

Managing High-Risk Elders. A small share of “high-risk” elders are responsible for a disproportionately high share of medical care expenditures. Such high-risk elders are subject to repeated hospitalizations and can be identified with an eight-item scale called the Probability of Repeated Admissions (P_{ra}). Items include self-rated health, hospital stays over the prior 12 months, number of physician visits in the prior 12 months, diabetes, heart disease (coronary heart disease, angina, myocardial infarction), gender, presence of a person “who would take care of you for a few days, if necessary,” and age. Once the high-risk elder is identified, this person’s medical care should be managed to maximize effective treatment and minimize disability. Three areas of progress in this area, offering major benefit to older people, include geriatric evaluation and management, self-management of chronic disease, and reduction in polypharmacy.

5

Disability and Functioning

Disability and functioning are central outcomes for public health and aging. The prevalence of chronic disease increases with older ages, as does the development of senescent changes that lead to frailty. As such, older people are at risk for dropping below the thresholds of physical, cognitive, affective, and sensory functioning required for safe, independent, and efficient completion of everyday self-maintenance and domestic-related tasks and for participation in social and community life. Self-maintenance tasks include, the basic “activities of daily living”: bathing, dressing, grooming, feeding oneself, and getting to and using the toilet. Domestic-related activities include getting groceries, preparing meals, cleaning clothes, and performing everyday household chores. Participation restrictions refers to reduced involvement for reasons related to functioning in major life activities such as working, volunteering, or caring for others, or in social or community activities, such as participating in organized activities or attending religious events.

As we will see, the term “disability” is not used consistently by those conducting research on aging or by those working in public health. In this chapter, we use disability as a broad term that encompasses reductions in physical, cognitive, affective, and sensory functioning, difficulty with self-maintenance and domestic-related tasks, and restrictions in the ability to participate in productive, social, and community life. When

compensatory mechanisms (such as environmental modification, use of assistive technology, or other behavior adaptations) are unavailable or no longer suffice for completion of tasks that have become difficult, older adults may need the assistance of other people to manage their daily lives. Individuals who adopt such compensatory strategies, even if they do not report having difficulty with daily activities, are also included under the disability umbrella to the extent that they are at increased risk for developing limitations.

Public health and aging professionals benefit from the perspectives of many fields as they attempt to understand the intersection between disability and aging. Demographers have focused largely on the population-level trends in disability, their causes, and identifying high-impact opportunities for intervention. Epidemiology has been concerned with identifying risk factors for the onset of activity limitations and functional decline, and more recently with understanding trajectories that individuals follow from onset through end of life. Clinical geriatrics emphasizes prevention of the loss of capacity and, in the face of such loss, the deceleration or mitigation of the effects of such losses on the progression of basic activity limitations—difficulty and dependence in bathing, dressing, eating, toileting, and basic mobility. The rehabilitation and professional therapy fields (occupational, physical, and speech) have focused on regaining and maintaining antecedent skills and making changes to the environment that translate into participation in a much broader range of activities.

The field of public health and aging draws on each of these perspectives but yet maintains a unique focus on implementing programs to create the conditions under which older adults can maintain and maximize physical function well into late life. To some extent, each of these fields speaks a slightly different language, so we begin this chapter with a review of the language and measurement of disability.

THE LANGUAGE OF DISABILITY

Well-trained graduate students know that before formulating a research hypothesis, whether for their thesis, dissertation, or graduate course in Public Health and Aging, they should first review and synthesize the relevant literature on their topic. Now imagine you are interested in designing a public health intervention to prevent the onset of disability among older adults through physical activity. A Medline search of studies using key words “exercise,” “prevent,” and “disability” with limitation

fields set to find only clinical or randomized trials and age group 65 and older, yields 10 articles. After eliminating the five that do not actually examine disability or functioning as an end point in a trial, the remaining five studies define and operationalize disability (or functioning) in at least four different ways: (a) impairments in physical capacity related to mobility including strength, gait, and functional reach; (b) speed of performance of daily tasks and/or walking; (c) self-reports of difficulty with self-maintenance; and (d) self-reports of difficulty or the need for personal assistance with self-maintenance or mobility.

Such a finding—that the term disability is used at least a half a dozen different ways—is not atypical in the study of disability and aging. In some studies, the term may mean having impaired physical functioning; in others, it may mean reporting difficulty with daily activities, needing help with such activities, or receiving help. Policy discussions around public health goals for disability have been hampered by such a lack of a universally accepted and understood terminology. Not only have researchers used the term to connote a variety of concepts about undertaking activities important in daily life, but federal policies also use an equally wide range of definitions. A search of the United States Code found 67 acts or programs that define disability in at least 14 different ways (CESSI, 2003). Whether discussing the size of the population with late-life disabilities or interventions to minimize avoidable dependency, diminished quality of life, and lost productivity of older individuals and family members, the clarity surrounding such conceptual distinctions is critically important.

Recognizing the absence of universally accepted and understood terms and concepts as a major barrier to consolidating knowledge about disability and developing interventions to maximize functioning, the Institute of Medicine’s Committee on the Future of Disability in America recommended in its 2007 report the adoption and refinement of the World Health Organization’s International Classification of Functioning, Disability and Health (ICF) as the language for disability monitoring and research.

The International Classification of Functioning, Disability and Health (ICF)

The ICF language is presented in Table 5.1. The framework starts with the concept of *health conditions*, which encompasses disease, disorders, injuries, and trauma. Examples of health conditions include cataracts, chronic obstructive pulmonary disease (COPD), or congestive heart

failure (CHF). *Impairments* may occur to either body functions (for example, impaired vision, reduced lung function, or reduced cardiac function) or body structures (loss of a lens or narrowing of a heart valve). *Activity limitations* are difficulties an individual may have in executing activities related to learning, communicating, mobility, self-care, or domestic life. *Participation restrictions* are problems an individual may experience in involvement in life situations such as school, work, or community life.

Disability and functioning are used as umbrella terms, rightly reflecting the myriad of uses that currently exist in the research, public health, and policy spheres. In fact, in the pictorial representation of the ICF, the terms do not appear at all (Figure 5.1).

What do appear are the terms “environmental factors” and “personal factors,” and these clearly influence and are influenced by all other functioning domains. Environment is defined broadly in the ICF to include products and technologies, the physical environment and human-made changes to it, and attitudes, as well as services, systems, and policies. Personal factors are contextual factors related to the individual, such as age, gender, social status, and life experiences.

Table 5.1

MAJOR CONCEPTS IN THE INTERNATIONAL CLASSIFICATION OF FUNCTIONING DISABILITY AND HEALTH

- Health condition:** includes disease, disorder, injury, or trauma
- Impairment in body function or structure:** problems in body function or structures, including physical, mental, and sensory
- Activity limitation:** difficulties in executing activities related to learning, communicating, mobility, self-care, or domestic life
- Participation restriction:** problems in involvement in life situations such as school, work, or community life
- Disability:** umbrella term for impairments, activity limitations, and participation
- Functioning:** umbrella term for body functions and structures, activities, and participation

Adapted from *The Future of Disability in America* (p. 38, Box 2-1), by Institute of Medicine, 2007, Washington, DC: National Academies Press.

