Disability Transitions for Older Persons With Arthritis

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This article reports changes over 2 years in physical, activities of daily living (ADL), and instrumental activities of daily living (IADL) disabilities for older U.S. adults with arthritis, compared to those without arthritis. The data source is the 1986 Longitudinal Study on Aging, a follow-up survey of community-dwelling persons ages 70 and over when first interviewed in 1984 (N = 4,717). Disability is defined as difficulty doing an activity on one's own and without special equipment. Transitions from t0 status (1984: No Difficulty, Yes Difficulty) to t1 status (1986: No Difficulty-Community Dwelling, Yes Difficulty-Community Dwelling, Institutional Residence, Dead) are studied. (a) Among nondisabled persons at t0, people with arthritis are more likely to incur all types of disability over a 2-year period. (b) Among disabled persons at t0, those with arthritis regain ADL, IADL, and walking abilities more readily than do their nonarthritis peers, but they are less likely to regain physical functions requiring endurance, strength, and dexterity. (c) Regardless of initial disability status, nonarthritis people are more likely to be institutionalized or die in 2 years than are arthritis persons. (These results are clear but vary in statistical strength: Most comparisons for [a] are significant at $p \leq .01$; one third are significant at $p \leq .05$ for [b]; most comparisons for institutional outcome are nonsignificant due to small cell sizes; one third for dead outcome are significant at $p \leq .01$.) The results reflect the medical nature of arthritis (musculoskeletal locale, moderate impact, nonfatal) and also people's successful accommodations to it. In sum, disability is an especially dynamic experience for persons with arthritis. Clinical and public health efforts to prevent disability onset and to aid restoration of function for this common disease can have high payoff, benefiting many persons for relatively low cost.

Chronic conditions (diseases and sensory/structural impairments) accumulate for individuals as they age. Having crossed some threshold

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of severity such as medical diagnosis, they are typically permanent fixtures of a person's life. Most chronic conditions are nonfatal, so their consequences are mostly symptoms and disability over many years rather than death.

In contrast to the "once gained, never lost" character of chronic conditions, disability is a highly dynamic feature of health. It fluctuates over time in response to disease activity and to medical and personal interventions. For example, disability can increase as a disease progresses and as therapies and home remedies prove ineffectual. It can decrease as drugs slow the disease's course or its symptoms, as physical therapy restores strength and range of motion, or as assistive devices are brought into use.

To track the dynamics of disability that people experience and to locate factors that prompt disability incidence and recovery, longitudinal data are now being collected for middle-aged and older people in community health surveys. Analyses of disability prevalence, probabilities and rates of change over a time interval, and patterns of change (for data with 3 or more time points) are conducted.

This article studies changes in physical, personal care, and household management disabilities over a 2-year time interval among older U.S. adults (ages 70 and over) who have arthritis. Their transitions over this time interval are compared to nonarthritis persons those ages. It is asked if disability dynamics are distinctive for arthritis persons in ways that reflect the disease's nature and people's abilities to cope with it. The data set is the 1986 Longitudinal Study on Aging (LSOA).

The central questions are these: Does disability prevalence increase faster over time for arthritis persons than for those without the disease? Do arthritis people acquire disabilities (incidence) at a faster rate than do nonarthritis people? Are they also more likely to restore functional abilities over time? Which group experiences faster exits from the community-dwelling population into institutions or death? What medical and social factors may account for the differences?

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Background

ARTHRITIS

Arthritis was selected because it is so prominent in mid and late life and because its impact is concentrated on disability, not death.

Arthritis is the highest prevalence chronic condition for middle-aged and older people in the United States, based on health interview data. By gender, arthritis is women's most prevalent chronic condition in middle and older ages, and the first or second rank condition for men (Verbrugge, 1987, 1989, Table 2.8). Arthritis is the most frequently cited cause of activity limitations by middle-aged and older women, and the first or second rank cause by men of those ages (Verbrugge, 1989, Table 2.16, 1990a). These high limitation rates for arthritis come about from its combination of high prevalence and moderate disabling impact (Haber, 1971; Lando, Cutler, & Gamber, 1982; LaPlante, 1988, 1989; Verbrugge, Lepkowski, & Imanaka, 1989). The importance of arthritis in everyday life is not reflected in medical care settings (ambulatory care visits and hospital stays). There, it is outranked by cardiovascular and neoplasm conditions (Verbrugge, 1990b). Finally, arthritis rarely appears on death certificates as an underlying cause of death (National Center for Health Statistics [NCHS], 1988, Table 1-22).

DISABILITY DYNAMICS

Scientific reports on disability transitions for large community-based samples are increasing. Transition data are studied "as is" (rates of change into and out of disabled status) or are condensed into estimates of active life expectancy (number of years people can anticipate being disability free) and disabled life expectancy (years being disabled). These reports are reviewed overall below and it is indicated where this analysis fits.

1. *Incidence* rates of activities of daily living (ADLs) dependency and *recovery* rates (return to independence) were first reported for a Massachusetts sample ages 65 and over (Branch, Katz, Kniepmann, & Papsidero, 1984; Katz et al., 1983). Rates of restored independence

were quite similar for men and women, but they decreased sharply with rising age. Estimates of active (independent) life expectancy were calculated for the data (Katz et al., 1983) and subsequently revised (Rogers, Rogers, & Branch, 1989). Women ages 65 and over could expect to be dependent a larger fraction of their remaining years. A recent study shows clearly that women have more expected years of both independence and dependence than do men and, repeating the Massachusetts data, their fraction of remaining life spent dependent is greater (Rogers, Rogers, & Belanger, 1989).

2. The predictive importance of initial disability for later *institutionalization* and *death* has been shown in several studies. Instrumental activity of daily living (IADLs) dependency at t0, but not ADL dependency at t0, is a strong predictor of later institutionalization (Branch & Jette, 1982). IADL difficulties at t0 hasten mortality (Koyano et al., 1989). Physical dysfunctions at t0 are strong predictors of mortality over 5 years for men ages 55 to 69 (Chirikos & Nestel, 1985) and of mortality or nursing home entry over 2 years (Harris, Kovar, Suzman, Kleinman, & Feldman, 1989).

3. Only a few studies have reported disability transitions for people with *specific chronic conditions*. For arthritis, absence of arthritis is associated with maintaining physical abilities over 2 years (Harris et al., 1989) and over 19 years (Guralnik & Kaplan, 1989). Yelin and Katz (1989) provide national estimates of arthritis people with various types of disability. Analyzing disability transitions, they find net increases in disability over a 2-year period; thus incidence exceeds recovery (return to function).

4. Because data on disability dynamics are so new, there is plenty of interest in *sociodemographic differentials* – how population groups vary in their transitions among disability statuses over time. Age and sex differences are routinely reported for large-scale studies. Manton (1988, 1989) found similar disability incidence for females and males ages 65 to 84, and higher incidence for females after that (85+). Based on our own review of the tables, men have higher probabilities of recovery, that is, restoration of all ADL/IADL functions or reduction in the number of disabilities; conversely, women have higher probabilities of an increased number of disabilities. Manton notes that risks of institutionalization are higher for women over 2 years, and mortality

risks are higher for men. Branch and Ku (1989) offer abundant transition tables by sociodemographic characteristics for three different time intervals (15 months, 6 years, 10 years). They found that ADL dependency is less likely to occur and more likely to disappear over time for persons with initial better health, less health services use, and higher socioeconomic status.

