 1994 survey were augmented to account for subsampling of healthy respondents for a screener interview in 1999, nonresponse to the 1999 screener interview, and exclusion of patients enrolled in an HMO by redistributing weights for healthy respondents in 1994 who were excluded from our analyses to the respondents in our sample within cells defined by age and sex. Statistical tests and standard errors were also corrected for the complex survey design using approximations based on Taylor series linearizations.

5.5 Results

5.5.1 Empirical Pathways to Disability

Sixty-six percent of nondisabled respondents in 1994 survived and remained nondisabled to 1999, while 15.1 percent became disabled over the five-year period and 18.9 percent died between survey waves. Out of the nondisabled respondents to the 1994 survey, 12, 10, and 11 percent developed one or more mobility-related, complex task, or self-care disabilities, respectively, between survey waves. Death and incident cases of disability were more common among older, African American, and unmarried respondents (table 5.1). Females were more likely to become disabled but less likely to have died compared to males. Hip and pelvic fractures, dementia, Parkinson's and related diseases, depression, and stroke had the strongest association with new cases of disability. Most disabling conditions were also associated with death.

Regression models with main effects for the thirty-one conditions identified six clinical conditions—arthritis, infectious disease, dementia, heart failure, diabetes, and stroke—that contributed to at least 5 percent of new cases of disability. Only 17 percent of elderly respondents did not have one of these six conditions, and a majority (54 percent) had two or more.

Our final regression models included fifteen pairwise interactions between the six largest contributors to overall disability. Regression results are presented in table 5.2. Several interactions were found to be important in these analyses. For any disability, the interaction between diabetes and arthritis was positive, suggesting that these two conditions have synergistic effects such that having both conditions was more disabling than would be expected by the effects of each individual condition. In contrast, two interactions with dementia were negative (stroke/dementia and heart failure/dementia), suggesting that in the presence of a highly disabling condition like dementia, other conditions have effects that are dampened relative to what would be expected when the disease occurs in isolation. These general patterns were found in the analysis of each type of disability, although the strength of the interactions (and their statistical significance) varied some across the three types. In addition, several new interactions were important

Table 5.1 **Health status at follow-up according to demographic and clinical characteristics of study cohort**

		Status at 1999 Interview (%)			
	% of cohort (N = 7727)	Newly disabled	Deceased	Alive and nondisabled	*P* value
All respondents	100	15.1	18.9	65.9	
Age in 1994					< 0.001
67–69	22.5	8.8	11.1	80.2	
70–74	34.3	10.5	13.9	75.6	
75–79	23.6	18.6	20.9	60.5	
80–84	13.0	25.6	28.5	45.9	
85–89	5.3	29.4	43.4	27.2	
90 and over	1.3	21.5	57.5	21.0	
Race					0.008
White	91.7	15.1	18.7	66.2	
Black	6.6	16.3	24.1	59.7	
Other	1.7	9.6	12.3	78.2	
Gender					< 0.001
Female	56.7	17.7	15.6	66.7	
Male	43.3	11.7	23.3	65.0	
Marital status in 1994					< 0.001
Married	56.5	12.4	16.3	71.3	
Widowed	32.0	19.4	21.6	59.0	
Divorced/separated/never married	9.0	18.2	21.2	60.5	
Unknown	2.5	11.5	36.2	52.3	
Clinical conditions[a]					
Hip and pelvic fracture	6.1	34.6	28.8	36.6	< 0.001
Dementia and organic brain diseases	15.3	33.9	36.5	29.6	< 0.001
Paralysis, Parkinson's, and related diseases	10.7	30.3	34.8	34.9	< 0.001
Depression	13.3	27.1	22.7	50.3	< 0.001
Stroke	29.9	23.5	25.7	50.9	< 0.001
Other mental disorders	24.2	22.3	24.6	53.1	< 0.001
Chronic renal failure	6.9	22.1	44.3	33.6	< 0.001
Peripheral vascular disease	32.5	21.9	23.6	54.5	< 0.001
Heart failure and arrhythmia	44.2	20.9	29.9	49.2	< 0.001
Diabetes	28.0	20.3	21.8	58.0	< 0.001
Infectious diseases[‡]	47.9	20.2	22.5	57.3	< 0.001
Respiratory failure	23.1	20.0	37.6	42.4	< 0.001
Anemia	42.1	19.6	24.2	56.3	< 0.001
Other blood diseases	16.3	19.1	29.5	51.4	< 0.001
Thyroid disorders	30.6	18.9	17.4	63.7	< 0.001
Arthritis and arthropathy	58.6	18.5	16.4	65.1	< 0.001
Ischemic heart disease	49.8	18.5	23.0	58.6	< 0.001
Back/neck pain	50.9	18.2	16.3	65.5	< 0.001
COPD and related diseases	49.6	17.4	21.7	61.0	< 0.001
Hypertension	75.2	17.0	18.8	64.2	< 0.001
Respiratory diseases	71.8	16.9	21.4	61.7	< 0.001

Table 5.1 (continued)

	% of cohort (N = 7727)	Status at 1999 Interview (%)			
		Newly disabled	Deceased	Alive and nondisabled	*P* value
Other circulatory diseases	76.1	16.8	20.9	62.3	< 0.001
Acute renal failure and insufficiency	4.7	16.8	60.8	22.5	< 0.001
Other metabolic and immunity disorders	70.7	16.6	19.5	64.0	< 0.001
Musculoskeletal disorders	84.5	16.5	18.8	65.8	< 0.001
Gastrointestinal diseases	73.1	16.3	20.1	63.7	< 0.001
Colorectal and lung cancer	7.7	16.3	43.7	40.0	< 0.001
Glaucoma and cataract	70.9	16.2	15.5	68.4	< 0.001
Genitourinary diseases	77.2	16.1	18.8	65.1	< 0.001
Other cancers	60.7	14.8	19.6	65.6	0.14
Breast and prostate cancer	13.0	13.4	22.4	64.2	0.006
No condition (no claims)	5.4	9.0	16.1	74.9	0.001

Notes: Not including pneumonia, acute respiratory infections, or influenza. All percentages based on weighted sample size. Statistical tests account for complex survey design. Conditions are ordered based on strength of their relationship with disability. COPD = chronic obstructive pulmonary disease

[a] Respondents are considered to have the condition if there was at least one inpatient claim or two non-hospital claims (outpatient, home health, SNF, or hospice) with a primary or secondary diagnosis of interest between Jan 1, 1992 to December 31, 1999.

for disability in complex tasks. In particular, stroke exacerbated the effects of both diabetes and heart failure in disability in complex tasks.

Dementia in the absence of heart failure, stroke, arthritis, infectious disease, or diabetes had the strongest association with new disability of all types in multinomial regression models (odds ratio [OR] for any disability relative to remaining alive and health = 8.0; 95 percent CI = [4.6, 13.8]). Other conditions with strong relationships with incident disability included Parkinson's and related disorders (OR for any disability = 2.3 [1.8, 3.0]), hip and pelvic fractures (OR for any disability = 2.1 [1.6, 2.9]), colorectal and lung cancer (OR for any disability = 1.9 [1.4, 2.4]), acute renal failure (OR for any disability = 1.7 [1.1, 2.7]), and heart failure in the absence of stroke, arthritis, infectious disease, diabetes, or dementia (OR for any disability = 1.6 [1.1, 2.4]). While many conditions were strongly related to all three types of disability, the strength of the association varied for many of these conditions. For example, infectious disease, heart failure, and arthritis had the strongest relationship with complex task disability, while hip and pelvic fractures were strongly associated with mobility and self-care disability.

In adjusted models, divorced, separated, or never married respondents and females were more likely to become disabled. Race was not significantly associated with future status after controlling for the other factors.