Embedded in the various documents that accompany the classification system, including the introductory guide (World Health Organization [WHO], 2002), is another important distinction between the *capacity* to carry out activities and the actual *performance* of those activities. The former relates to an individual’s ability to function without aids or help from another person, whereas performance concerns itself with whether, how often, and with what supports an individual actually carries out particular activities.

Thus, the revised WHO model blends both social and medical models of disability. Disability is not an attribute of the individual, but rather a feature of person-environment relationships (WHO, 2001). In contrast, definitions that frame disability as exclusively caused by a health condition—with treatment of that condition the only focus—are symbiotic with the medicalized model of disability.

The ICF language, which has broad acceptance worldwide, offers several advantages for public health and aging. First, components can be expressed in both “positive and negative terms” (WHO, 2001, p. 10; e.g., functioning and disability), thus changing the dialogue from disability prevention to maximizing functioning. Second, it introduces the notion of participation in activities beyond those necessary for self-care

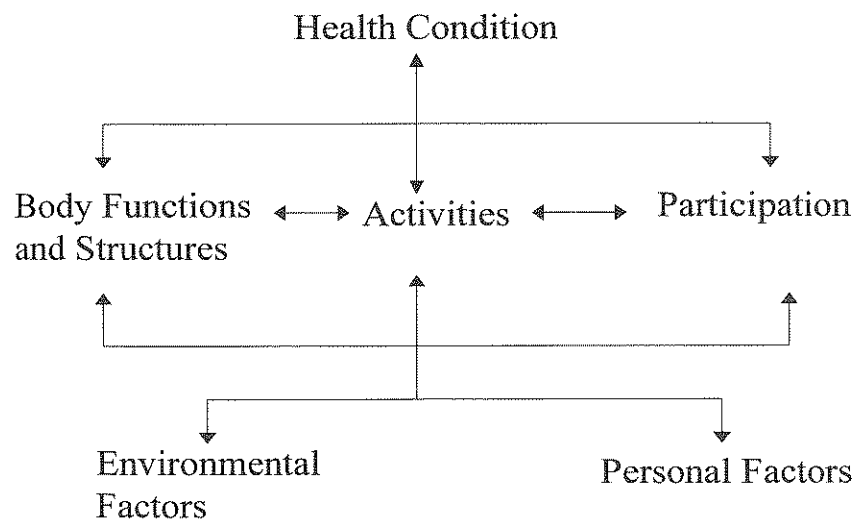


Figure 5.1 International Classification of Functioning, Disability and Health (ICF).

Source: From *International Classification of Functioning, Disability and Health*, by World Health Organization (p. 18), 2001, Geneva, Switzerland: Author.

(so-called ADLs) and domestic life (so-called IADLs). Gerontology and to some extent public health and aging has been almost singularly focused on these outcomes for many years. The ICF facilitates research and policy around additional activities and life situations that may be valued at different points in the life course. Third, in the ICF there is an explicit role for environmental factors of central interest to public health, including services, systems, and policies in filling the gap between capacity and performance.

Despite these advantages, the Institute of Medicine (2007) also pointed out several directions for refining and improving the ICF to better serve research and public policy purposes. The ICF does not currently offer crisp distinctions between activity and participation, an omission that researchers are working to rectify (Jette, Haley, & Kooyoomjian, 2003; Jette, Tao, & Haley, 2007). Current measures available in most surveys and studies of later life have measures that were developed in line with the Nagi disablement model (described below) and, therefore, do not map precisely into the ICF, making it difficult to use with many existing data resources. Nor does the ICF language link directly to quality-of-life measures and paradigms (see Chapter 8 for discussion of quality of life).

Finally, and perhaps most important in the public health and aging context, the ICF is not inherently a dynamic model. Like the International Classification of Diseases (ICD-10), the ICF is inherently a classification system that offers standardized internationally accepted language. For understanding dynamic relationships among factors predicting changes and maintenance of functioning, however, elements of the Nagi model of disablement (described below) remain useful to consider.

The Nagi Model of Disablement

The Nagi disablement model (Verbrugge & Jette, 1994) differs from the WHO approach in asserting a strict four-part temporal and causal sequence shown in Figure 5.2.

In the Nagi model, *pathology* (e.g., sarcopenia) first leads to *impairment* (e.g., lower extremity weakness evident in manual muscle testing). When lower extremity weakness crosses some threshold, *functional limitation* becomes evident, measurable perhaps in gait speeds below age- and gender-appropriate norms. When gait speed in turn drops below the minimum speed required to cross at a signaled intersection, a person is

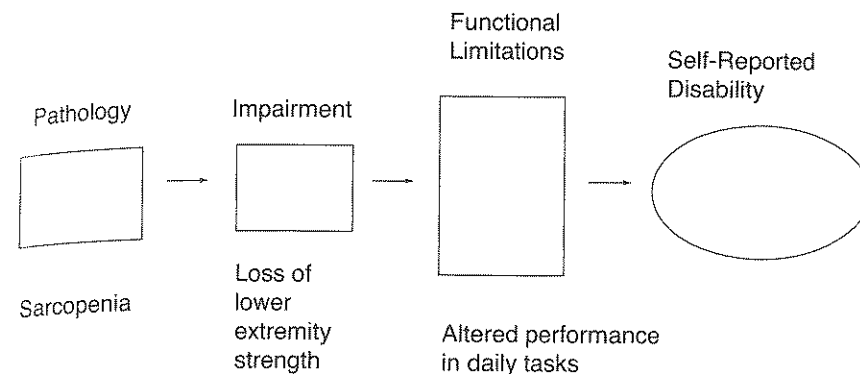


Figure 5.2 Nagi Disablement Model.

likely to report difficulty or a need for help crossing the street, that is, *disability*.

Note that in this framework, unlike in the ICF approach, the term disability more narrowly encompasses only: (a) *self-reported* difficulty or need for assistance, (b) a *need* rather than use or receipt of assistance, and (c) difficulty or need due to impairment, that is, a problem with one's *health*. The first condition construes disability as a matter of subjective evaluation. The second condition, the stress on need rather than on use, is important because it gives due recognition to unmet need (Allen & Mor, 1998). Only some of the elders with a need for assistance receive such assistance, so that restricting disability to the group actually receiving assistance would severely underestimate disability. Indeed, difficulty and dependence define important distinctions (Gill & Kurland, 2003), with the former more prevalent among older adults than the latter. Finally, the third condition requires that self-reports of disability be due to health conditions rather than solely to an environmental restriction, personal motivation, or other nonhealth sources of task restriction. This distinction may be hard to maintain in some cases, because environmental restrictions can also be considered legitimate targets for public health interventions and disease may affect motivation (as in the case of depression).