This article contributes to all four topics above, with emphasis on changes for a target disease (Topics 1-3). Descriptive differentials and multivariate models are presented to compare the disability experience of arthritis persons and nonarthritis persons over 2 years.

Methods

DATA SOURCE

The data source is the 1986 Longitudinal Study on Aging (LSOA; NCHS, 1989). It is a follow-up survey of older persons initially interviewed in the 1984 Supplement on Aging (SOA), a component of the 1984 National Health Interview Survey (NHIS; Fitti & Kovar, 1987; Ries, 1986). The LSOA was jointly conducted by the National Center for Health Statistics and the National Institute on Aging.

The LSOA has a probability sample of the U.S. civilian community-dwelling population ages 70 and over in 1984. The selected sample (N = 5,151) had provided data in 1984, and efforts were made to find and reinterview them in 1986. Ultimately, information was obtained for 4,717 of them: In 1986, 84% (3,963) were still community dwelling, 3% (150) were institutionalized, and 13% (604) were deceased. In this article, 1984 is t0 and 1986 is t1.

These analyses use the located sample (N = 4,717). The sample is called *Initial Community Dwellers*, for their t0 residence. At various points, subsamples are used that include only persons found alive at t1 (*Interviewed Survivors*, N = 4,113; excludes dead) or persons still found in the community at t1 (*Still Community Dwellers*, N = 3,963; excludes institutional residence and dead).

Our analysis file was specially prepared to merge variables from the LSOA and SOA public-use files. In particular, the variables for

arthritis status and total count of chronic conditions are derived from the SOA; they are not present on the LSOA public-use file.

ARTHRITIS DETERMINATION

The most medically based determination of arthritis possible in the data is used: In 1984, respondents were queried about their chronic conditions in the core NHIS and SOA interviews by direct questions about diseases/impairments and by questions about what caused limitations and medical care. Standard NHIS procedures for these self-reports were used: Interviewers enter each condition on a special condition record and then probe for details, including diagnosis names when possible. Later, medical coders review the information and assign the most specific International Classification of Diseases (ICD) code possible to each condition (NCHS, 1985). The medical coding scheme is conservative; for example, an ICD code for arthritis occurs only when (a) the respondent states that a physician or physician's assistant named the condition as "arthritis" (that title or a more specific one such as osteoarthritis) or (b) a nondiagnosed respondent uses that name and all additional details about the condition corroborate it.[1]

The term *arthritis* actually encompasses about 100 specific diseases (Schumacher, 1988). In this article, the scope is defined as NCHS does for national prevalence rates: The ICD-9 codes included in the title Arthritis are 711.0,9; 712.8,9; 714-716; 720.0; 721 (no decimal entry means all 4th digits 0-9 included) (Health Care Financing Administration, 1980).

The most common form of arthritis is osteoarthritis (OA), and most arthritis records in the SOA (90.6%) have a pertinent code (ICD 715, 716.9; 715 is specified OA, 4.9%; 716.9 is presumptive OA, used when the medical coder determines arthritis is present but cannot assign a more specific form, 85.7%). Rheumatoid arthritis (RA) accounts for 3.2% of the records (ICD 714), axial arthritis for 5.7% (ICD 721), and rare forms 0.5% (all other codes). The results reported here reflect the impact of the combined arthritis titles, but they can essentially be read as the impact of osteoarthritis as well. To verify this concretely, some analyses were run for just the osteoarthritis group; results are virtually identical in every respect to the total arthritis group.

The data set does not indicate body site(s) of the disease, so we cannot study here the distinctive impacts of, for example, hand versus knee arthritis.

Arthritis status is determined for 1984 (t0). This allows a comparison of disability changes for people who had the disease at the outset versus those then free of the disease. The chronic condition questions were not asked again in 1986 (t1). Thus incident cases (people who acquired arthritis over the 2 years) are not ascertained, and their possibly special pace of disability cannot be observed. Such people remain in the nonarthritis group of this analysis. They are probably a small fraction thereof; studies show that osteoarthritis advances slowly over years, as detected by standard radiographic procedures (Altman et al., 1987; Buckland-Wright, MacFarlane, Lynch, & Clark, 1990; Kallman, Wigley, Scott, Hochberg, & Tobin, 1990; Plato & Norris, 1979). The rate of progression slows as severity increases (Kallman, Wigley, Scott, Hochberg, & Tobin, 1990). It follows that clinically defined disease, typically manifested at moderate or severe radiographic stages, emerges still more slowly.

ARTHRITIS PREVALENCE

Just over half (50.6%) of the selected LSOA sample (N = 5,151) had arthritis in 1984. Prevalence rates for age-sex groups are shown in Table 1. The stasis of rates at these older ages may surprise readers. Other studies of radiographic arthritis, self-reported arthritis, and chronic joint pain show steadily rising rates from ages 18 to about 70; some series continue to increase after age 70, others do not (Felson, et al., 1987, Table 3; Lawrence et al., 1989, Table 4; Maurer, 1979; Roberts & Burch, 1966). The data in this study—medically coded self-reports of arthritis for a probability sample of U.S. adults—also show no distinct rise after age 70.

Arthritis rates for the located sample (N = 4,717) are almost identical to those in Table 1. Overall, 50.9% of located persons had arthritis in 1984 (t0); they constitute the *arthritis* group for this analysis. The remaining 49.1% are the *nonarthritis* group. (Rates by gender and by age for the located sample are available on request.)

Table 1
Arthritis[a] Prevalence Rates (in percentages), by Age-Sex, U.S. 1984 (U.S. community-dwelling persons ages 70+)[b]

	Both sexes		Males	Females	Ratio F/M
Ages					
70-74	49.8	(2,136)	41.4	55.9	1.35
75-79	50.1	(1,578)	38.6	57.8	1.50
80-84	53.7	(874)	42.2	59.7	1.41
85+	49.9	(563)	37.5	55.2	1.47
All 70+	50.6	(5,151)	40.3 (1,994)	57.1 (3,157)	1.42

a. ICD codes 711.0,9; 712.8,9; 714-716; 720.0; and 721.
b. Rates are for the selected LSOA sample (N = 5,151). Weighted Ns for age and gender groups are shown in parentheses. Arthritis status was ascertained in 1984 (t0). The prevalence rates are medically coded self-reports (see text).

Each group has some important heterogeneity. The arthritis group contains people who have just arthritis and no other chronic condition (9.9%) and more typical ones who have additional chronic conditions (90.1%). The nonarthritis group contains very healthy people with no chronic conditions at all (18.4%) and more typical ones who have one or more chronic conditions (81.6%). The subgroups' distribution in the sample is as follows: zero chronic conditions (9.1%), arthritis only (5.0%), other chronic conditions only (40.3%), and arthritis plus other chronic conditions (45.6%). For brevity, the subgroups are referred to as *Zero CC*, *Arth Only*, *Other CC*, and *Arth Plus*.[2] Some of the comparisons made here will be for the four subgroups.

DISABILITY

Disability is difficulty in performing a given physical or social function due to a chronic condition. Physical disability refers to problems that the body has in producing adequate force or appropriate motion for tasks. Social disability concerns problems someone has in personal care, household management, productive work, socializing, civic activities, recreation, and leisure.