Table 5.2 **Multinomial regression estimates of the association between clinical conditions and any mobility, complex task, and self-care disability**

Variable	Any disability vs. health coefficient (SE)	Mobility disabled v. Healthy coefficient (SE)	Complex task disabled vs. healthy coefficient (SE)	Self-care disabled vs. healthy coefficient (SE)
		Diseases/conditions		
Dementia and organic brain diseases	2.08 (0.28)**	2.00 (0.28)**	2.67 (0.29)**	1.79 (0.28)**
Paralysis, Parkinson's, and related diseases	0.84 (0.14)**	0.98 (0.15)**	1.14 (0.14)**	1.07 (0.13)**
Hip and pelvic fracture	0.76 (0.15)**	0.75 (0.16)**	0.58 (0.17)**	0.90 (0.17)**
Colorectal and/or lung cancer	0.62 (0.14)**	0.61 (0.16)**	0.63 (0.18)**	0.53 (0.17)**
Acute renal failure and insufficiency	0.54 (0.24)**	0.58 (0.26)**	0.74 (0.25)**	0.47 (0.24)**
Heart failure and arrhythmia	0.48 (0.19)**	0.41 (0.20)**	0.99 (0.27)**	0.44 (0.23)*
Arthritis and arthropathy	0.40 (0.18)**	0.44 (0.19)**	0.71 (0.24)**	0.56 (0.22)**
Respiratory failure	0.38 (0.09)**	0.37 (0.11)**	0.43 (0.12)**	0.56 (0.11)**
Chronic renal failure	0.32 (0.16)**	0.43 (0.17)**	0.31 (0.18)*	0.34 (0.17)*
Depression	0.30 (0.11)**	0.39 (0.12)**	0.38 (0.12)**	0.33 (0.12)**
Other mental disorders	0.27 (0.10)**	0.30 (0.11)**	0.31 (0.13)**	0.23 (0.11)**
Infectious diseases	0.22 (0.21)	0.41 (0.27)	0.65 (0.24)**	0.33 (0.24)
Peripheral vascular disease	0.14 (0.08)*	0.22 (0.09)**	0.20 (0.11)*	0.14 (0.09)
Respiratory disease	0.14 (0.10)	–0.04 (0.12)	0.17 (0.13)	0.11 (0.12)
Stroke	0.13 (0.22)	0.02 (0.25)	–0.10 (0.27)	0.39 (0.25)
Anemia	0.12 (0.10)	0.11 (0.11)	0.00 (0.11)	0.03 (0.12)
Other blood disease	0.10 (0.11)	0.17 (0.12)	0.28 (0.13)**	0.04 (0.11)
COPD and related diseases	0.05 (0.09)	0.09 (0.09)	0.06 (0.10)	0.02 (0.10)
Back/neck pain	0.05 (0.10)	–0.01 (0.09)	–0.02 (0.10)	0.02 (0.10)
Hypertension	0.05 (0.12)	0.18 (0.13)	0.04 (0.14)	0.02 (0.12)
Ischemic heart disease	0.04 (0.09)	0.02 (0.10)	–0.02 (0.11)	0.12 (0.11)
Musculoskeletal disorders	–0.01 (0.18)	–0.01 (0.20)	–0.11 (0.21)	0.09 (0.21)

Diabetes	–0.02 (0.22)	0.03 (0.25)	0.30 (0.28)	–0.06 (0.28)
Genitourinary diseases	–0.04 (0.11)	–0.12 (0.12)	–0.15 (0.14)	0.03 (0.13)
Thyroid Disorders	–0.04 (0.09)	–0.13 (0.09)	–0.11 (0.10)	0.01 (0.09)
Breast and/or prostate cancer	–0.06 (0.13)	0.04 (0.13)	–0.16 (0.15)	–0.12 (0.13)
Other metabolic and immunity disorders	–0.11 (0.13)	–0.20 (0.14)	–0.18 (0.13)	–0.10 (0.13)
Other circulatory diseases	–0.13 (0.11)	0.07 (0.12)	–0.27 (0.15)*	–0.18 (0.15)
Gastrointestinal diseases	–0.20 (0.10)**	–0.30 (0.10)**	–0.15 (0.12)	–0.14 (0.11)
Glaucoma and cataract	–0.24 (0.11)**	–0.40 (0.12)**	–0.17 (0.13)	–0.23 (0.11)**
Other cancers	–0.26 (0.08)**	–0.20 (0.09)**	–0.30 (0.10)**	–0.19 (0.09)**
No diseases or conditions	0.12 (0.26)	0.05 (0.32)	0.37 (0.28)	0.23 (0.29)
		Interactions		
Infectious diseases and diabetes	0.22 (0.19)	0.21 (0.19)	0.03 (0.22)	0.26 (0.22)
Infectious diseases and dementia	–0.02 (0.19)	–0.06 (0.21)	0.02 (0.23)	0.21 (0.22)
Infectious diseases and heart failure	0.24 (0.19)	0.27 (0.20)	–0.02 (0.23)	0.21 (0.21)
Infectious disease and arthritis	–0.20 (0.19)	–0.28 (0.21)	–0.45 (0.22)**	–0.25 (0.23)
Diabetes and dementia	–0.23 (0.19)	–0.22 (0.22)	–0.58 (0.21)**	–0.28 (0.24)
Diabetes and heart failure	–0.11 (0.19)	–0.09 (0.22)	–0.28 (0.26)	0.09 (0.24)
Diabetes and arthritis	0.43 (0.19)**	0.47 (0.21)**	0.24 (0.24)	0.33 (0.27)
Dementia and heart failure	–0.50 (0.22)**	–0.48 (0.22)**	–0.60 (0.22)**	–0.22 (0.24)
Dementia and arthritis	–0.38 (0.24)	–0.25 (0.27)	–0.38 (0.26)	–0.18 (0.24)
Arthritis and heart failure	–0.07 (0.21)	–0.03 (0.22)	–0.35 (0.27)	–0.14 (0.23)
Stroke and infectious disease	0.15 (0.20)	0.07 (0.22)	0.11 (0.25)	–0.13 (0.22)
Stroke and diabetes	0.07 (0.19)	0.09 (0.21)	0.44 (0.24)*	–0.09 (0.23)
Stroke and dementia	–0.41 (0.20)**	–0.33 (0.21)	–0.31 (0.20)	–0.44 (0.20)**
Stroke and heart failure	0.28 (0.18)	0.29 (0.21)	0.44 (0.22)**	0.29 (0.22)
Stroke and arthritis	–0.14 (0.18)	0.01 (0.20)	–0.16 (0.20)	–0.28 (0.20)

(*continued*)

Table 5.2 (continued)

Variable	Any disability vs. health coefficient (SE)	Mobility disabled v. Healthy coefficient (SE)	Complex task disabled vs. healthy coefficient (SE)	Self-care disabled vs. healthy coefficient (SE)
		Demographic characteristics in 1994		
Age 70–74	0.09 (0.15)	–0.01 (0.17)	0.11 (0.19)	0.28 (0.17)
Age 75–79	0.77 (0.15)**	0.77 (0.16)**	0.84 (0.18)**	0.87 (0.19)**
Age 80–84	1.31 (0.16)**	1.33 (0.18)**	1.46 (0.19)**	1.44 (0.21)**
Age 85–89	1.74 (0.19)**	1.75 (0.20)**	1.97 (0.23)**	1.76 (0.22)**
Age 90 +	1.78 (0.37)**	2.02 (0.39)**	2.12 (0.40)**	2.06 (0.42)**
Widowed	0.10 (0.09)	0.15 (0.10)	0.06 (0.10)	0.13 (0.11)
Divorced, separated, or single	0.45 (0.15)**	0.47 (0.16)**	0.24 (0.18)	0.35 (0.15)**
Missing marital status	–0.41 (0.28)	–0.30 (0.28)	–0.33 (0.34)	–0.24 (0.27)
Black	0.04 (0.21)	0.10 (0.20)	0.28 (0.22)	–0.10 (0.20)
Other race	–0.29 (0.28)	–0.48 (0.38)	0.11 (0.40)	–0.08 (0.31)
Female	0.28 (0.09)**	0.31 (0.10)**	0.06 (0.11)	0.22 (0.11)**

Notes: Reference groups were individuals "age 65–69" for age categories, "married" for marital status indicators, and "white" for race variables. Conditions are ordered based on strength of their relationship with overall disability. Standard errors account for complex survey design.