What of the older adult who uses personal assistance or equipment to complete ADL tasks? Ambiguity exists in the Nagi model, as specified above, as to whether this person would be considered to have a disability. In their elaboration of the model Verbrugge and Jette (1994) have made the additional important distinction between underlying

difficulty—the level of difficulty without help or special equipment—and residual difficulty—that is, with whatever assistance is generally used. (The former is similar to the notion of capacity in the ICF.) Agree and Freedman (2003) refer more generally to behavioral compensations for impairments, such as using personal care, update of devices, or altering the demands of the environment, as accommodations. Individuals who make such compensations to complete daily tasks and carry out social roles would be considered to have underlying disability but, depending on the effectiveness the compensation, perhaps not residual disability.

The Nagi model has been used as a framework to identify early signals for the development of disability later in life. One advantage of the Nagi model for such work is the solid tradition of measurement behind it (Guralnik & Ferrucci, 2009). Even in people who do not report mobility problems, for example, weakness in lower extremity strength predicts future mortality and onset of limitations in daily activities (Guralnik et al., 1995). Likewise, people who do not report difficulty in ADL but report they have changed the way they perform these tasks have an increased risk for incident mobility limitations (Fried et al., 1996, 2000). More recently, the Nagi model has been used as the basis for identifying older adults at risk for interventions designed to deter the onset of activity limitations (Pahor et al., 2006).

Yet the Nagi model also has some important limitations. Because the environment is not an explicit domain in the model, for example, the emphasis to date in the literature has been on individually focused rather than population-level levers to reduce activity limitations. Indeed, many public health interventions that might reduce residual difficulty in a population—for example, changing the timing of traffic lights or extending health insurance to cover assistive technologies or motorized wheelchairs that may be used to enhance participation—have been overlooked. The ICF, in contrast, makes clear that environmental factors influence all aspects of functioning.

The Nagi model also makes disability an outcome and uses a fairly narrow definition of disability. This approach has been criticized for neglecting other components of daily life, such as non-ADL activity and general participation in social life, which can be preserved even with severe ADL limitations, and which may be more important to personal identity and self-worth than independence in ADL. Studies focusing, for example, on the ill effects of social isolation (both objective and subjective) among frail older adults (Simonsick, Kasper, & Phillips, 1998) and the beneficial effects of social engagement, in particular, volunteerism

(e.g., Fried et al., 2004) might benefit from the more inclusive language that ICF has to offer.

Which approach is superior? The question sets up a false choice and is inappropriate because the ICF is not meant to describe disablement, but rather to inspire more extensive integration of environmental and personal factors into the management of impairing conditions. While the disablement model suggests clinical strategies, the ICF language offers a broader, common framework and language for taking action (Jette, 2009). As the authors state, if “disability is not an attribute of the individual, but rather a complex collection of conditions, many of which are created by the social environment,” then “the management of [disability] requires social action, and it is the collective responsibility of society at large to make the environmental modifications necessary for the full participation of people with disabilities in all areas of social life” (WHO, 2001, p. 20). Efforts to bring the ICF language into studies of aging with a dynamic context are in progress (see for example, Freedman, 2009).

THE MEASUREMENT OF DISABILITY

Centrality of the Activities of Daily Living in Measuring Late-Life Disability

Activity limitations have long been a central focus of studies of late-life disability. Indeed, avoiding difficulty and need for help with the tasks of everyday life has been a focal point of chronic disease research. Chronic disease can also cause symptoms or changes in physical, social, affective, and cognitive capacity, an increased risk of hospitalization and death, a need for regular medications and physician visits to monitor indicators of disease progression or therapy, changes in behaviors such as dependency on people or equipment in daily self-maintenance activities, depression and anxiety, and changes in self-image and sense of control. All of these outcomes are appropriate targets for public health inquiry, but activity limitations are central because of their implications for each of these alternative outcomes.

Chronic disease, as described in Chapter 4, may cause difficulty or make it impossible for people to learn, go to school, work, play sports, travel, participate in conversation, drive, or complete the basic tasks required for independent living, such as eating, bathing, dressing, grooming, using the toilet, or moving between a bed and a chair. In short,

chronic disease may lead to activity limitations or participation restrictions. The former are often operationalized in later life as the "activities of daily living" (Katz et al., 1963) or "personal self-maintenance activities" (Lawton & Brody, 1969), which over time have picked up the prefix of "basic" or "physical" ADL (hence, BADL and PADL) to distinguish them from more complex, household (or "domestic") tasks usually considered IADLs.

In public health and aging, there has been an almost exclusive focus on the activities of daily living. The reasons for this focus are numerous. Perhaps the most salient reason is that, traditionally in public health ADL competencies were typically considered the primary sphere of activity in old age, on a par with attending school for children and working or running a household for adults (Sullivan, 1966). Whereas older adults do not work or attend school at rates anywhere near those of younger people, an increasing proportion do; and we may want to rethink this rationale for the focus on ADL. (Indeed, the early Sullivan [1966] classification also considered housework the primary sphere of activity for adult women under age 65.)

Second, *ADLs are the basic and universal competencies of adulthood*. The loss of basic ADL competencies—the ability to toilet or bathe oneself—is a severe threat, not just to social participation and safety, but also to adulthood as we understand it, and hence self-worth. (However, note that there is some variability by culture in the degree to which this sort of independence is considered central to adulthood [Albert & Cattell, 1994]). Loss of ADL competency, then, represents a major milestone in the progression of chronic disease. From a public health perspective, providing the services to care for individuals who do not have the basic competencies in place is an enormous intergenerational obligation, one that is projected to grow in the United States as the population ages.

A third reason is *the universality of ADLs: all people need to accomplish ADL tasks; and people perform these tasks on all or most days*. Thus, all older people can be asked whether they have difficulty bathing or dressing or using the toilet. The tasks are not gender-specific, optional, or subject to variation in lifestyle. This is not the case with other competencies, such as the IADLs. The IADLs are household competencies, which typically include managing finances, going shopping, doing housework, doing laundry, using the telephone, and taking medications. The need, desire, and training to perform IADL tasks

varies by gender, education, health status, lifestyle, and culture. The same applies to the so-called advanced ADL, such as using a microwave oven, programming a VCR, or using a computer, and to any of the more general lists of activities that have been proposed as indicators of adult competencies.

A fourth reason for the focus on ADLs relates to their measurement properties; that is, the tasks are hierarchical in nature. *ADLs differ in task complexity, and hence in motor and cognitive demand, and as a result appear to be gained and lost in a generally consistent (but not necessarily fixed) order*. Early on, Katz et al. (1963) suggested that the order in which ADL tasks are acquired in childhood development (first, feeding and transfer; later, toileting and dressing; last, bathing) is the reverse of the order in which they are lost in chronic disease (so that the first lost is bathing, the most complex of the tasks), as well as the order in which they are regained in recovery from stroke or brain injury (so that the last competency reacquired is again bathing). For this reason, Katz considered the ADL a measure of "primary sociobiologic function." His early research showed that the disability status of almost all elders in a skilled care setting adhered to this rough hierarchy of preservation and loss of task ability, which formed a Guttman scale. That is, people who were unable to do just one task from this set of tasks almost always had lost the ability to bathe. Likewise, people who could not dress themselves independently were also very likely to have trouble bathing independently. People who could perform only one task independently from the set of ADLs were likely to have retained the ability to feed themselves. In fact, a simulation study has shown that a number of alternative patterns, mostly relating to the order of the most primitive of the ADL tasks, form equally good hierarchical scales (Lazirides, Rudberg, Furner, & Cassel, 1994). However, it is well to remember that Katz and his colleagues (who developed the measure in the late 1950s and early 1960s) did not have access to sophisticated modeling software and that their clinical judgment regarding the scalability of the items was essentially accurate.