Our emphasis on difficulty differs from many current analyses, which focus on dependency (personal assistance for an activity). The choice depends on the investigator's goal: Scientists interested in the epidemiology of disability (factors that diminish functional capabilities in the general population or among persons with a target disease) often choose indicators of difficulty. By contrast, those interested in the use of or needs for long-term care at home or institutions are more likely to focus on dependency (Verbrugge, 1990c).

In the LSOA data, there are physical function items for gross mobility (2 items) and local motions and strengths (10). The social disability items refer to two arenas of life: personal care activities (called ADLs, or basic activities of daily living—5 items) and household management activities (called IADLs, or instrumental activities of daily living—6 items). They are described in Table 2 notes.

For each item, a person is scored by disability status at t0 and also t1. There are two disability statuses at t0 (No Difficulty, Yes Difficulty) and four at t1 (No Difficulty-Community Dwelling, Yes Difficulty-Community Dwelling, Institutional Residence, Dead).

PROCEDURES

The study begins by comparing *marginal distributions* at t0 and t1 to see net changes in disability prevalence (Table 2).

Then *transition tables* showing changes from each t0 status to t1 statuses are studied (Tables 3 and 4). These are simply cross-tabulations of t1 (1986) status by t0 (1984) status; percentages of t1 statuses add to 100.0 for each t0 status. Separate tables were produced for the arthritis and nonarthritis groups, for each of the 12 physical, 5 ADL, and 6 IADL items. Transition tables were estimated for Initial Community Dwellers (N = 4,717) and also for Still Community Dwellers (N = 3,963). The former can have all four t1 outcomes noted above; the latter have just two (No Difficulty, Yes Difficulty). All tables produce statistically significant chi-square values (at $p \leq .01$). To test whether t1 outcomes differ for arthritis versus nonarthritis groups, contingent on a t0 status, subtables were prepared and chi-square values computed; results are stated in the text.

Table 2
Disability Prevalence (percentage with any difficulty) for Arthritis and Nonarthritis Persons, 1984 and 1986

	1984: Community Dwelling[a]		1986: Interviewed Survivors[b]		1986: Still Community Dwelling[c]	
	Arth (A)	Nonarth (B)	Arth (C)	Nonarth (D)	Arth (E)	Nonarth (F)
Weighted *N*	2,605	2,546	2,140	2,043	2,072	1,983
Mobility[d]						
Walking	30.6	13.2	40.6	22.0	39.3	20.1
Getting outside	16.0	7.9	21.9	11.8	19.7	9.6
Specific motions and strengths[e]						
Walk 1/4 mile	45.1	23.8	46.8	27.1	45.1	25.2
Climb 10 steps	38.6	18.8	39.7	22.7	37.8	20.4
Stand 2 hours	51.5	26.9	61.0	38.1	59.9	36.1
Sit 2 hours	16.3	6.0	22.6	10.7	21.8	10.2
Stoop/crouch/kneel	58.0	28.2	57.7	33.7	56.4	31.7
Reach up over head	25.0	10.9	29.3	16.9	28.0	15.9
Reach out	3.2	1.8	4.4	2.7	3.9	2.3
Use fingers to grasp	17.8	5.7	19.7	8.7	18.9	7.8
Lift 25 pounds	53.7	31.4	60.2	40.0	58.9	38.0
Lift 10 pounds	22.8	12.0	31.0	18.0	29.2	16.1
Personal care (ADL)[f, g]						
Bathe/shower	15.8	7.8	20.9	14.7	19.1	12.3
Dress	9.6	4.6	13.4	9.4	11.5	7.3
Eat	2.4	1.6	6.2	3.9	5.2	2.9
Transfer	13.8	5.2	23.3	12.0	21.4	10.2
Get to and use toilet	7.1	4.0	10.3	7.0	8.3	4.9
Household management[g, h] (IADL)						
Prepare own meals	10.7	6.2	—[i]	—	14.9	8.9
Shop for personal items	18.1	10.6	—	—	22.1	13.1
Manage own money	7.2	6.1	—	—	12.1	10.0
Use telephone	6.6	5.8	—	—	15.2	14.2
Heavy housework	36.1	18.4	—	—	47.3	30.3
Light housework	11.4	6.1	—	—	13.9	8.9

a. U.S. community-dwelling persons aged 70 and over (unweighted $N = 5,151$).
b. Cohort members who are still community dwelling or are institutionalized in 1986 (unweighted $N = 4,113$).
c. Cohort members still living in the community in 1986 (unweighted $N = 3,963$). This is a subset of interviewed survivors.
d. Question wording: "By yourself and without using special equipment: Because of a health or physical problem, do you have any difficulty – walking? getting outside?"

(continued)

Table 2 Continued

e. Question wording: "By yourself and not using aids, do you have any difficulty – walking for a quarter of a mile (that is about 2 or 3 blocks)? walking up 10 steps without resting? standing on your feet for about 2 hours? sitting for about 2 hours? stooping, crouching, or kneeling? reaching over your head? reaching out (as if to shake someone's hand)? using your fingers to grasp or handle? lifting or carrying something as heavy as 25 lbs. (such as two full bags of groceries)? [if 'yes' to 25 lbs. answer next question] lifting or carrying something as heavy as 10 lbs.?"
f. Question wording: "By yourself and without using special equipment: Because of a physical or health problem, do you have any difficulty – bathing or showering? dressing? eating? getting in and out of bed or chairs? using the toilet, including getting to the toilet?"
g. People who said they do not do an activity for some reason besides health (e.g., cultural) are coded as having no difficulty. People with status not ascertained (n.a.) are deleted.
h. Question wording: "By yourself: Because of a health on physical problem, do you have any difficulty – preparing your own meals? shopping for personal items (such as toilet items or medicines)? managing your money (such as keeping track of expenses or paying bills)? using the telephone? doing heavy housework (like scrubbing floors or washing windows)? doing light housework (like doing dishes, straightening up, or light cleaning)?"
i. The 1986 household management items are asked of community dwellers, but not of institutional residents, so [C] and [D] are unknown for Interviewed Survivors.

The marginal and cross-tabulation results do not have controls for age, sex, or race differences between the arthritis and nonarthritis groups. This is purposeful because it was desired that the results reflect typical kinds of people who appear in clinical and societal settings. In fact, the arthritis and nonarthritis groups scarcely differ in age and race distributions. They do differ in sex distribution (69% female for arthritis, 53% for nonarthritis), so all transition tables were constructed by sex; those results are reported as well.[3]

Finally, various *multivariate models* were estimated with t1 disability status as the dependent variable, and predictors for age, sex, race, overall morbidity (total number of chronic conditions),[4] t0 disability, and arthritis (Tables 5 and 6). These show the impact of arthritis on disability changes, net of potential confounders. The program used was OSIRIS IV Multiple Classification Analysis (Andrews, Morgan, Sonquist, & Klem, 1973; Institute for Social Research, 1982). It is a regression-based technique for dichotomous dependent variables and categorical predictors. It computes net effects and adjusted means (grand mean plus net effect) for *all* categories of each predictor. OSIRIS IV Multiple Classification Analysis (MCA) is viewed as an exploratory technique; statistical significance of effects is not computed. This is compatible with the aims of our study, that is, identifying

consistent effects of predictors across many dependent variables, not precisely estimated effects on one or two key ones.