* Significant between 0.05 and 0.10.

** Significant at less than 0.05.

We found some differences in the effect of demographic characteristics on disability. In particular, women were more likely than men to report new disabilities in mobility and self-care tasks, but not with complex tasks.

Age, even after adjusting for a set of thirty-one clinical conditions and interactions among the top six contributors, was strongly associated with disability. For example, the adjusted odds of becoming disabled relative to remaining alive and nondisabled was 3.7 (95 percent CI = [2.7, 5.1]) times higher for eighty to eighty-four-year-olds compared to sixty-seven to seventy-year-olds. This represents a 23 percent decline in the effect of age relative to a model that controlled only for demographic factors.

5.5.2 Largest Contributors to Disability

Figures 5.1–5.4 display adjusted attributable fractions for each type of disability based on regression results. Attributable fractions, a combination of the prevalence of the conditions and their association with disability, estimate the proportion of disability that was explained by each condition, holding all other characteristics of the respondents constant. Although arthritis was only moderately associated with incident disability (OR for any new disability = 1.5 [1.1, 2.1]), because it is a common condition it was the largest contributor, accounting for 13 percent of any new disability. Five other conditions—infectious diseases, dementia, heart failure and arrhythmia, diabetes, and stroke—contributed to at least 5 percent of new cases of disability, and these six top conditions together explained almost half (48 percent) of new cases.

We observed some heterogeneity in these pathways across the different types of disability (figs. 5.2–5.4). Arthritis was the largest contributor to impairments in mobility (explaining 17 percent of this type of disability), but played a much less prominent role in disability in complex tasks. Similarly, stroke contributed most to less severe forms of disability and explained only 4 percent of disability associated with self-care tasks. Dementia was a large contributor to overall disability, was responsible for almost a quarter of disability in completing complex tasks, and was also the largest contributor to the most severe form of disability, dependence in self-care tasks. Ischemic heart disease, which was not found to be a prominent contributor to overall disability, explained more than one in twenty cases of new disability in self-care tasks. Not all diseases, however, demonstrated such specificity. For example, heart failure and infectious disease played a prominent role in all three types of disability, each explaining between 10 percent and 15 percent of each type of disability.

5.5.3 Characteristics of Pathways

Almost all (96 percent) of newly disabled respondents had at least one of the top six conditions leading to disability—dementia, stroke, heart failure, infectious diseases, arthritis, or diabetes. Moreover, there was sub-

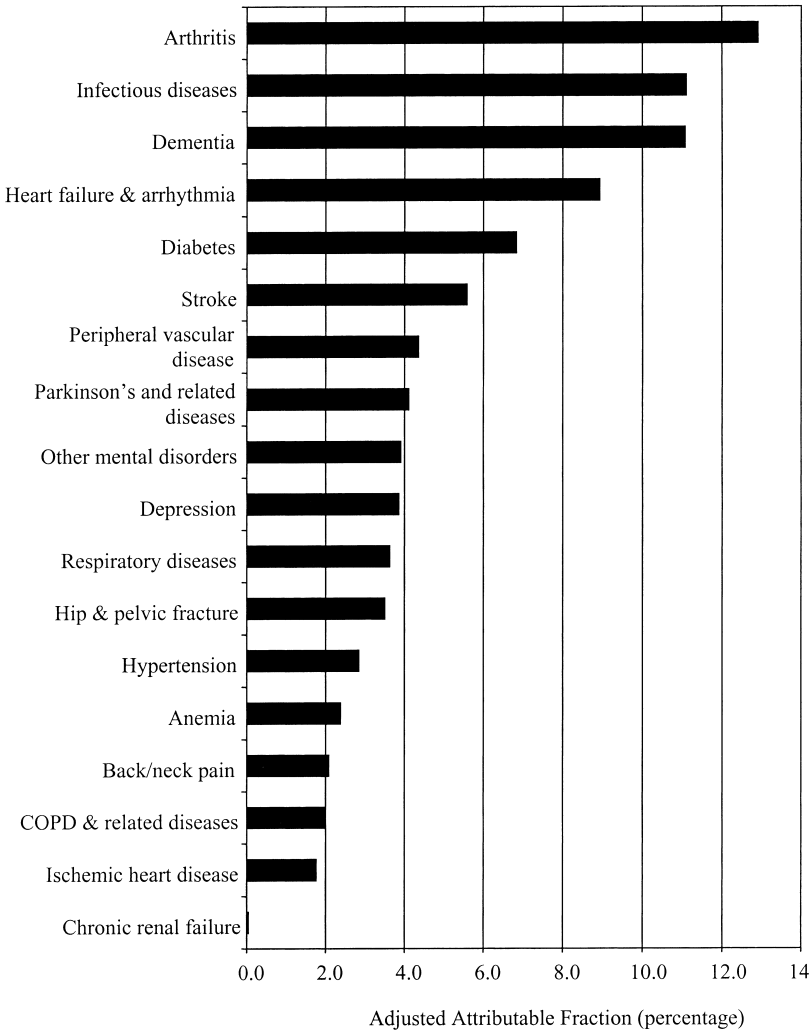

Fig. 5.1 Estimated percentage of any new disability attributable to each condition

stantial overlap among the six pathways: only 12 percent of the newly disabled cohort had only one of the six conditions, and two-thirds had three or more.

Figure 5.5 displays the average number of functional limitation, IADL limitations, and ADL limitations in newly disabled respondents according to diagnoses in their medical claims (table 5.A2 in the appendix provides information on specific limitations). The newly disabled cohort had a large number of each type of limitation. Physical limitations in particular were