It is worth mentioning, as well, that a number of changes in task items have been introduced since Katz first proposed the measure. The original Katz items included bathing, dressing, toileting ("going to the toilet room for bowel and urine elimination; cleaning self after elimination, and arranging clothes"), transferring, continence (ability to control urination and bowel movements), and feeding. These items

were initially developed as observations made by clinicians in institutional settings. Over the years these measures have made their way onto national surveys and studies in which older adults, typically in a community setting, are asked to self-report their level of difficulty or need for help or use of help with daily activities. Current measures of ADL competency generally include only one toileting item, and have added indoor mobility and expanded dressing in some cases to include personal grooming. Also, the original Katz scale items had very detailed descriptors for categories of ability. Each item was assessed on a three-point scale, and the scale values were quite detailed. For example, the middle scale point for dressing was “gets clothes and gets dressed without assistance except for assistance in tying shoes.” Current versions of the measure typically use a single underlying measure for all ADL tasks: either level of difficulty (none, some, a lot, unable) or need for help (none, sometimes, all the time).

A last point involves the source of information about ADLs. While the ADL items have been selected to minimize “does not apply” or “don’t know” responses (since the tasks are both basic and universal), cognitive impairment prevents a small proportion of the young-old (approximately 6% of people under age 75) and a much larger proportion of the old-old (about 20% of people aged 75 and older and perhaps 50% of people residing in nursing homes) from answering the questions. For information about the ADL status of these respondents, researchers and clinicians must rely on proxy reports, that is, information from family or service providers. But for people able to report on ADL status, it is their judgment that defines disability. As in the case of quality-of-life measures (see Chapter 8), this seems appropriate: who other than the person at hand is better able to report on the degree of difficulty he or she faces in performing daily tasks (Gill & Feinstein, 1994)? In fact, studies comparing patient and proxy reports of patient ADL status show moderate levels of agreement, and if patient factors affect accuracy (i.e., denial, loss of insight, wish for a more intense level of services), so do proxy factors (i.e., degree of contact with patient, mental health, perceived burden as caregiver) (Magaziner, Simonsick, Kashner, & Hebel, 1988).

Still, even with these limitations, the ADL hierarchy is highly robust. For example, the Venn diagram shown in Figure 5.3 demonstrates that in a sample of more than 2,000 elders *none* had difficulty with feeding or toileting without also having difficulty in bathing, grooming, or dressing.

Functional Status: WHICAP

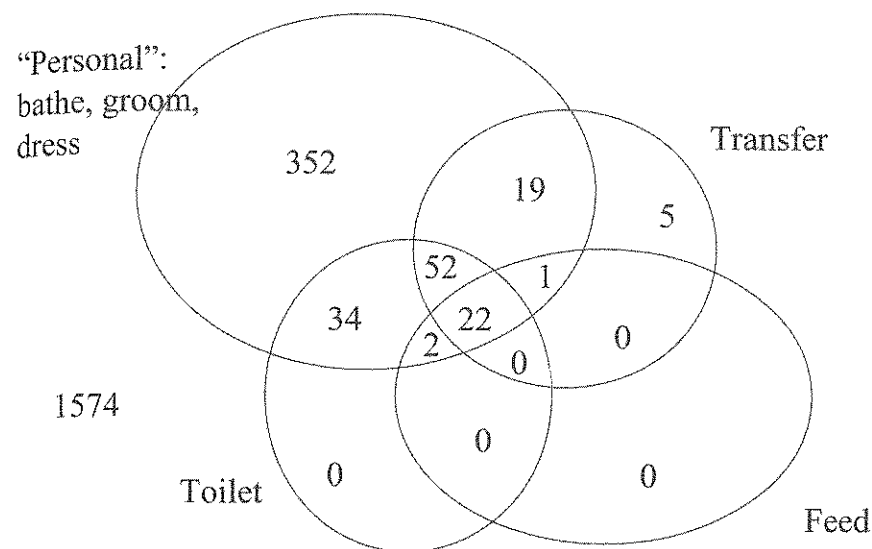


Figure 5.3 Functional status: Washington Heights-Inwood Columbia Aging Project.

Difficulties in Measuring Activity Limitations Among Older Adults

The centrality of BADLs and IADLs as measures of disability is clear, but measuring these most basic tasks is not simple. Kovar and Lawton (1994) describe many issues to be considered in assessing self-reports. These include:

1. Decisions about which activities should be assessed (“the number of possible IADL tasks seems almost limitless”);
2. Ceiling effects (“the ADL/IADL scales do best at identifying the most-disabled minority”);
3. Problems with the standardization of question formats to control for interpretation of environmental effects (“estimates of functioning reflect an unknown mix of personal disability and contextual constraint”);
4. Effect of emphasizing different components in question formats (“dependence” vs. “difficulty” vs. “limitation”) or combining them (Gill, Robison, & Tinetti, 1998);

5. Effect of proxy reporting (proxy respondents are more likely to report limitations than self-respondents, but they may be the only source of information for people with severe impairment);
6. Relevance of cultural differences ("socially or culturally assigned roles are obvious conditioners of IADL task performance and, conceivably, capability");
7. Cognitive factors in interpreting questions ("help from another person" can mean ongoing help, occasional help, or indirect help, that is, purchasing an assistive device).

An additional challenge relates to the variation across questions in whether underlying or residual difficulty is being assessed (Freedman, 2000). That is, sometimes questions explicitly ask, "without help or special equipment, do you have difficulty," whereas others ask simply, "do you have difficulty ____." The former are problematic in that respondents may not consider their assistive devices "special" and those who use equipment all the time may be answering about a hypothetical situation; the latter are problematic in their ambiguity, particularly for people who may not always carry out a task the same way every time (e.g., use their cane only some of the time).

These measurement challenges may be responsible for the different prevalence estimates of ADL limitations evident in national surveys. In their now classic study, Wiener, Hanley, Clark, and Van Nostrand (1990) identified substantial variation among the major national probability surveys of disability in the 1980s in the number of ADLs queried, whether "disability" in an ADL required a specified period of duration, and whether distinctions were made between need for assistance and receipt of personal assistance, use of special equipment, and standby help. The prevalence of receiving help with any ADL ranges from 5.0% (Supplement on Aging, 1984) to 7.8% (National Long Term Care Surveys, 1982 and 1984). Given the common definition of "receives help from another person," these differences are impressive. This variability applies to disability in all the ADLs, both those with relatively high prevalence, such as bathing (4.6%–6.3%), and those with low prevalence, such as eating (0.7%–2.5%).