All results are weighted to adjust for disproportionate sampling and response (NCHS, 1989). Thus the arthritis rates, disability rates, and disability transitions are estimates for the national population. Variances for clustered sampling are not estimated; it is not imperative or cost-efficient here. (Adjusted variances are important when precise estimates are desired for one or two key outcomes.)

In summary, our approach is to control for other chronic conditions in a global way, have few predictors in the multivariate models, and use disability items one by one. This strategy was carefully chosen; arthritis is kept at the forefront of attention and particular activities that pose protracted or remediable difficulty for arthritis persons are identified. The analyses begin with broad group differences (arthritis vs. nonarthritis) and end with quantitative estimation of the effect of arthritis on disability; both are of interest.

Results

DISABILITY PREVALENCE

Table 2 shows levels of disability for the arthritis and the nonarthritis groups at t0 and t1. Four results are noted:

1. Arthritis people have more difficulty in physical, ADL, and IADL functions than nonarthritis people do, both at t0 and t1 (compare columns A and B; C and D). At the outset, disability rates for arthritis people are typically about twice those for their nonarthritis peers. One reason for this is higher overall morbidity in the arthritis group; but as we soon show, even when overall morbidity is controlled, arthritis still has a propelling effect on disability (see also Verbrugge, Lepkowski, & Konkol, 1991).

2. Arthritis persons' excess disability was greater at t0 than t1 (ratios for columns A/B and C/D; not shown). The narrowing over time is partly due to higher mortality in the nonarthritis group, which siphons off very ill and disabled persons; this makes the two surviving groups more similar in disability than before.

3. Disability prevalence increases over the 2 years for both groups (compare columns A and C; B and D). This reflects overall worsening health and reduced vigor among survivors as they age.

4. If disability levels of the community-dwelling populations of 1984 and 1986 are compared, the net changes in disability look modest (compare columns A and E; B and F). This gives a false impression of what actually happens to the cohort. There are three subgroups to consider (data not shown): First, people who remain in the community (Still Community Dwellers) had lower disability at t0 than did the whole sample. Thus they were selected for good function; this is true for both arthritis and nonarthritis people. Over the 2 years, their disability levels increase substantially and pass the 1984 community-dwelling levels. Second, people who became institutionalized had above-average disability in 1984. Their absolute increases exceed those for the Still Community Dwellers just discussed. Third, people who died have still higher disability in 1984; their absolute increases to time of death are presumably large but not observable in the data set. In sum, changes in disability prevalence that are visible in the community underestimate the actual changes experienced by an initial cohort. This is due both to initial selectivity for low disability among persons who remain in the community setting and to departure of very disabled persons to death and institutions.

DISABILITY TRANSITIONS: SPECIFIC ACTIVITIES

Transitions for Arthritis and Nonarthritis Persons

1. Disability incidence. Among nondisabled persons (No Difficulty) at t0, arthritis people are more likely to acquire physical, ADL, and IADL disabilities over a 2-year period than nonarthritis people are (Table 3). For each function, incidence percentages are higher for the arthritis group; thus there is a faster pace of disability onset for arthritis compared to other diseases (taken together). This makes good sense; musculoskeletal diseases have direct impact on physical abilities in the affected regions and for daily activities that rely on basic physical abilities. (The result says nothing about when the impact happens relative to disease duration; it represents an "average" effect for all

durations pooled together.) Almost all (25 of 27) subtable chi-squares are significant at $p \leq .01$.

2. *Disability recovery.* Among disabled persons (Yes Difficulty) at t0, arthritis people are more likely to regain ADL and IADL functions. By contrast, nonarthritis people are more likely to regain virtually all physical functions, especially those that require endurance, strength, or dexterity. There is one exception: Arthritis people who start out with trouble walking do improve more often in this critical function. The results point out the enduring nature of physical dysfunctions but remediable nature of ADL and IADL ones for arthritis, relative to other chronic conditions. Arthritis people apparently find ways to overcome their social disabilities — such as taking drugs to control pain, changing the procedures to accomplish an activity, reducing the time spent on an activity — even though the basic physical dysfunction persists. The differences are consistent within activity domains (as stated), but statistically modest (9 of 28 chi-squares significant at $p \leq .05$, 2 $p \leq .10$).

3. *Institutionalization and death.* Regardless of initial disability status (No or Yes, t0), nonarthritis people are more likely to be institutionalized or, especially, to die over a 2-year period compared to arthritis people. Having lower extremity, mobility, or ADL difficulties elevates mortality risks for the nonarthritis people a good deal, compared to their arthritis peers. These results ostensibly reflect the moderate impact and nonfatal nature of arthritis, compared to other chronic conditions in late life (Verbrugge, Lepkowski, & Imanaka, 1989). Chi-squares for institutional outcome are seldom significant due to small cell sizes (2 of 55 at $p \leq .05$, 1 $p \leq .10$); more tables are significant for dead outcome (15 of 55 at $p \leq .01$, 1 $p \leq .05$, 5 $p \leq .10$).

These results are for Initial Community Dwellers. The tables were produced also for Still Community Dwellers: The disability onset and recovery results are repeated (available on request); institutional and death outcomes are not germane.

Transitions by Gender

The arthritis group is more female, so longstanding gender differences in institutionalization and mortality rates could affect the results

(Text continues on page 230)

Table 3

Disability Transitions for Arthritis and Nonarthritis Persons: Specific Physical, ADL, and IADL Items[a]

	Model Transition Table				
	t1: No Difficulty	Yes Difficulty	Institutionalized	Dead	
t0: No Difficulty	(1)	(2)	(3)	(4)	100.0%
Yes Difficulty	(5)	(6)	(7)	(8)	100.0%

Cells 2 through 4, 5, 7, and 8 of the transition table are shown as columns. Cells 1 and 6 (stasis) are not shown. Results are for Initial Community Dwellers. t0 is 1984; t1 is 1986.

	Percentage with No Difficulty t0 who moved to t1 status named				Percentage with Yes Difficulty t0 who moved to t1 status named			
	→Yes (2)	→Institutionalized (3)	→Dead (4)	Weighted *N* (No)	→No (5)	→Institutionalized (7)	→Dead (8)	Weighted *N* (Yes)
Mobility								
Walking								
Arthritis	25.7	1.4	8.5	1,678	23.8	7.2	16.8	727
Nonarthritis	13.0	2.2	9.3	1,999	18.9	8.0	28.4	296
	***	*	n.s.		n.s.	n.s.	***	
Getting outside								
Arthritis	11.6	2.0	8.9	2,020	22.9	9.1	22.5	380
Nonarthritis	5.8	2.3	9.8	2,114	19.1	10.6	34.2	183
	***	n.s.	**		n.s.	n.s.	***	
Motions/strengths								
Walk 1/4 mile								
Arthritis	22.2	1.4	7.1	1,305	18.5	5.6	16.7	1,026
Nonarthritis	13.4	1.9	6.7	1,716	17.4	6.6	29.1	540
	***	n.s.	n.s.		n.s.	n.s.	***	
Climb 10 steps								
Arthritis	18.6	1.5	8.7	1,397	23.6	6.1	16.0	868
Nonarthritis	11.4	1.9	8.0	1,780	21.1	7.6	28.9	419
	***	n.s.	n.s.		n.s.	n.s.	***	