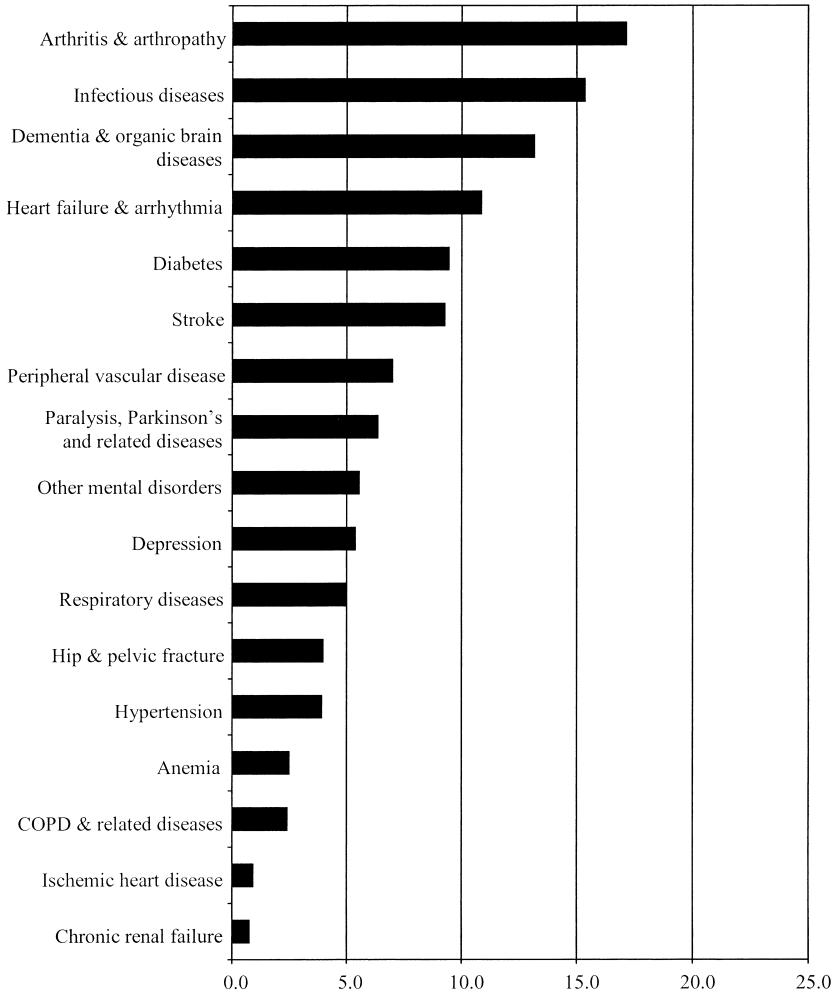

Fig. 5.2 Estimated percentage of mobility disability attributable to each condition

quite prevalent, with community-dwelling respondents reporting 3.3 limitations on average. Even the most severe forms of disability—inability to perform ADL tasks—were prevalent, with respondents reporting on average 2.6 ADL limitations. Newly disabled respondents with dementia reported the largest number of limitations of each type, including more than four IADLs on average. Newly disabled respondents with each of the top six conditions were more likely to report functional limitations compared to those not reporting the condition, and most of the conditions (dementia, stroke, heart failure, and infectious diseases) were associated with a higher number of limitations of each type. However, neither arthritis nor

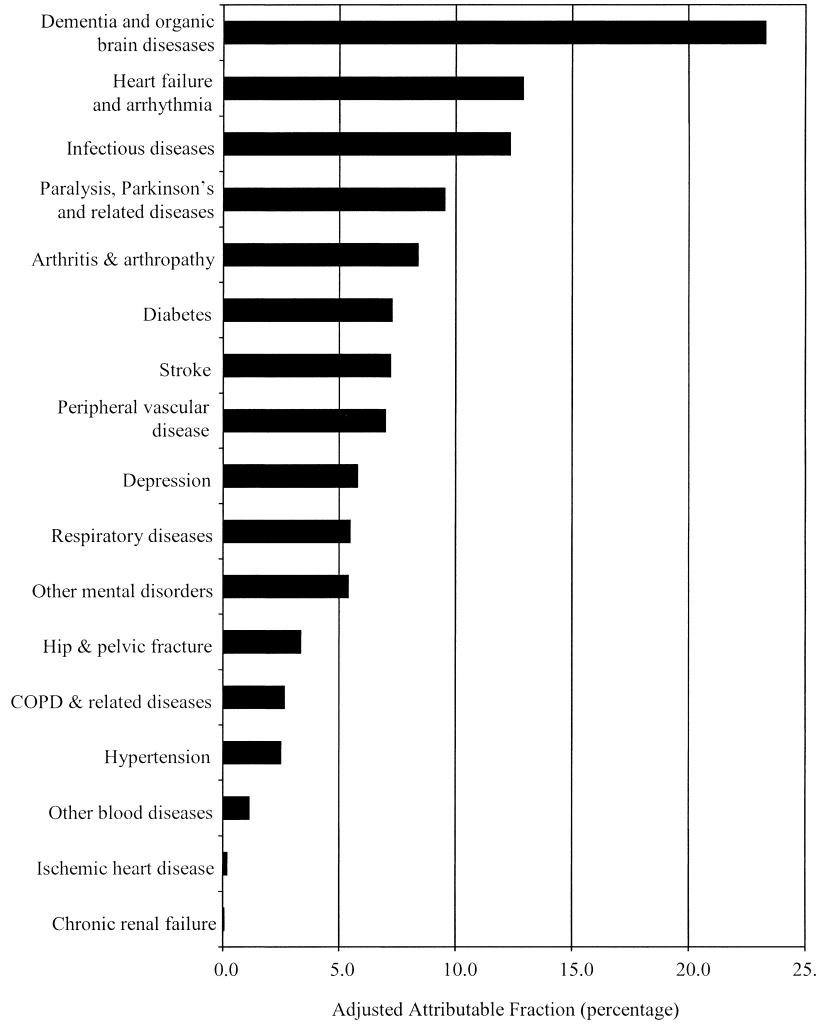

Fig. 5.3 Estimated percentage of disability in complex tasks attributable to each condition

diabetes was associated with higher numbers of IADL limitations, and diabetes was not associated with a higher number of ADL limitations.

We present self-reported utilization of health care and assistive services in table 5.3. Approximately 20 percent of the newly disabled cohort was institutionalized. Of those living in the community 12 percent reported past nursing home stays; however, only a small number reported living in assistive living facilities. Institutionalization and nursing home stays were most likely among newly disabled respondents with dementia, stroke, heart fail-

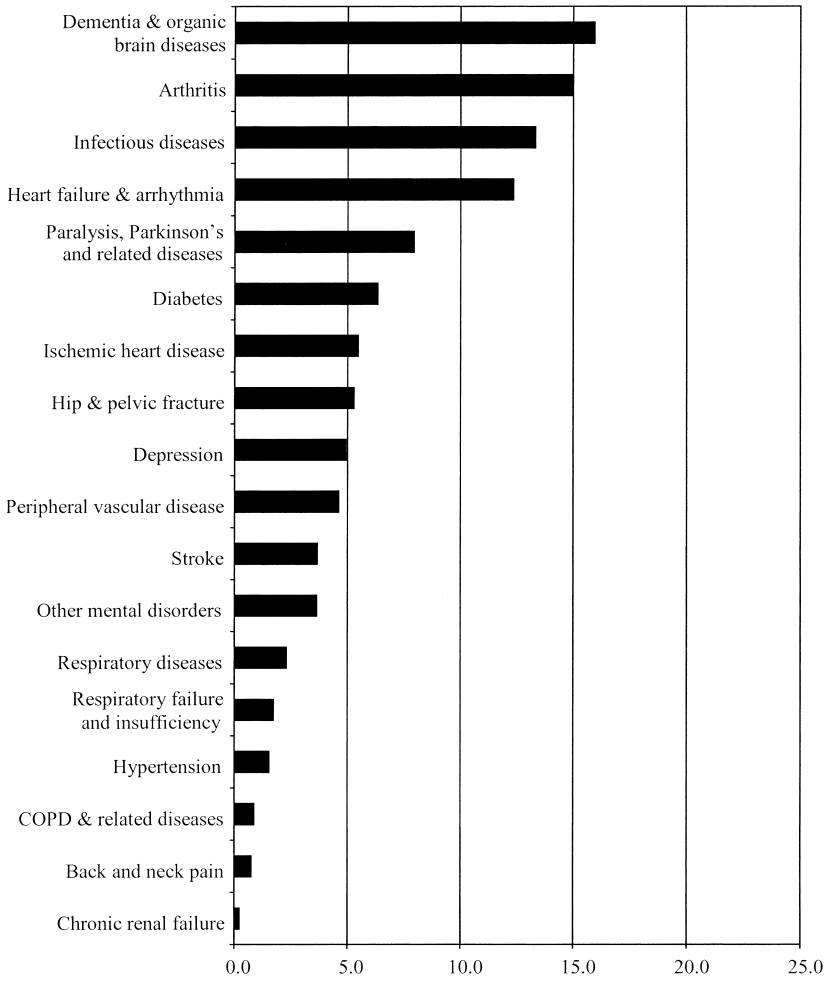

Fig. 5.4 Estimated percentage of disability in self-care tasks attributable to each condition

ure, or infectious diseases. Those with dementia were also most likely to receive supportive services, including physical and occupational therapy and home health services. In addition, health care use was high among this cohort. Approximately half of newly disabled respondents reported a physician visit in the prior month, over a third reported a hospitalization in the prior year, and they reported filling an average of four prescriptions in the past month. Health care utilization was highest among respondents with stroke, heart failure, and diabetes, and lowest among respondents with dementia and arthritis.