Rodgers and Miller (1997) conducted a similar exercise, analyzing the prevalence of reporting any difficulty and receiving help with six ADLs in the Asset and Health Dynamics of the Oldest Old Study (now the oldest cohorts in the Health and Retirement Study). At the end of their interviews, respondents to the survey were randomly assigned ad-

ditional ADL questions from existing health and aging surveys. Thus, unlike the comparisons in Weiner et al. (1990), estimates from Rodgers and Miller are generated from the same study sample. A summary of their findings is presented in Table 5.2.

Note the differences in prevalence for the same respondents in the same survey are even greater for different measures of difficulty than they are for measure of help. The difference between the estimate from the Asset and Health Dynamics of the Oldest Old (AHEAD) Study and the National Long Term Care Survey (NLTC) is especially striking: one survey yields a prevalence of approximately 24% and the other survey yields closer to 11%. Such a large discrepancy is potentially of major public health significance. One only needs to consider the costs of providing support in the community for 24% of the population versus 11%

Table 5.2

PREVALENCE OF ACTIVITY LIMITATIONS AMONG ASSET AND HEALTH DYNAMICS OF THE OLDEST OLD COHORT, NHIS SUPPLEMENT ON AGING, AND NATIONAL LONG TERM CARE SURVEY (AGES 70 AND OLDER AND LIVING IN THE COMMUNITY)

	RECEIVES HELP		HAS DIFFICULTY/ UNDERLYING DIFFICULTY		HAS DIFFICULTY/ PROBLEM	
	AHEAD	SOA	AHEAD	SOA	AHEAD	NLTCS
Waking	3.2	3.9	17.2	24.3**	19.3	6.7**
Dressing	3.8	2.7	8.9	5.0**	10.0	4.6**
Bathing	3.9	3.1	8.0	6.3*	7.9	5.8**
Eating	2.6	0.8**	3.9	2.1**	2.7	1.0**
Transferring	1.3	1.8	6.5	6.9	7.8	3.5**
Using Toilet	0.6	0.6	1.9	3.4**	2.4	1.6*
Any	9.1	6.7+	26.7	24.1+	24.4	10.8+
N (Module)	N = 845 (3)				N = 915 (4)	

* $p < .05$, ** $p < .01$ difference from AHEAD; +, statistical test not reported.
From "A Comparative Analysis of ADL Questions in Surveys of Older People," by W. Rodgers and B. Miller, 1997, *The Journals of Gerontology, Series B, Psychological Sciences and Social Sciences*, 52, Tables 5, 8, 13, and 15.

of the population to begin to appreciate how meaningful these estimates are. And, although significance tests were not reported for this particular contrast, given that all the other contrasts between the AHEAD and NLTCs approach to asking ADL items—including some much smaller differences—reach statistical significance, it is highly likely that this difference also reached statistical significance.

Measuring Capacity: Performance-Based Tests

Elicitation of capacity to perform activities—in Nagi's model, functional limitations—usually involves self-reports of difficulty or need for assistance in a global sense; for example, "By yourself, that is, without help from another person or special equipment, how much difficulty do you have climbing stairs?" As explained previously, these types of questions pose problems of interpretation (Is the handrail or my cane special equipment?) and may even require some individuals to consider a hypothetical situation (Would I have difficulty climbing if I did not use the railing or my cane?).

Fortunately, a growing arsenal of tools is available to the field of public health and aging to measure capacity with performance-based assessments. Physical performance measures involve an individual performing a movement or task according to a standardized protocol and a trained observer rating the performance by use of objective, predetermined criteria. Batteries have been developed to measure the basic components of functioning (strength, balance, coordination, flexibility, endurance) as well as physical movements (e.g., walking speed) and goal-oriented functions (e.g., ADLs and IADLs). For example, the Short Physical Performance Battery (SPPB; Guralnik et al., 1994), assesses the time it takes respondents to walk 4 m and stand up repeatedly from a chair, and asks participants to hold progressively more complicated stances. Quartiles established within each of the three tests are then used to establish a "physical performance" score with a range of 0 (poorest performance on all three measures) to 12 (top quartiles of performance on all three measures). Such tests have been administered by interviewers in the home environment in population-based studies such as the Established Populations for Epidemiologic Study of the Elderly (EPESE) and the Women's Health and Aging Study (WHAS), and are now incorporated into the designs of population-based studies such as the large, national studies, the Health and Retirement Study and the English Longitudinal Study of Ageing (ELSA). Evaluations of the SPPB suggest that it is a strong predic-

tor of incident activity limitations (Guralnik, Fried, Simonsick, Kasper, & Lafferty, 1995b; Guralnik et al., 2000) and is particularly useful for detecting change within individuals (Guralnik et al., 1999; Onder et al., 2002).

Other tools from the occupational therapy field may also be useful, because they tap the antecedent skills necessary to perform a range of activities. In the Assessment of Motor and Process Skills (AMPS) test mentioned earlier, occupational therapists obtain *performance-based ratings of specific motor and cognitive skills* used in completing two tasks from a pre-specified list of 54 IADL/BADL tasks (Fisher, 2006a, 2006b). An occupational therapist, having undergone a 5-day training program in the AMPS, makes the ratings. Each of the motor and cognitive or "process" skills, drawn from extensive experience in occupational therapy with a variety of patient populations, is rated on a 4-point scale (competent, questionable, ineffective, deficit). The skills (and domains) are shown in Table 5.3.

An important advantage of the AMPS is its use of a many-faceted Rasch measurement model. The Rasch model has been used to (a) calibrate difficulty levels for the 54 tasks, (b) establish difficulty levels for ratings of each skill item, and (c) combine these skill ratings and task difficulty ratings to establish a single score for respondents on separate motor and cognitive/process skill dimensions. The equating of AMPS

Table 5.3

ASSESSMENT OF MOTOR AND PROCESS SKILLS

AMPS Motor Skills:

Posture: stabilizes, aligns, positions.

Mobility: walks, reaches, bends.

Coordination: coordinates, manipulates, flows.

Strength and Effort: moves, transports, lifts, calibrates, grips.

Energy: endures.

AMPS Cognitive/Process Skills:

Energy: paces, attends.

Using Knowledge: chooses, uses, handles, heeds, inquires.

Temporal Organization: initiates, continues, sequences, terminates.

Space and Objects: searches/locates, gathers, organizes, restores, navigates.

Adaptation: notices/responds, accommodates, adjusts, benefits.

tasks, linked by common skill items, makes it possible to compare the ability of respondents who perform *different* sets of tasks.

An advantage of this approach is its explicit focus on the skill elements elders use *to get tasks done*, as observed in home settings by using prespecified but ecologically valid tasks. In this way it differs from existing IADL or BADL performance tests (e.g., Karagiozis, Gray, Sacco, Shapiro, & Kawas, 1998; Lowenstein et al., 1992; Muharin, DeBettignies, & Pirozzolo, 1991; Myers et al., 1996), which are limited to only a few tasks, require subjects to perform tasks they may not do in normal activity, and do not yield measures of ability or skill that are involved in all IADL/BADL tasks.