Stand 2 hours								
Arthritis	33.5	0.9	7.7	1,093	12.5	5.4	14.8	1,185
Nonarthritis	21.7	2.2	7.4	1,582	15.9	5.6	24.6	600
	***	**	n.s.		**	n.s.	***	
Sit 2 hours								
Arthritis	15.5	3.0	10.5	1,997	44.6	4.3	15.3	368
Nonarthritis	7.7	2.8	11.5	2,117	49.3	()[b]	20.0	137
	***	n.s.	n.s.		**	n.s.	n.s.	
Stoop								
Arthritis	33.0	1.3	7.7	1,002	22.3	4.6	13.5	1,373
Nonarthritis	18.3	2.2	8.0	1,602	24.8	5.1	21.7	646
	***	n.s.	n.s.		**	n.s.	***	
Reach up								
Arthritis	16.2	2.4	9.7	1,776	31.0	5.7	15.7	584
Nonarthritis	10.3	2.9	10.8	2,001	37.0	()	20.3	254
	***	n.s.	n.s.		**	n.s.	n.s.	
Reach out								
Arthritis	3.0	3.1	10.6	2,324	51.4	()	29.3	69
Nonarthritis	1.8	2.9	11.5	2,243	52.9	()	28.7	44
	**	n.s.	n.s.		n.s.	n.s.	n.s.	
Grasp								
Arthritis	11.4	3.1	9.7	1,978	39.8	3.7	17.4	421
Nonarthritis	5.0	2.8	11.2	2,151	41.1	()	19.4	135
	***	n.s.	n.s.		n.s.	n.s.	n.s.	
Lift 25 lb.								
Arthritis	32.0	1.6	7.9	1,063	14.6	4.7	14.4	1,215
Nonarthritis	22.3	1.7	8.0	1,481	19.4	5.6	21.5	690
	***	n.s.	n.s.		**	n.s.	***	

(continued)

Table 3 Continued

	Percentage with No Difficulty t0 who moved to t1 status named				Percentage with Yes Difficulty t0 who moved to t1 status named			
	→Yes (2)	→Institutionalized (3)	→Dead (4)	Weighted *N* (No)	→No (5)	→Institutionalized (7)	→Dead (8)	Weighted *N* (Yes)
Motions/strengths								
Lift 10 lb.								
Arthritis	18.0	2.0	8.9	1,839	22.2	7.5	20.1	509
Nonarthritis	10.6	2.2	9.8	2,021	25.9	8.5	28.5	269
	***	n.s.	n.s.		**	n.s.	***	
Personal care								
Bathe								
Arthritis	11.4	2.1	8.9	2,034	25.0	8.9	22.7	372
Nonarthritis	8.2	2.3	9.6	2,118	13.8	11.1	37.7	179
	***	n.s.	n.s.		*	n.s.	***	
Dress								
Arthritis	7.3	2.2	9.6	2,177	28.7	12.0	24.6	228
Nonarthritis	5.0	2.5	10.1	2,188	15.0	11.3	43.4	111
	***	n.s.	n.s.		n.s.	n.s.	***	
Eat								
Arthritis	4.1	2.9	10.4	2,345	33.8	( )	36.7	61
Nonarthritis	2.1	2.8	11.2	2,259	( )	( )	44.2	39
	***	n.s.	n.s.		n.s.	n.s.	n.s.	
Transfer								
Arthritis	14.6	2.4	9.6	2,083	29.0	8.1	20.1	323
Nonarthritis	7.3	2.6	10.3	2,174	17.7	9.5	38.9	121
	***	n.s.	n.s.		n.s.	n.s.	***	
Toilet								
Arthritis	5.6	2.7	9.5	2,238	30.2	9.7	32.1	162
Nonarthritis	3.2	2.6	10.4	2,201	18.3	12.1	42.4	94
*	***	n.s.	n.s.		n.s.	n.s.	*	

Household management								
Prepare meals								
Arthritis	9.2	2.3	9.0	2,147	18.6	10.3	28.0	252
Nonarthritis	5.4	2.4	10.1	2,143	11.8	11.9	37.0	143
	***	n.s.	n.s.		n.s.	n.s.	*	
Shop								
Arthritis	12.4	1.9	8.3	1,962	19.6	8.9	23.2	435
Nonarthritis	7.4	1.9	9.7	2,049	15.6	11.7	29.5	243
	***	n.s.	n.s.		n.s.	n.s.	*	
Manage money								
Arthritis	8.8	2.6	9.2	2,225	21.6	10.9	35.1	169
Nonarthritis	6.5	2.4	10.3	2,146	13.5	11.5	34.7	141
	n.s.	n.s.	n.s.		n.s.	n.s.	n.s.	
Use phone								
Arthritis	10.7	2.7	9.8	2,236	15.3	9.8	28.1	158
Nonarthritis	9.8	2.5	10.6	2,154	10.4	9.9	30.6	133
	n.s.	n.s.	n.s.		n.s.	n.s.	n.s.	
Heavy housework								
Arthritis	28.4	1.8	8.3	1,531	16.1	5.6	16.1	856
Nonarthritis	19.6	2.0	9.0	1,857	14.9	7.2	24.6	420
	***	n.s.	n.s.		n.s.	n.s.	***	
Light housework								
Arthritis	8.6	2.3	8.8	2,111	23.7	9.7	28.1	267
Nonarthritis	5.7	2.4	10.3	2,132	16.1	12.1	36.1	141
	***	n.s.	n.s.		n.s.	n.s.	*	

a. See Table 2, Note d.

b. ( ) = weighted $N < 10$.

*$.05 < p \leq .10$; **$.01 < p \leq .05$; ***$p \leq .01$; n.s. $p > .10$. Tests are for subtables that compare outcomes for arthritis versus nonarthritis persons, contingent on a t0 status. For example, the first column compares "No" t0 → "Yes" t1 for the two groups.

just discussed. For example, the lower mortality rates for arthritis people may be due, in part, to the high representation of females. Nevertheless, when tables are run separately for each sex, the findings about disability *incidence* and *recovery* are repeated. The findings about *institutionalization* (higher for nonarthritis) persist for women; results for men are unclear due to small *N*s. *Mortality* differences appear strongly among men: Men without arthritis are much more likely to die than those with arthritis, regardless of initial disability status. Among women, this difference appears only for those disabled at t0, and it is weaker.

Transitions for Four Subgroups

Arthritis and nonarthritis people differ in overall morbidity (4.3 vs. 2.4 chronic conditions), so the interpretations about the differences need further evaluation. The four subgroups provide better control of morbidity; the average number of chronic conditions is 0.0 for Zero CC, 1.0 for Arth Only, 2.9 for Other CC, and 4.6 for Arth Plus. Transition tables for Arth Only, Other CC, and Arth Plus were prepared (available on request). The Zero CC group was dropped because of its extremely low levels of disability (thus small cell counts).