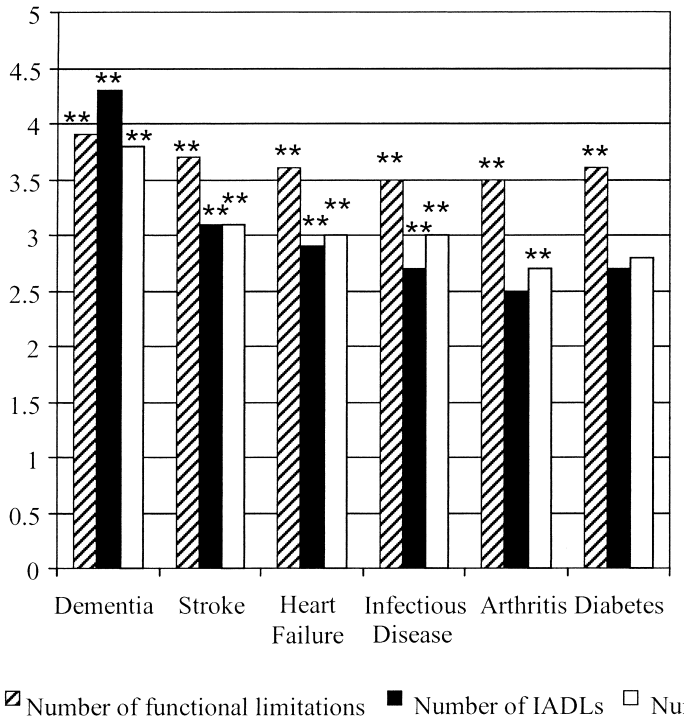

Fig. 5.5 Number of limitations among newly disabled respondents by conditions in medical claims

* Marginally significantly different from respondents without evidence of condition in their medical claims ($0.05 < p\text{-value} < 0.10$).

** Significantly different from respondents without evidence of condition in their medical claims ($p\text{-value} < 0.05$).

Institutionalized respondents are excluded from calculations of average numbers of functional limitations and IADL tasks.

5.5.4 Self-Reported Causes of Disability

Over half of the newly disabled community-dwelling respondents reported that a chronic condition was a factor in their limitations, while 30 percent reported an acute event (table 5.4). Musculoskeletal problems and cardiovascular diseases were the most common reported cause of disability. Dementia, lung diseases, diabetes, eye diseases, surgeries, fractures, and falls were also commonly cited causes of disability. While a majority of respondents reported chronic or acute medical conditions as the cause of their disability, 30 percent reported symptoms that were not directly linked to a chronic or acute health problem, and 14 percent of respondents reported that old age contributed to their disability.

Respondents often cited multiple causes, and those citing symptoms and old age often cited specific acute and chronic conditions as well. We report

Table 5.3 **Self-reported utilization of health and assistive services by conditions in medical claims**

	All newly disabled	Dementia	Stroke	Heart failure	Infectious disease	Arthritis	Diabetes
N	1,264	450	598	781	808	911	449
% of cohort	100	34.2	46.4	61.2	63.8	71.7	37.5
Institutionalized (at time of survey)	20.3	45.9**	26.9**	23.1**	26.1**	21.2	21.2
Hospitalization (in the past year)	37.1	42.9**	47.2**	45.6**	42.1**	39.4**	42.8**
		Of those in community:					
Past nursing home stay (ever)	11.8	18.3**	15.5**	14.0**	14.8**	11.5	11.5
Assisted living (at time of survey)	2.8	5.6**	3.4	2.5	2.5	2.0**	3.5
Home health care (in the past month)	11.7	20.1**	15.3**	15.6**	13.9**	11.9	13.8
Physical, occupational, speech or hearing therapy (in the past month)	8.4	11.8**	12.2**	8.5	9.5	8.9	8.1
Emergency room visit (in the past month)	6.6	5.7	6.4	8.3**	6.3	6.2	7.2
Physician visit (in the past month)	49.8	44.8*	51.5	52.2	49.7	52.1**	53.4
Number of prescriptions (in the past month)	3.9	3.5*	4.5**	4.7**	4.4**	4.1**	4.7**

*Marginally significantly different from respondents without evidence of condition in their medical claims ($0.05 < p\text{-value} < 0.10$).

**Significantly different from respondents without evidence of condition in their medical claims ($p\text{-value} < 0.05$).

conditions cited by these respondents in table 5.5. Among respondents reporting symptoms, 44 percent and 21 percent reported at least one chronic or acute condition, respectively, while the remaining 41 percent reported only symptoms. Heart disease was the most frequently reported condition among those citing symptom causes. Only 8 percent of those reporting symptom causes also cited old age as a contributor. Old age was the only reported cause for 46 percent of respondents attributing their disability to old age. About a third of respondents citing old age as a cause of their disability also cited a chronic condition and 13 percent cited acute causes. Arthritis was the most commonly cited condition among those attributing disability to old age.

Table 5.6 reports characteristics of newly disabled respondents according to self-reported cause of disability. Respondents citing old age were more likely to be female, African American, and widowed at the time of the 1999 survey and were approximately four years older (80.2 versus 75.8 years old) than those citing only medical causes. However, they were no

Table 5.4 **Self-reported causes of disability among the newly disabled cohort residing in the community (N = 892)**

Cause	N†	%
Chronic condition	489	54.8
Arthritis	186	22.2
Heart or circulatory disease (not including heart failure)	91	10.0
Dementia/memory problems	88	9.2
Lung disease (asthma, emphysema)	38	4.7
Diabetes	36	3.9
Eye disease (cataract, glaucoma, macular degeneration)	38	3.6
Cancer	30	3.4
Heart failure	23	2.8
Osteoporosis	19	2.4
Hypertension	21	2.4
Parkinson's	14	1.7
Depression/other mental illness	6	0.7
Back disease	6	0.4
Other chronic condition	64	8.0
Acute event	275	32.1
Stroke	83	10.1
AMI or bypass surgery	42	5.4
Hip/knee replacement	40	4.1
Other surgery	33	4.6
Hip fracture	36	3.6
Other fracture or fall	42	4.0
Amputation	7	1.0
Other acute event	34	3.9
Symptom not linked to condition	266	30.2
Pain/Discomfort (includes pain, swelling, stiffness, and other problems)	105	11.8
Hips/knees	44	5.1
Back	30	3.4
Legs	25	3.0
Feet/ankle	13	1.5
Upper extremities	4	0.4
Other pain/discomfort	6	0.8
Balance	40	4.4
Unsteady/balance problems	31	3.4
Dizziness	12	1.5
Endurance	22	2.8
Shortness of breath	15	2.0
Fatigue	8	0.9
Weakness	37	3.7
General weakness	23	2.2
Lower body weakness	14	1.4
Other symptoms	105	12.3
Vision/blindness	48	5.6
Hearing	16	2.0
Fear/security	9	1.1
Other symptom	38	4.3
Old age	133	14.0

Note: Respondents were able to list up to ten causes for their disability. *N* represents the number of respondents who reported the condition or symptom as at least one cause of their disability. All percentages based on weighted sample size.