Measuring the Environment

The emergence of the ICF highlights the need to improve measures of the environments in which older adults conduct their daily activities. Indeed, the expansion of measures of assistive technology and the physical environment would allow analysts to more fully understand the reasons for population-level changes in disability prevalence, and could further understanding at the individual level of the accommodation process and interventions to enhance independence and participation.

Keysor (2006) summarizes three general approaches to environmental measurement. The first approach involves assessment of an individual's perceptions of how the environment influences his or her participation. For example, the CHIEF (Whiteneck et al., 2004) is a 24-item self-report instrument that asks how often various barriers in the environment have been a problem in the past 12 months (and, if so, whether it has been a big problem or a small problem). The CHIEF focuses on barriers related to attitudes and support, services and assistance, physical and architectural features, policies, work, and school. A second approach is to literally observe study subjects and characterize avoidance and/or encounters with various features in the physical environment. Shumway-Cook and colleagues (2003), for example, used this approach to assess eight dimensions of the physical environment that may influence mobility: temporal, physical load, terrain, postural transitions, distance, density, attentional demands, and ambient conditions. A third approach is to ask research participants to characterize the presence or absence of various features in the environment (rather than perceptions about their roles as barriers). Keysor, Jette, and Haley's (2005) 36-item Home and Community Environment Instrument and the Pilot

Study of Aging and Technology (PSAT) instrument (Freedman, Agree, & Cornman, 2005) are examples of the latter strategy.

Such measures are beginning to make their way into clinical studies and national surveys. An example of the latter, the items from the PSAT were incorporated into an experimental module in the Health and Retirement Study in 2006, to assess the existence, acquisition, and use of assistive home features and devices by adults ages 52 and older (Freedman & Agree, 2008). Findings suggest that assistive home features are common: 78% of this age group have one or more features, 37% have added them, and 53% used them in the past 30 days. Of particular concern for public health and aging, one in four near-elderly and older adults were found to be at risk for a home modification, that is, had a mobility limitation and an unmodified barrier at the entry to their home, inside their home, or in the bathroom (either shower/bath area or toilet area). Adults receiving Medicare through the Disability Insurance program were identified as having elevated chances of being at risk for a home modification, suggesting a possible programmatic opportunity for reaching such a population.

TRENDS IN DISABILITY PREVALENCE AND ACTIVE LIFE EXPECTANCY

A central question for demographers interested in population aging is, "what are the implications for lengthening life for the health of the older population?" Simply put, the question is, are these additional years spent in good health and function or in a state of dependence?

Trends in Prevalence

Early studies on this question suggested that longer life implied worsening health, as measured by increases in self-reported activity limitations and chronic disease. Some researchers have questioned whether these increases were due to changing social forces during the period that made reports of disability more acceptable. The evidence for the 1980s and early 1990s was much more mixed, with Manton and colleagues first noting large declines in activity limitations (Manton, Corder, & Stallard, 1993) and Crimmins and colleagues concluding that there was no clear ongoing trend (Crimmins, Saito, & Reynolds, 1997b). A review of these inconsistencies by the Committee on National Statistics of the National

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Research Council (Freedman & Soldo, 1994), concluded that there had been modest declines in the proportion of older people with limitations in IADLs, but inconsistencies across surveys in trends in ADLs.

In the 15 years since that workshop more than a dozen studies have focused on late-life disability trends. A review by Freedman, Martin, and Schoeni (2002b) highlighted methodological considerations in the comparison of trends in prevalence across surveys and reported findings for a range of outcomes, including physical, cognitive, and sensory limitations, as well as ADL and IADL limitations. Of the 16 studies identified, the authors analyzed 8 unique surveys: for the purposes of trend analysis, 2 were rated as good, 4 were rated as fair, 1 was rated as poor, and 1 was rated as mixed (fair or poor, depending on the outcome). Studies rated fair or good consistently showed substantial declines in IADL limitations. For example, evidence from the National Health Interview Survey (NHIS) suggests that between 1982 and 2004 there was a 6% decline in the population ages 70 years and older needing help with only routine care (but not personal care) activities, such as shopping, preparing meals, and managing money, sometimes called IADLs. Subsequent analysis of data from the NLTCs suggested that declines in limitations in three IADL activities—managing money, shopping for groceries, and doing laundry—were notably large from 1984 to 1999; however, among those reporting a limitation in ADL or an IADL, the severity of disability increased over time (Spillman, 2004).

At the time that the review was published, disagreement remained about whether there had been a decline in the proportion of older Americans having difficulty with self-care activities, such as bathing, dressing, toileting, and walking around inside, sometimes called ADLs. The answer was sorted out by a technical working group that analyzed five national surveys conducted from the early 1980s through 2001 (Freedman et al., 2004). The 12-person panel prepared estimates by use of identical methodologies and investigated sources of the inconsistencies among the population age 70 years and older. They found that during the middle and late 1990s consistent declines on the order of 1%–2.5% per year for two commonly used measures in the disability literature: difficulty with daily activities and help with daily activities. Mixed evidence was found for a third measure: use of help or equipment with daily activities. In comparing findings across surveys, the panel found that the time period, definition of disability, treatment of the institutional population, and standardization of results by age were important considerations.

More recently, the NLTCs suggested that declines continued from 1999 to 2004 (Manton, Gu, & Lamb, 2006), but other surveys, such as the Medicare Current Beneficiary Survey (Federal Interagency Forum on Aging-Related Statistics, 2008), suggested a possible leveling off of “any limitation.” Disagreement also exists about trends among the generations approaching late life (see Martin et al., 2009; Seeman, Merkin, Crimmins, & Karlamangla, in press; Soldo, Mitchell, Tfaily, & McCabe, 2007; Weir, 2007) and some have warned that trends in obesity and other potentially disabling conditions among working-age adults could offset future improvements in late-life functioning (Bhattacharya, Choudhry, & Lakdawalla, 2006; Sturm, Ringel, & Andreyeva, 2004). Hence, reconciling disparate findings remains an important focus among demographers.

Trends in Active Life Expectancy

Prevalence measures are helpful policy and planning tools but do not yield information on whether increasing years of life are active. Measures of active life expectancy are needed to ask whether, on average, older adults spend more of their lives living free from limitations. Active life expectancy is a summary measure that combines information on age-specific mortality with age-specific activity limitations. Some researchers use cross-sectional activity limitation information (“Sullivan method”) and others have drawn on transition probabilities in making these calculations, but in either case the concept is similar: how many years on average could an individual be expected to live without activity limitations if age-specific rates of such limitations and mortality held over a hypothetical cohort’s lifetime. Comparisons of active life expectancy estimates over time are subject to many of the same threats to validity as are prevalence trends.