The Arth Only and Arth Plus groups are compared with the Other CC group. All results above continue to hold true: (a) *Disability incidence*—although Arth Only people are on average "less sick" than Other CC people, they are more likely to incur physical disability. They are less likely to develop ADL and IADL disabilities. Arth Plus people have higher incidence of all kinds of disability than do Other CC people; they are on average "more sick" than the Other CC group. (b) *Disability recovery*—Arth Plus people show greater recovery of ADL and IADL functions and walking (despite being "more sick") and less recovery of all other physical functions, than the Other CC group. There are too few cases of Arth Only for these comparisons. (c) *Institutionalization and death*—Both Arth Plus and Arth Only have much lower risks of institutionalization and death than do Other CC people, regardless of initial disability.

In sum, the results buttress the explanations about the distinctive consequences that arthritis has for people's functioning over time.

Table 4
Disability Transitions: Any Difficulty and IADL-ADL Hierarchy Items (in percentages)

Full transition tables (Cells 1-8) are shown. Results are for Initial Community Dwellers. t0 is 1984; t1 is 1986.

Any Physical Difficulty t1:	No	Yes	Inst	Dead		Weighted *N*
t0: No						
Arthritis	41.9	50.1	()[a]	7.4	100.0	554
Nonarthritis	57.9	34.8	1.5	5.8	100.0	1,207
		***	n.s.	n.s.		
Yes						
Arthritis	8.7	75.3	3.9	12.1	100.0	1,860
Nonarthritis	13.1	64.1	4.5	18.3	100.0	1,112
	**		n.s.	***		
Any ADL Difficulty t1:	No	Yes	Inst	Dead		
t0: No						
Arthritis	69.2	20.6	1.7	8.5	100.0	1,865
Nonarthritis	76.5	12.3	2.1	9.2	100.0	2,090
		***	n.s.	n.s.		
Yes						
Arthritis	21.3	51.1	7.9	19.7	100.0	549
Nonarthritis	14.0	40.4	10.5	35.1	100.0	236
	*		n.s.	***		
Any IADL Difficulty t1:	No	Yes	Inst	Dead		
t0: No						
Arthritis	69.3	20.9	1.8	8.0	100.0	1,856
Nonarthritis	74.2	14.8	1.7	9.3	100.0	1,985
		***	n.s.	n.s.		
Yes						
Arthritis	15.4	52.3	11.2	21.1	100.0	553
Nonarthritis	12.8	50.1	10.5	26.6	100.0	319
	n.s.		n.s.	*		
IADL-ADL Hierarchy t1:	No Difficulty	IADL Only	Any ADL	Inst	Dead		Weighted *N*
t0: No IADL/ADL Difficulty							
Arthritis	63.0	9.6	18.5	1.6	7.3	100.0	1,662
Nonarthritis	71.2	7.8	10.8	1.6	8.6	100.0	1,917
		***		n.s.	n.s.		
IADL Difficulty Only							
Arthritis	15.7	25.7	37.3	()	18.4	100.0	198
Nonarthritis	16.2	32.4	28.8	8.3	14.3	100.0	151
		**		**	n.s.		

(continued)

Table 4 Continued

IADL-ADL Hierarchy

t1:	No Difficulty	IADL Only	Any ADL	Inst	Dead		Weighted *N*
Any ADL Difficulty							
Arthritis	14.7	6.6	51.3	7.9	19.5	100.0	548
Nonarthritis	7.2	6.9	40.3	10.5	35.1	100.0	236
		**		n.s.	***		

a. ( ) = weighted $N < 10$.
*.05 < $p \leq .10$; **.01 < $p \leq .05$; ***$p \leq .01$; n.s. $p > .10$. Tests are for subtables that compare outcomes for arthritis versus nonarthritis persons, contingent on a t0 status. For example, the first column compares "No" t0 → "Yes" t1 for the two groups. Tests are done for transitions, not for stasis.

DISABILITY TRANSITIONS: GLOBAL ITEMS

The specific disability items were condensed: (a) *Any Difficulty* — A transition table for Any Physical Difficulty (yes if person has difficulty on any of the 12 items) was prepared. Similarly, tables for Any ADL Difficulty (yes on any of 5 items) and Any IADL Difficulty (yes on any of 6 items) were prepared. (b) *IADL-ADL Hierarchy* — Further condensation occurred by pooling the IADL and ADL domains in a hierarchical manner (No IADL/ADL Difficulty, IADL Difficulty Only, Any ADL Difficulty). Table 4 shows the transition tables.

The Any Difficulty tables repeat the findings of higher disability incidence and higher restoration of ADL and IADL functions for arthritis people and higher institutionalization, death, and return of physical functions for nonarthritis people. The variations by gender reported earlier persist (not shown). The IADL-ADL Hierarchy tables reach the same conclusions, and they add two new pieces of information: (a) Arthritis people advance in the hierarchy (IADL Only→Any ADL; t0→t1) more readily than nonarthritis people do. This is true for both men and women. (b) Arthritis people are especially able to restore ADL functions (Any ADL→No Difficulty) than other people; this is true for both sexes. Their ability to restore IADL functions (IADL Only→No Difficulty) is comparable to other people. Subtables to test the arthritis versus nonarthritis differences are all significant ($p \leq .05$), with just one exception.

MULTIVARIATE MODELS OF CHANGE

Now, the distinctive impact of arthritis is quantified by estimating multivariate models that control for potential confounders (linked to both arthritis and disability).

Status at t1

First, models that use sociodemographic and t0 disability items to predict t1 status are shown. The basic model is this: Status t1 = *f*(Age, Gender, Race, Morbidity t0, Disability t0 × Arth). Age categories are 70 to 74, 75 to 79, 80 to 84, 85 and over. Race categories are White, non-White. Morbidity t0 is the total number of chronic conditions counted in the initial interview; categories are 0,1,2, . . . ,10+. Disability t0 refers to a specific activity; Disability t0 × Arth is a cross-variable with four categories (No Difficulty-Arthritis, No Difficulty-Nonarthritis, Yes Difficulty-Arthritis, Yes Difficulty-Nonarthritis), allowing us to measure the arthritis effect for each t0 status.

We are interested in three t1 statuses: difficulty in a specific activity, institutional residence, and dead. The basic model is estimated for each. Stated plainly, one estimated model shows how disability at t0 predicts presence of the same kind of disability at t1. Another shows how that disability at t0 predicts institutional residence at t1; and the third, how it predicts death by t1. The set of three models is estimated for each specific disability item ($n = 23$). Altogether, 69 MCA models are estimated. The results are extensive; for illustration, Table 5 shows the adjusted means for the central predictor Disability t0 × Arth, for 15 models.

The following summarizes the results of all models: (a) The probability of having *difficulty at t1* (in any specific item) increases with age and total morbidity, and is higher for females and non-Whites. Arthritis persons have higher incidence of disability (empirically, the adjusted means are higher for No Difficulty-Arth than for No Difficulty-Nonarth). Arthritis persons have higher recovery of ADL, IADL, and walking functions (adjusted means are lower for Yes Difficulty-Arth than Yes Difficulty-Nonarth; see Table 5, Note a). But nonarthritis persons have higher recovery for all other physical functions. (b) The probability of

Table 5
Prediction Models of Yes Difficulty, Institutional, and Dead Statuses at t1

The model is this: Status t1 = *f*(Age, Gender, Race, Morbidity t0, Disability t0 × Arth).[a] The column title is the Disability t0 predictor used in a given equation. It is used in three separate equations: to predict the same kind of disability at t1 (Yes Difficulty t1), Institutional Residence at t1, and Dead by t1. The grand mean is the overall proportion with the status t1 (Yes Difficulty t1, Institutional, Dead). Adjusted means for the main predictor (Disability t0 × Arth) are shown. Adjusted means for age, gender, race, and morbidity are not shown. Results are for Initial Community Dwellers.