Table 5.5 **Chronic condition cited by community-dwelling newly disabled respondents who also cite symptoms or old age as a cause of their disability.**

	All newly disabled	Old age	Symptom
N	892	133	266
% of cohort	100	14.0	30.2
Chronic conditions	54.8	32.8	43.5
Arthritis	22.2	17.1	12.0
Heart disease	12.5	6.1	15.7
Lung disease	4.7	3.1	5.5
Dementia	9.2	6.2	4.8
Diabetes	3.9	1.5	5.4
Eye disease	3.6	0.0	2.6
Acute conditions	32.1	12.8	20.5
Hip fracture	3.6	0.9	2.5
Heart attack or open heart surgery	5.4	4.2	3.2
Stroke	10.1	4.6	5.9
Old age	14.0	100.0	8.4
Old age only	6.5	46.0	0.0
Symptom	30.2	18.1	100.0
Symptom only	12.5	0.0	41.4
Pain	11.8	2.0	39.2
Balance	4.4	1.4	15.5
Endurance	2.8	5.0	9.1
Weakness	3.7	5.4	12.1
Other symptom	12.3	7.2	40.8

more likely to have any of the most disabling clinical conditions, and in fact were less likely to have diagnoses of arthritis, diabetes, Parkinson's and related diseases, and respiratory diseases compared to respondents who did not cite old age as a cause of their disability. Respondents reporting symptoms were also often less likely to have disabling conditions compared to those reporting chronic conditions or acute event. However, patients reporting pain/discomfort or weakness as a cause of their disability were more likely to have evidence of arthritis. Respondents citing weakness were more likely to be female. However, the sample sizes were small in several of these categories, making precise inference difficult.

5.5.5 Types and Severity of Limitations

We report the number of functional limitations, IADL limitations, and ADL limitations according to self-reported cause of disability in figure 5.6 (table 5.A3 in the appendix provides information on specific limitations). Newly disabled respondents reporting only chronic or acute conditions reported more functional limitations than respondents who reported old

Table 5.6 **Characteristics of newly disabled cohort according to self-reported cause of disability.**

	Medical only[a]	Old age	Symptom	Pain	Balance	Endurance	Weakness
N	518	133	266	105	40	22	37
% of cohort	58.3	14.0	30.2	11.8	4.4	2.8	3.7
Average age	75.8	80.2**	76.4	76.3	76.2	77.2	77.0
Female	63.5	71.5*	67.2	68.2	55.4	61.2	88.7**
Race		*					
White	92.9	87.3	95.0	96.3	90.7	96.1	85.0
Black	6.0	9.6	4.4	3.2	9.3	3.9	11.3
Other	1.1	3.1	0.6	0.4	0.0	0.0	3.8
Marital status (1994)							
Married	51.5	45.1	50.9	43.7	55.8	55.8	34.1
Widowed	37.2	43.0	36.3	44.5	30.5	28.4	44.1
Not married	10.1	10.5	11.1	11.8	10.3	7.2	21.7
Missing	1.3	1.5	1.6	0.0	3.4	8.6	0.0
Marital status (1999)		**					
Married	39.6	26.6	39.1	33.0	49.9	47.0	30.4
Widowed	51.8	68.8	52.1	57.3	44.1	37.3	63.4
Not married	8.6	3.7	8.7	9.7	5.9	15.8	6.3
% with conditions/ diseases:[b]							
Arthritis and arthropathy	74.5	61.6**	69.9	80.9**	59.8	67.4	71.9
Infectious disease	61.1	51.1	58.1	63.7	47.4	54.2	42.4
Dementia and organic brain diseases	25.3	23.8	16.4**	13.2**	16.5	22.4	7.0[a]
Heart failure and arrhythmia	58.4	58.5	63.2	61.5	61.1	72.9	61.2
Diabetes	37.3	24.8**	40.8	41.7	39.2	24.6	38.0
Stroke	43.6	40.9	42.9	44.6	50.3	43.8	39.1
Peripheral vascular disease	44.6	41.1	44.0	39.3	35.7	45.2	52.7
Paralysis, Parkinson's	22.5	9.3**	12.4**	12.5	15.5	16.2	3.6[a]
Depression	21.8	19.2	12.8**	10.9**	6.6	20.4	5.6
Other mental disorders	31.7	32.1	28.7	23.6	39.3	18.3	28.6
Respiratory diseases	80.5	72.2**	82.1	84.9	84.9	77.0	80.7
Hip and pelvic fracture	14.0	11.5	9.4	9.4	6.0	14.6	7.2

[a]Respondents who reported chronic or acute causes of their disability without citing either symptoms or old age.

[b]Based on diagnoses in respondents medical claims.

*Marginally significantly different from respondents reporting only medical causes ($0.05 < p\text{-value} < 0.10$).

**Significantly different from respondents reporting only medical causes ($p\text{-value} < 0.05$).

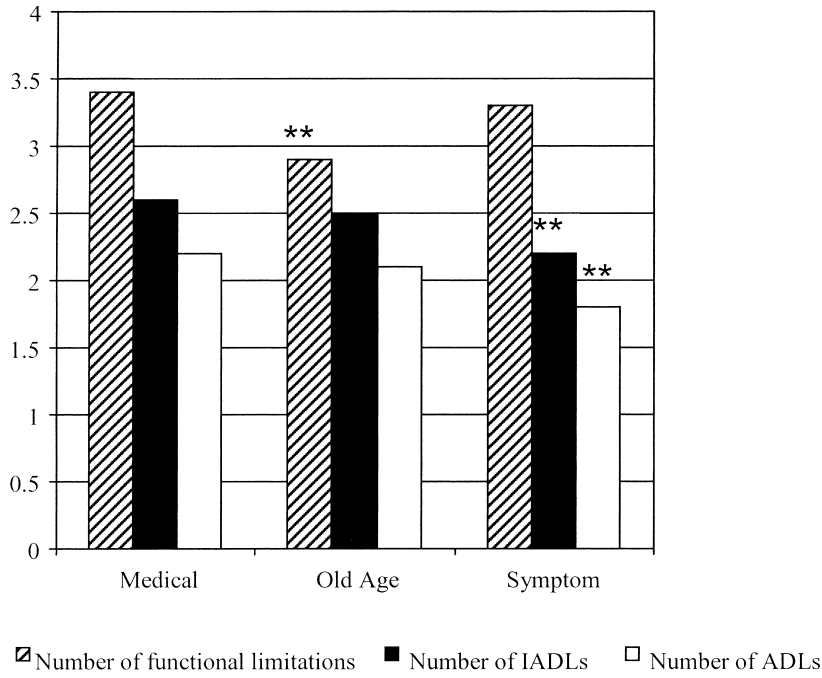

Fig. 5.6 Number of limitations among newly disabled respondents by self-reported cause of disability

* Marginally significantly different from respondents reporting only medical causes ($0.05 < p$-value < 0.10).

** Significantly different from respondents reporting only medical causes (p-value < 0.05).

age, and significantly more ADL and IADL than respondents who reported symptoms.

5.5.5 Medical and Assistive Services

We present self-reported utilization of health care and assistive services in table 5.7. Past nursing home stays were highest among those who reported clinical causes and lowest among those citing symptoms. Respondents citing symptom causes were also less likely to report use of physical or occupational therapy services. Consistent with the observation that respondents citing old age or symptoms were less likely to have evidence of clinical conditions in their medical claims, these respondents have lower levels of health care utilization (physician visits, medications, and hospitalizations). However, health care use was high in all groups. Forty percent of respondents citing old age reported a physician visit in the past month and a quarter reported being hospitalized in the previous year, suggesting sufficient contact with the health care system to receive care for chronic conditions.