What have the studies shown? Several studies of the 1970s suggested that increases in active life expectancy were being accompanied by an increase in the number of years lived with a limitation, but this trend appeared to reverse during the 1980s and more recently. Three studies using different measures, methods, and dates (Cai & Lubitz, 2007; Crimmins et al., 1997b; Manton et al., 2006) suggest surprisingly similar results: all three show an increase in the expected number of years of active life and in the percentage of life expectancy expected to be spent without activity limitations. A fourth study (Crimmins, Hayward, Hagedorn, Saito, & Brouard, 2009) suggests stable levels of active life

expectancy between the 1980s and 1990s that are the result of several underlying processes: declines in the onset of limitations, increases in the chances of recovery, and reductions in mortality among those living with an activity limitation at age 70.

Disparities in Trends and Causes

Adopting a public health focus, we may ask, have all groups benefited equally from these trends or are some groups being left behind? Although the evidence is thin, and with few exceptions, statistical tests have not been performed to determine whether these differences are due to chance, the answer appears to be no, at least when the population is sliced by major racial and socioeconomic groups. In one of the few studies including such tests, Schoeni, Martin, Andreski, and Freedman (2005), found persistent gaps in activity limitations between Blacks and other groups and widening gaps between socioeconomic groups from 1982 to 2002. Educational disparities in both the prevalence of activity limitations and in the extent of expansion in active life are also evident. For instance, older adults with less than a high school education as a group have experienced increases in the prevalence of basic activity limitations, while other groups have experienced declines (Schoeni et al., 2005). Similarly, a study by Crimmins and colleagues found a compression of morbidity—that is, an increase in the percentage of life expectancy to be lived in an active state—for highly educated groups but an expansion of morbidity for less educated groups (Crimmins & Saito, 2001).

In searching for ways to promote further declines in late-life disability prevalence, we might ask, what are the causes of trends to date and are those forces expected to continue as the Baby Boom generations reach late life? Four distinct realms of explanation have been explored to date: demographic and socioeconomic shifts; changes in chronic disease and related treatments; trends in underlying physical, cognitive, and sensory functioning; and environmental changes, in particular, growth in the use of assistive devices.

Research to date suggests that the decline is likely the result of a combination of factors and not any single underlying trend (Schoeni, Freedman, & Martin, 2008). For example, the improvement has been attributed in part to the greater educational attainment of older adults today compared with cohorts who were in late life in the mid-1980s. Yet such changes account for only a portion—and not all—of the decline in

limitations. One analysis suggests that impending increases in education levels will continue to contribute to improvements in late-life functioning, albeit at a reduced rate (Freedman & Martin, 1999).

Other evidence also suggests that the extent to which some chronic conditions are expressed in terms of disability may have been ameliorated in recent decades. In particular, arthritis, vision-related conditions such as cataracts, and cardiovascular diseases appear to be less debilitating even as the prevalence of these and related conditions has increased in the older population (Schoeni et al., 2008). It could be that earlier diagnosis and better management of such conditions has led to lower reported rates of disabilities. Evidence supporting this possibility is lacking, however.

A third area of focus has been on trends in underlying physical, cognitive, and sensory functioning. Self-reported measures of capacity (using Nagi's functional limitations—difficulty with body movements such as reaching, bending, and lifting) have shown consistently large declines (Freedman, Martin, & Schoeni, 2002b), but no study of trends in performance measures has been conducted to date because of data limitations. Evidence regarding trends in cognitive function among the elderly population is not as well developed, although there may be some positive movement in that regard (Langa et al., 2008). Vision impairments appear to be less debilitating than they were 10 years ago, possibly because of the increases in cataract surgery over the past decade (Schoeni et al., 2008).

A final avenue of inquiry has focused on the role of assistive technology in disability trends. Well-known shifts have been occurring in the forms of assistance available to help people cope with disability in later life, and the use of technology without personal care has increased markedly among those reporting reduced functional capacity (Freedman, Agree, Martin, & Cornman, 2006a). Some researchers have also attributed declines in IADL disabilities to the increased availability of modern conveniences, such as no longer having to go to the store to shop or to the bank to manage money, and having microwave ovens to facilitate cooking (Spillman, 2004). Moreover, many more seniors are living in supportive living environments that provide assistance with these tasks, such as continuing-care retirement communities, assisted living facilities, and other retirement communities. The role of these pervasive technologies and specialized living environments has not been quantified.

THE EPIDEMIOLOGY OF DISABILITY: RISK FACTORS FOR FUNCTIONAL DECLINE

Prospective cohort studies have proven very productive in helping to identify factors that increase the risk of developing an activity limitation in later life. In these studies, a group of people without difficulty in daily activities at baseline is monitored during some defined interval. Onset of disability is recorded, typically at 1- or 2-year intervals, sometimes more frequently. We are thus able to identify incident (new) cases and go back to baseline assessments to see how these people differ from people who never reached the end point of interest. Typically, we examine a series of baseline risk factors and calculate the risk associated with a factor, independent of other risk factors that make up a person's profile. Features associated with the disability outcome are "risk factors"; features that reduce likelihood of incidence are called "protective factors." We often calculate these risks by use of logistic regression models, or proportional hazards models if we wish to incorporate a time dimension into analyses (i.e., time to onset rather than simply onset).

In a comprehensive review, Stuck and colleagues (1999) summarized findings across a large number of such studies, with a focus on potentially modifiable risk factors for functional loss. Findings varied somewhat between studies, according to the demographic composition of the cohort, the length of follow-up, how attrition was handled, how risk factors were categorized, and how competing risks (for death and disability) were handled. Nevertheless, the review identified some consistent findings across studies. Consistent predictors of functional loss included, for example, cognitive, vision, and lower body impairments; depression; comorbidity; high/low body mass index; few social contacts; low physical activity; and smoking as consistent predictors of functional loss. Stuck also identified several areas that required further investigation, including the role of biological factors (earlier in the disablement pathway) and the environment.

Since Stuck's review, progress has been made on both fronts. On the biological front, potential biomarkers for disability have been identified. For example, serum albumin level (g/liter) is a risk factor for both incident activity limitations and mortality. Within the EPESE cohort, serum albumin concentration and activity limitations were strongly related at baseline. Moreover, at follow-up, greater serum albumin concentration was associated with a greater risk of mortality within categories of base-

line functioning. A new set of biomarkers for function is currently under investigation, including C-reactive protein, interleukin-6 (IL-6), and other cytokines.