Disability t0:	Walking	Standing	Light lifting	Bathing	Heavy housework
Yes Difficulty t1					
Grand mean	.299	.483	.219	.158	.390
Adjusted means for Disability t0 × Arth					
No Difficulty-Arthritis	.272	.360	.173	.114	.302
No Difficulty-Nonarthritis	.195	.300	.153	.123	.295
Yes Difficulty-Arthritis[b]	.595	.776	.580	.554	.671
Yes Difficulty-Nonarthritis[b]	.634	.740	.518	.651	.708
Institutional					
Grand mean	.031	.030	.030	.031	.030
Adjusted means for Disability t0 × Arth					
No Difficulty-Arthritis	.015	.012	.020	.021	.021
No Difficulty-Nonarthritis	.027	.028	.026	.028	.027
Yes Difficulty-Arthritis[b]	.058	.042	.056	.069	.042
Yes Difficulty-Nonarthritis[b]	.069	.047	.073	.098	.061
Dead					
Grand mean	.114	.113	.113	.114	.114
Adjusted means for Disability t0 × Arth					
No Difficulty-Arthritis	.090	.085	.086	.088	.086
No Difficulty-Nonarthritis	.107	.087	.103	.107	.101
Yes Difficulty-Arthritis[b]	.132	.121	.164	.185	.136
Yes Difficulty-Nonarthritis[b]	.247	.220	.261	.334	.224

a. R^2s (adjusted for degrees of freedom) are typically .200-.250 for Yes Difficulty t1, .030 for Institutional, .070 for Dead. Low values for Institutional and Dead are due to small model (few predictors) and low proportions in those statuses.
b. The Yes Difficulty values are proportions who continued to have difficulty. Thus return to function is 1.000 minus that value. For example, proportions who recover walking ability are .405 (1.000-.595) for arthritis persons and .366 (1.000-.634) for nonarthritis persons.

being *institutionalized* increases with age and morbidity, and it is higher for females and Whites. Regardless of initial disability, non-arthritis people become institutional residents more readily than ar-

Table 6
Prediction Models of Any Difficulty, Institutional, and Dead Statuses at t1

The model is this: Status t1 = *f*(Age, Gender, Race, Morbidity t0, Any Difficulty t0 × Arth).[a] The column title is the Difficulty t0 to predictor used in a given equation. It is used in three separate equations: to predict the same kind of disability at t1 (Any Difficulty t1), Institutional Residence at t1, and Dead by t1. The grand mean is the overall proportion with the status t1 (Any Difficulty t1, Institutional, Dead). Adjusted means for the main predictor (Any Difficulty × Arth) are shown. Adjusted means for other predictors are not shown. Results are for Initial Community Dwellers.

Any Difficulty t0:	Any Physical Difficulty	Any ADL Difficulty	Any IADL Difficulty
Any Difficulty t1			
Grand mean	.694	.251	.285
Adjusted means for Any Difficulty t0 × Arth			
No Difficulty-Arthritis	.548	.214	.222
No Difficulty-Nonarthritis	.445	.179	.216
Yes Difficulty-Arthritis[b]	.850	.612	.651
Yes Difficulty-Nonarthritis[b]	.821	.655	.708
Institutional			
Grand mean	.030	.030	.031
Adjusted means for Any Difficulty t0 × Arth			
No Difficulty-Arthritis	.012	.018	.020
No Difficulty-Nonarthritis	.026	.025	.022
Yes Difficulty-Arthritis[b]	.032	.064	.059
Yes Difficulty-Nonarthritis[b]	.042	.094	.096
Dead			
Grand mean	.114	.114	.113
Adjusted means for Any Difficulty t0 × Arth			
No Difficulty-Arthritis	.094	.088	.083
No Difficulty-Nonarthritis	.077	.102	.108
Yes Difficulty-Arthritis[b]	.108	.164	.168
Yes Difficulty-Nonarthritis[b]	.175	.314	.230

a. R^2s are about .250 for Any Difficulty t1, .030 for Institutional, .070 for Dead.
b. The Yes Difficulty values are proportions who continued to have difficulty. Thus return to function is 1.000 minus that value. For example, proportions who recover physical function (so they have No Difficulty at t1) are .150 (1.000-.850) for arthritis persons and .170 (1.000-.821) for nonarthritis persons.

thritis people do. Their risk is especially pronounced if ADL or IADL difficulties were present at t0. (c) The probability of *death* increases with age and morbidity, and it is higher for males; no net difference by race. Nonarthritis persons are more likely to die regardless of initial

disability. As noted earlier, their risk is especially elevated when they had mobility or ADL problems at t0.

Additional Models

Two other sets of models that condense the disability items were computed. These are described very tersely; that can cause confusion, so readers are encouraged to focus on the summaries of results.

Any Difficulty. Any Difficulty t0 in a domain (physical, ADL, IADL) was used to predict three t1 statuses: any difficulty in the same domain, institutional residence, dead. The basic model is this: Status t1 = *f*(Age, Gender, Race, Morbidity t0, Any Difficulty t0 × Arth). Altogether, 9 MCA models are estimated (3 Any Difficulty items × 3 t1 statuses). Results are in Table 6.

These general models repeat the results found for specific items. Again, the probability of any difficulty rises with age and morbidity and is higher for non-Whites; sex differences are inconsistent. Arthritis people experience higher incidence for all items, higher restoration of ADL and IADL functions, and lower restoration of physical ones. Results for institutional residence and death are the same as before.

Disability counts. The number of physical limitations were counted at t0 and at t1; similarly for ADLs and for IADLs. Numerical differences (t1 – t0) were calculated and these serve as the dependent variables. Models that predict the direction and size of change were estimated. The basic model is this: Change t1 – t0 = *f*(Age, Gender, Race, Morbidity t0, Arth). Because MCA requires a dichotomous Y, four versions of Change t1 – t0 were tried: More (t1 – t0 ≥ 1), Much More (≥ 2), Less (≤ –1), Much Less (≤ –2).[5] Altogether, this produced 12 MCA models (3 count items × 4 models).

New results are as follows: (a) Arthritis people tend to *increase* disability level over time more than do their nonarthritis peers. This extends the finding about higher incidence. (b) Arthritis people also tend to *decrease* their social disability levels over time more than do nonarthritis people but decrease their physical disability levels less. This extends our prior finding about recovery.

Discussion and Conclusion

Other studies have highlighted the disability impact of arthritis (Acheson & Ginsburg, 1973; Aniansson, Rundgren, & Sperling, 1980; Baron, Dutil, Berkson, Lander, and Becker, 1987; Kramer, Yelin, & Epstein, 1983; Liang et al., 1984; Pincus, Mitchell, & Burkhauser, 1989).[6] This study is one of the first to look at dynamic aspects for a population-based sample (see also the section on Background). The following summarizes the results: (a) People ages 70 and over with arthritis have higher levels of physical, ADL, and IADL disability than do nonarthritis people those ages. (b) Arthritis people acquire disabilities at a faster pace than nonarthritis people do. (c) But over time, disabled people with arthritis regain ADL/IADL functions and basic mobility (walking) better than do disabled people with other chronic conditions. They are, however, less likely to regain physical functions that require endurance, strength, or dexterity. These results are consistent but statistically weaker than others; they require study in other samples for confirmation. (d) Arthritis people are less likely to be institutionalized or die than are their nonarthritis peers. All of these results appear in simple transition tables and persist when controls for age, gender, race, and total morbidity are included.