Table 5.7 **Self-reported utilization of health and assistive services by self-reported cause of disability**

	Medical only[a]	Old age	Symptom	Pain	Balance	Endurance	Weakness	Other symptom
N	518	133	266	105	40	22	37	105
% of cohort	58.3	14.0	30.2	11.8	4.4	2.8	3.7	12.3
Past nursing home stay (ever)	15.1	9.7	6.5**	5.5**	8.4	4.4	4.7*	9.4
Assisted living (now)	3.0	3.7	2.1	2.8	4.7	0.0	0.0	3.2
Home health care (in the past month)	11.9	11.1	10.7	8.6	9.0	21.9	16.4	9.9
Physical, occupational, speech, or hearing therapy (in the past month)	10.3	9.3	4.9**	5.9	7.5	9.6	5.4	2.2**
Emergency room visit (in the past month)	5.7	8.1	8.4	9.2	12.8	0.0	10.3	6.9
Hospitalization (in the past year)	36.6	25.1**	36.5	36.3	37.7	30.4	34.0	39.0
Physician visit (in the past month)	52.3	41.8*	50.1	52.2	57.6	36.8	63.2	45.5
Number of prescriptions (in the past month)	4.2	3.0**	3.7	3.6	3.3*	3.5	4.2	3.7

[a] Respondents who reported chronic or acute causes of their disability without citing either symptoms or old age.

* Marginally significantly different from respondents reporting only medical causes ($0.05 < p\text{-value} < 0.10$).

** Significantly different from respondents reporting only medical causes (p-value < 0.05).

5.6 Discussion

Analyzing thirty-one clinical conditions, we estimate that arthritis, dementia, infectious diseases, heart failure, diabetes, and stroke each explained at least 5 percent of incident disability. These top six conditions together explained almost half of new disability (48 percent). Consistent with these findings, arthritis, stroke, dementia, and heart disease were the conditions most often mentioned among respondents who reported an acute or chronic condition as a cause of their limitation.

We also found that newly disabled respondents with these six conditions typically experience problems in multiple categories of functional limitations, ADL, and IADL tasks. Elderly patients with any of these six conditions were also more likely to have been hospitalized in the past year and had a greater average number of prescription drugs in the past month compared to the average newly disabled patient. However, there were differences across these pathways in the types of disability experienced and in the use of services. For example, dementia represents the pathway most strongly associated with the most severe types of disability and the largest

number of reported limitations. Newly disabled respondents with dementia were also the heaviest users of supportive services, including nursing home residence. In contrast, arthritis, while being the largest contributor to overall disability, was associated most strongly with mobility limitations, and newly disabled respondents with arthritis used relatively few supportive and medical services.

Our comparison of newly disabled respondents who attributed their disability to old age or symptoms to those citing chronic or acute medical conditions also demonstrated important differences. First, we found that those who reported age as a cause of their disability had similar or lower levels of disabling conditions compared to those who reported a clinical condition. In addition, newly disabled respondents attributing disability to symptom causes or old age tended to have less severe disability and use fewer supportive services. While those citing old age had lower use of health care, there were sufficient interactions with clinicians (42 percent report visit with a physician in prior month) to have had chronic disease diagnosed. These results suggest that those reporting old age or symptoms represent a different pathway; that is, frailty or preclinical disease that lead to their disability. The importance of infectious diseases in our empirical models also suggests a role for heightened vulnerability in the elderly, as past diagnoses of infectious diseases may be a marker for frailty.

We found that self-reported causes and empirical analyses of claims-based measures provided complementary information. Claims-based diagnoses were available on all respondents, and empirical models allowed us to estimate the fraction of disability attributable to each condition independently of the other conditions. However, binary measures of diagnoses from medical claims may not adequately capture disease severity. In addition, claims-based analyses did not capture most visual and hearing impairments, which have been shown to be important correlates of disability here and in other studies (Kosorok et al. 1992; Dunlop et al. 2002). Analyses based on self-reported causes, which were only collected from community-based respondents, may underestimate the effect of highly disabling conditions like dementia. Given the differing strengths and weaknesses of clinical data and self-reports, future attempts to measure causes of disability should combine the two approaches.

These analyses have important implications. First, an understanding of the major contributors to disability in the late 1990s provides insight into potential future trends in the health of the elderly. We found that conditions without effective medical treatments—dementia in particular—were major contributors to disability in older persons. Alzheimer's and other forms of dementia are highly disabling progressive diseases with few effective interventions to slow their progression (Cummings and Cole 2002). Until effective treatments are found, dementia-related disability is likely to increase in importance. In contrast, many conditions—stroke, heart disease, and arthritis—in particular—are amenable to both medical and

lifestyle interventions, suggesting that increased use of effective medical therapies and control of risk factors could lead to continued improvement in the health of the elderly (Manton 1989; Boult et al. 1996; Singer and Manton 1998). However, obesity rates continue to rise and obesity is a risk factor for four of the six most important pathways in our analysis (arthritis, heart failure, stroke, and diabetes). The increase in obesity rates in the elderly and nonelderly population, coupled with increases in disability rates in younger populations, have led others to suggest that disability rates in older persons will increase in the future (Lakdawalla, Bhattacharya, and Goldman 2004; Leveille, Wee, and Iezzoni 2005). Moreover, a recent study found that obesity contributed to an increasing number of cases of arthritis between 1971 and 2002 (Leveille, Wee, and Iezzoni 2005).

Second, our results suggest potential avenues for medical and other interventions to alleviate dependence in the elderly. We found that various diseases and conditions are specific to different types of disability. This suggests that interventions to prevent or reduce disability may be targeted to different types of tasks, depending on the medical condition experienced by the patient. Interventions likely need to be targeted to multiple ADL and IADL tasks within a category of disability, as the six diseases and conditions were associated with limitations in multiple tasks.

In addition, medical care and assistive service utilization varied across conditions, suggesting that there may be variation in opportunities to intervene through medical and nonmedical services. For example, while respondents with dementia had relatively low rates of hospitalizations and physician visits, almost half were institutionalized and 20 percent were using home health services. Until effective medical interventions are available for dementia patients, current interventions may be best targeted through supportive care services and within their living environment. In contrast, newly disabled respondents with arthritis were relatively infrequent users of intensive inpatient or nursing home care, but had higher than average use of medications and physician visits, suggesting that interventions for disability assessment and prevention services among these patients may be most effectively conducted by physicians. For all diseases and conditions studied, improved medical care in the future may help to reduce disability.

Our analyses of newly disabled respondents attributing their disability to old age or symptoms suggest a greater focus on physician-based assessment of preclinical disease and treatment of symptoms in order to prevent disability. The large number of disabled respondents in the community who cited old age as a cause of disability may also imply that elderly respondents have low expectations for interventions, either medical or otherwise, to help them function independently. Physician-based interventions may help to educate patients about expectations for functioning and additional medical care treatments and interventions to minimize disability.

In conclusion, we identified six major clinical pathways to disability that account for almost half of incident disability, but differ in both the types of

disability experienced and use of medical and assistive services. These results have important implications for future trends in the health of the elderly population, highlighting substantial challenges to continued improvement in disability.

Appendix

Table 5A.1 Clinical conditions

Condition	ICD-9-CM Codes
Infectious diseases	001.*–139.*, 320.*–323.*, V09.*
Colorectal and lung cancer	153.*, 154.*, 162.*
Breast and prostate cancer	174.*–175.*, 185.*
Other cancers	140.*–239.* (~#2, #3), 611.72, V10
Diabetes	250.*, 251.3
Thyroid disorders	240.*–259.* (~#5)
Other metabolic and immunity disorders	270.*–273.*, 275.*–279.*
Anemia	280.*–285.*
Other blood diseases	285.*–289.*
Dementia and organic brain diseases	290.*, 294.*, 310.*, 330.*, 331.*
Depression	296.* (~296.9), 298.0, 300.4, 311.*
Other mental disorders	290.*–319.* (~#10, #11), 797.*
Paralysis, Parkinsons's, and related diseases	332.*, 340.*–344.*, 438.*
Stroke	362.34, 430.*, 431.*, 432.9, 433.*–436.*
Glaucoma and cataract	365.*–366.*, 743.2–743.3
Chronic renal failure	403.01, 403.11, 403.91, 404.02, 404.12, 404.92, 585.*–586.*, V45.1, V56.*
Hypertension	401.*–405.* (~#16), 437.0, 437.9
Ischemic heart disease	410.*–414.* (~414.11, 414.19), 429.5–429.7
Heart failure and arrhythmia	425.*, 427.1, 427.3–427.5, 428.*, 429.1, 429.3
Peripheral vascular disease	440.*, 442.*, 443.* (~443.2), 444.*, 446.*, 447.* (~447.6), 451.*, 453.1
Other circulatory diseases	391.*–459.* (~#13, #14, #16, #17, #18, #19, #20), 786.5, V717.*
Chronic obstructive pulmonary diseases and related diseases	466.*, 490.*–496.*, 518.12
Respiratory failure	518.*, 799.1
Respiratory diseases	460.*–519.* (~#22, #23), 786.0, 786.1, 786.52, 793.1
Gastrointestinal disease	530.*–579.*, 789.0, 787.0, 787.7
Acute renal failure and insufficiency	584.*, 587.*, 588.*
Genitourinary diseases	580.*–629.* (~#4, #16, #25, #26), 788.* (~788.3, 788.4), 793.8, V44.5–V44.6, V55.5–V55.6
Arthritis and arthropathy	274.*, 390.*, 710.*–716.*
Back/neck pain	720.*–724.*, 839.0–839.5, 846.*, 847.*
Hip and pelvic fracture	808.*, 820.*
Musculoskeletal disorders	717.*–739.* (~#29), 800.*–999.* (~#29, #30)

Table 5A.2 **Self-reported limitations in newly disabled cohort according to conditions in their medical claims**

	All newly disabled (n = 1264)	Dementia (n = 450)	Stroke (n = 598)	Heart failure (n = 781)	Infectious disease (n = 808)	Arthritis (n = 911)	Diabetes (n = 449)
Functional limitations (among noninstitutionalized)							
Going up stairs	78.9	84.1	82.2	84.4	81.5	81.5	85.3
Walking across room	41.1	51.0	46.1	45.1	43.8	42.7	46.6
Bending	52.9	59.1	59.4	56.7	56.2	56.7	58.7
Lifting ten pound package	62.4	72.8	70.3	67.7	67.0	64.0	67.0
Reaching above head	36.6	43.9	44.0	40.9	39.7	38.4	39.3
Grasping small objects	32.7	38.9	36.5	34.8	35.1	33.3	34.9
Seeing to read newsprint	20.2	25.7	24.7	21.9	22.5	20.9	22.5
Speaking	2.0	3.4	3.8	2.4	2.6	1.7	1.8
Hearing	6.5	14.2	6.5	6.1	6.6	7.1	8.3
IADLs (among noninstitutionalized)							
Light housework	22.4	40.9	30.9	27.0	25.2	22.1	25.9
Laundry	27.9	51.6	37.0	32.6	31.1	28.7	29.8
Cooking	24.3	52.6	32.2	28.9	26.8	24.1	25.8
Grocery shopping	42.6	63.4	52.3	48.5	45.9	41.3	45.7
Managing money	23.1	54.6	30.1	24.9	23.4	22.0	22.0
Taking medications	28.6	57.1	38.1	33.7	30.6	27.1	31.9
Using telephone	12.7	32.2	15.7	14.1	12.3	11.9	10.3
Getting around outside	72.9	76.6	78.2	76.3	76.9	75.4	79.8
ADLs (all respondents)							
Eating	18.4	37.3	25.6	22.0	22.6	17.7	17.6
Getting out of bed	45.2	65.8	55.8	50.8	50.8	47.6	50.6
Getting around inside	55.3	69.7	65.2	62.0	60.8	59.1	59.0
Dressing	33.4	62.2	43.6	39.8	40.5	35.2	37.9
Bathing	67.2	81.5	74.0	72.5	71.7	69.0	69.0
Toileting	42.8	63.6	50.4	48.7	50.1	45.8	43.7

Table 5A.3 **Self-reported limitations in community-dwelling newly disabled cohort according to self-reported cause of disability**

	All newly disabled (n = 892)	Medical only (n = 518)	Old age (n = 133)	Symptom (n = 266)	Pain (n = 105)	Balance (n = 40)	Endurance (n = 22)	Weakness (n = 37)	Other symptom (n = 105)
Functional limitations									
Going up stairs	79.8	80.3	69.5	82.6	92.2	81.3	70.6	87.4	78.8
Walking across room	40.1	41.4	38.9	37.8	44.5	45.6	45.7	22.5	31.5
Bending	52.9	55.9	40.6	51.4	62.9	47.4	24.8	49.7	51.6
Lifting ten pound package	62.0	62.6	56.8	62.6	68.3	47.1	69.8	77.3	61.3
Reaching above head	35.9	38.7	31.7	32.0	32.5	25.2	19.9	30.0	37.6
Grasping small objects	32.7	34.3	29.9	29.1	29.8	33.8	20.2	14.8	33.7
Seeing to read newsprint	20.4	20.0	16.9	24.1	12.0	18.0	16.7	16.9	41.5
Speaking	1.7	2.5	0.0	0.8	0.0	0.0	0.0	0.0	2.0
Hearing	6.7	6.8	4.1	7.2	5.5	4.0	0.0	1.9	14.8
IADLs									
Light housework	20.5	22.3	21.8	14.5	13.1	10.5	23.7	9.2	17.2
Laundry	26.3	28.4	27.9	21.5	20.3	18.3	41.2	16.4	21.9
Cooking	22.5	24.4	25.6	17.8	16.9	20.4	23.2	11.2	20.0
Grocery shopping	41.4	44.1	39.7	38.5	35.0	39.5	53.0	37.1	41.2
Managing money	22.3	25.5	24.1	14.3	6.0	13.3	24.1	10.6	24.8
Taking medications	27.2	28.5	26.6	24.5	22.3	22.6	16.4	12.5	34.0
Using telephone	11.9	12.2	9.9	11.8	4.5	12.0	6.5	7.3	21.9
Getting around outside	71.7	71.1	70.8	73.5	82.4	86.2	79.9	71.1	66.8
ADLs									
Eating	12.2	13.1	12.8	10.6	11.2	5.0	7.3	1.6	17.3
Getting out of bed	33.6	35.1	34.9	30.0	37.9	29.2	36.0	13.3	27.8
Getting around inside	47.0	48.4	48.2	44.1	51.3	44.3	38.3	59.0	40.1
Dressing	20.3	23.5	17.6	15.1	11.5	12.4	11.4	11.3	22.6
Bathing	60.0	64.7	60.0	52.2	49.5	42.3	52.2	57.8	57.2
Toileting	33.9	35.3	32.3	31.6	37.0	30.2	18.4	19.8	34.6

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