What accounts for this distinctive profile of disability levels and dynamics for arthritis people? We think it can be explained by medical and social factors; namely, by the musculoskeletal locale of arthritis, its moderate rather than severe impact, and its nonfatal nature, and by people's ability to cope with the disease. (a) Arthritis's toll is common and pervasive in life's activities. The data show this in the higher disability prevalence for all items among arthritis persons. Rising disability prevalence over time means that disability gradually accumulates in the arthritis group (function losses exceed restorations); this is most likely due to gradual progression of the disease.[7] (b) The musculoskeletal system is central to basic physical and social functioning. Arthritis causes musculoskeletal impairments such as decreased flexibility, malalignment, decreased strength, and swelling. These have direct and pronounced impacts on physical functioning, and thence to social functions (here ADL and IADL items) that depend closely on physical abilities. The timing of impact relative to disease

duration is not studied here, but finding a strong effect for pooled durations suggests that effects occur at all stages. (c) The main form of arthritis (osteo) is slowly progressive, and no existing medical therapies reverse the pathological process. Not surprisingly, its physical impacts tend to endure. But the social consequences can be remedied by taking drugs that reduce pain and inflammation and by doing tasks in a more limited or roundabout manner than before. People with other kinds of conditions (not differentiated in this analysis) recover physical functions more readily but are less successful in making accommodations in their social activities. (d) Because arthritis has moderate disability impact compared to other prominent conditions, people are able to remain living at home rather than being institutionalized. Arthritis is nonfatal compared to many prominent diseases in late life. Lower mortality does not reflect any "protective" feature of arthritis, but instead the life-threatening nature of other diseases.

One theme that emerges from this analysis is the crucial importance of the musculoskeletal system for tasks of everyday life. Because impairments there are seldom life-threatening, the system is often overlooked. We argue that, instead, it deserves very special attention in studies of late-life health and function.

The frequent coexistence of arthritis and disability prompts these questions: Can arthritis be avoided? After diagnosis, can it be slowed? Can disability due to arthritis be avoided? These speak to primary, secondary, and tertiary prevention respectively.

(a) *Primary prevention*—Current knowledge about etiologies of osteo (and also rheumatoid) arthritis is quite limited. There is not much that people can do to prevent or delay arthritis onset.[8] (b) *Secondary prevention*—When arthritis is diagnosed, medical therapies are used to reduce the main symptoms, namely pain and inflammation. There is no established medical therapy that slows or reverses the disease process for OA; there are such therapies for rheumatoid arthritis. Current interest to identify effective therapeutic regimens for osteoarthritis (OA) has spurred development of standardized outcome instruments and their use in clinical trials (Anderson, Firschein, & Meenan, 1989; Bellamy & Buchanan, 1984, 1985; Bellamy, Buchanan, Goldsmith, Campbell, & Stitt, 1988; Brandt & Flusser, 1991; Doyle,

Dieppe, Scott, & Huskisson, 1981; Liang, Larson, Cullen, & Schwartz, 1985; Mason, Anderson, & Meenan, 1989; Meenan, Gertman, Mason, & Dunaif, 1982). (c) *Tertiary prevention*—Given the current limits to knowledge about disease etiology and disease-modifying therapies, the focus of professional and personal care for arthritis eventually becomes disability. Health professionals devise drug and exercise regimens to help people maintain their current abilities or improve them. Similarly, self-care regimens aim to bolster function in the presence of disease.

This analysis reveals both disappointing and welcome aspects of arthritis disability: the high pace of disability onset for arthritis people, but also the apparent success many have in restoring social abilities. Personal tenacity and imagination, combined with some physicians' orientation to function rather than to pathology, lie behind those successes. Public policies and programs can join in such success by fostering public access and worksite modifications, technology improvements in special aids, psychosocial coping to chronic disease, weight reduction, and regular physical recreation.

NOTES

1. For readers familiar with SOA and LSOA, the following is noted: (a) The SOA has a direct question about arthritis presence ("During the past 12 months, did you have arthritis of any kind or rheumatism?" Yes, No). It is not used here. Instead, the final ICD-coded conditions are used. The overlap between the two approaches is high: Of persons with ICD-coded arthritis, 99.5% said "yes" to the direct question; of those with no ICD-coded arthritis, 94.7% said "no" to the question. (b) For this analysis, arthritis presence is not contingent on disability (i.e., saying "yes" to a limitations question, then stating that arthritis causes the limitation). Everyone was asked about arthritis and had an opportunity to state its presence or absence.

2. Use of the four subgroups was initiated by our team (Verbrugge, Lepkowski, & Konkol, 1991). Yelin and Katz (1989) also find the categories useful for their analysis and estimates.

3. For the four subgroups, age increases from Zero CC to Arth Plus; the two arthritis subgroups are more female; race differences are minimal. Tables were not run by age or sex because of small cell sizes.

4. This count captures morbidity in a global way. The strategy for querying chronic conditions in NHIS/SOA is complex, and this variable should be viewed as an ordinal measure (count may be incomplete, but higher scores do reflect worse health). A reviewer noted that (a) an index based on severity as well as number or (b) predictor variables for other conditions might provide even better control for comorbidities. For the first option, a severity weight would be assigned to condition titles; this procedure is not very suitable for the SOA because of the incomplete scope just mentioned. Elsewhere, the second option was used to study cross-section

disability (Verbrugge, Lepkowski, & Imanaka, 1989). There, equations with a simple count and those with condition-specific predictors produce similar *R*-squared values. All in all, the count is a good indicator of comorbidity and suitable to the data set's structure.

5. Models that also include a control for initial disability (number of limitations/ADL/IADL at t0) repeat the findings noted.

6. The references discuss osteoarthritis disability. Research on rheumatoid arthritis disability is more extensive (e.g., Badley, Lee, & Wood, 1979; Meenan, Yelin, Henke, Curtis, & Epstein, 1978; Meenan, Yelin, Nevitt, & Epstein, 1981; Mitchell, Burkhauser, & Pincus, 1988; Pincus et al., 1984; Reisine, Grady, Goodenow, & Fifield, 1989). For more references on arthritis disability, see review in Verbrugge (1990b).

7. Whether arthritis prompts development of other disabling chronic conditions is not known; one reviewer asked about this.

8. There are two exceptions: avoiding being overweight and avoiding activities that can injure joints. Overweight people are more likely to develop arthritis (Anderson & Felson, 1988; Davis, Ettinger, Neuhaus, & Hauck, 1988; Felson, Anderson, Naimark, Walker, & Meenan, 1988). And among people with the disease, overweight exacerbates disability (Verbrugge, Gates, & Ike, 1991). Thus weight control is likely to help prevent both arthritis and arthritis disability. For review of joint injury and arthritis, see Felson (1988).

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