In addition, strides have been made in understanding the relationship among inflammation, frailty, and loss of physical capacity that precedes limitations and frank limitations. Chronic inflammation, visible in elevations in IL-6, fibrinogen, C-reactive protein, and tumor necrosis factor-alpha, and decreases in serum albumin, are associated with loss of lean muscle mass (shrinking), low energy, decreased appetite, and the other symptoms of frailty. For instance, in the Women's Health and Aging Study, high levels of IL-6 and C-reactive protein were shown to predict incident difficulty with daily activities independent of other risk factors (Ferrucci et al., 1999). The mechanism for this effect is the catabolic effect of IL-6 on muscle, which leads to sarcopenia and, hence, loss of muscle strength in the lower extremities. This, in turn, leads to limitations in mobility and ultimately ADLs. Examination of changes in knee extensor strength and walking speed suggest that IL-6 affects muscle mass, and that this effect is responsible for the increased risk of disability. That is, the effect of IL-6 on risk of disability was attenuated when changes in muscle mass were introduced into regression equations. This attenuation in risk suggests that "change in muscle strength is intrinsic to the causal pathway leading from high IL-6 to the development of new disability" (Ferrucci et al., 2002). This is an indirect demonstration of the causal mechanism, but it is consistent with other research showing an association between high levels of IL-6 and lower muscle mass and strength (Visser et al., 2002a), as well as lower muscle mass and poorer lower extremity function (Visser et al., 2002b). A stronger demonstration would show an increased risk of disability among people whose IL-6 serum levels have increased (or a lower risk of disability in a group whose IL-6 levels have declined, perhaps as a result of a therapeutic intervention). This growing body of work suggests that intervention strategies that might prevent IL-6 and other cytokines from affecting muscle may be ready for investigation.

With respect to environmental influences, the role of neighborhoods in facilitating or impeding late-life function has been a recent focus (e.g., Balfour & Kaplan, 2002; Clarke & George, 2005; Freedman, Grafova, Schoeni, & Rogowski, 2008; Schootman et al., 2006). Balfour and Kaplan (2002), for example, found that functional loss among persons 55 and older in Alameda County, California, was related to self-reported problems with neighborhoods, including excessive noise, inadequate

lighting at night, heavy traffic, and limited public transportation. Clarke and George (2005) found that among adults age 65 and older living in North Carolina, greater independence in IADLs (e.g., shopping, managing money, household chores) was reported among those living in environments with more land-use diversity, and that among those with functional limitations, housing density was inversely related to self-care disability. Schootman and colleagues (2006) found that among middle-aged African Americans around St. Louis, Missouri, adults living in areas with 4–5 versus 0–1 fair/poor conditions were more than 3 times as likely to develop a lower body limitation. And, Freedman et al. (2008) have found by using tract- and county-level data linked to the nationally representative Health and Retirement Study that neighborhood economic advantage is associated with a reduced risk of lower body limitations for both men and women, and that high connectivity of the built environment is associated with reduced risk of limitations in instrumental activities for men.

While of interest to public health, such studies stop short of providing communities with the information they need to create environments that support functioning and well-being of older adults. Fortunately, progress has been made on this front through the Visiting Nurse Service of New York's AdvantAge Initiative (Feldman, Oberlink, Simantov, & Gursen, 2004). Based on the premise that communities matter in the daily lives of older adults, AdvantAge began by exploring what makes a neighborhood "elder friendly." By talking with people in four communities, they identified four domains of the elder-friendly community: (a) addressing basic needs, (b) optimizing physical health and well being, (c) maximizing independence for older adults who are frail or have disabilities, and (d) promoting social and civic engagement. They then developed a 33-item instrument for communities to rate their elder-friendliness (Feldman & Oberlink, 2003). In addition, they surveyed older adults in 10 communities to understand older adults' perceptions of the 33 indicators. Information was reported back to communities in chart book form. National survey results (Feldman et al., 2004) based on 1,500 older adults made norms available to communities so that they had a basis of comparison for each indicator. The national survey underscored the disparate experience of two groups of older adults—the vibrant, successfully aging seniors dubbed the "fortunate majority" and a smaller group referred to as the "frail fraction." The latter are living in ill health, with inadequate resources, and in nonsupportive and sometimes dangerous communities.

In an equally important companion project, the AdvantAge initiative identified and profiled best practices to promote health and independence among older adults. The resulting report highlighted several key "ingredients" to the success of community-based programs (Feldman & Oberlink, 2003). These ingredients are so fundamental to successful community-based interventions—whether related to elder friendliness or any other public health and aging topic—that we provide a summary here:

1. Broad stakeholder support throughout the planning, implementation, and life of the program
2. Knowledge of the community and how to tailor programs to that community
3. Leadership—both in terms of lead agency and lead person
4. The "right" lead agency and person
5. Building and sustaining relationships with all those involved in the effort
6. Marketing with tailored messages
7. Flexibility to change and grow with community needs

The information provided to participating AdvantAge Initiative communities has been used to help give a voice to the older adults of the community, as well as to identify barriers and solutions to promoting elder friendliness.

A CLINICAL PERSPECTIVE: IDENTIFYING DISABLEMENT PATHWAYS

For prevention of disability progression and frailty in older adults, a good target is the older adult with reduced capacity to carry out the building blocks of activities—those with mobility limitations, upper and lower body limitations, sensory limitations, and mild cognitive impairments. In ICF-language, by focusing on capacity in the domains upon which activities are built, it is possible to identify persons at risk for activity limitations and participation restrictions. (Put in terms of the Nagi formulation, it is important to measure *functional limitation* antecedent to *disability*.) The aim is to identify factors associated with reports of disability among individuals who demonstrate a range of limitation in the abilities or skills needed to undertake daily activities. Such "skill

elements”—for example, sequencing steps in a task, organizing a workspace, or maintaining bodily alignment—have been well-examined in occupational therapy research and have been defined, with clear scoring criteria, as in AMPS (Fisher, 2006a, 2006b).

The Link Between Capacity and Performance

What is the relationship between the motor and cognitive skills used in performing daily activities (functional limitation) and IADL/BADL limitations? A first investigation in this area involved the relationship between leg strength and gait speed. Buchner et al. (1996) found that the relationship between leg strength, measured in an exercise machine test, and gait speed was nonlinear. In such a nonlinear relationship (or flattened S-shaped curve), three regions are defined, as shown hypothetically in Figure 5.4. The figure relates gait speed, a measure of mobility capacity, to difficulty or needing help in bathing, a measure of activity limitation. However, this type of nonlinear relationship between capacity and activity limitations has been established for other indicators, including balance and gait speed, and between gait speed and IADL/BADL measures (Jette, Assmann, Rooks, Harris, & Crawford, 1998).

When mobility speed is extremely low, people are essentially unable to walk or stand, and disability in bathing is complete. The curve is flat (region A), indicating that until gait speed exceeds a certain minimum (despite some minor improvements), limitation in bathing will not change. In other words, there is a threshold of leg strength or gait speed required for bathing. Once this threshold is crossed, gait speed and independence in bathing are directly related, as shown in region B, so that each additional unit of leg strength or gait speed is associated with a proportional gain in independence or efficiency (or ease) in bathing. Once leg strength or gait speed exceeds a certain level again, a second threshold is crossed, defining the beginning of region C. At this point, additional gait speed or leg strength does not translate into greater bathing efficiency. Given the biomechanical and ergonomic properties of the task, individuals are already performing as efficiently as possible and any additional leg strength contributes to physiological reserve but does not affect the speed or efficiency of bathing. Above this threshold, increments in strength or skill are not associated with reduction in disability but only with increased reserve (Buchner et al., 1996; Sonn, Frandin, & Grimby, 1995).

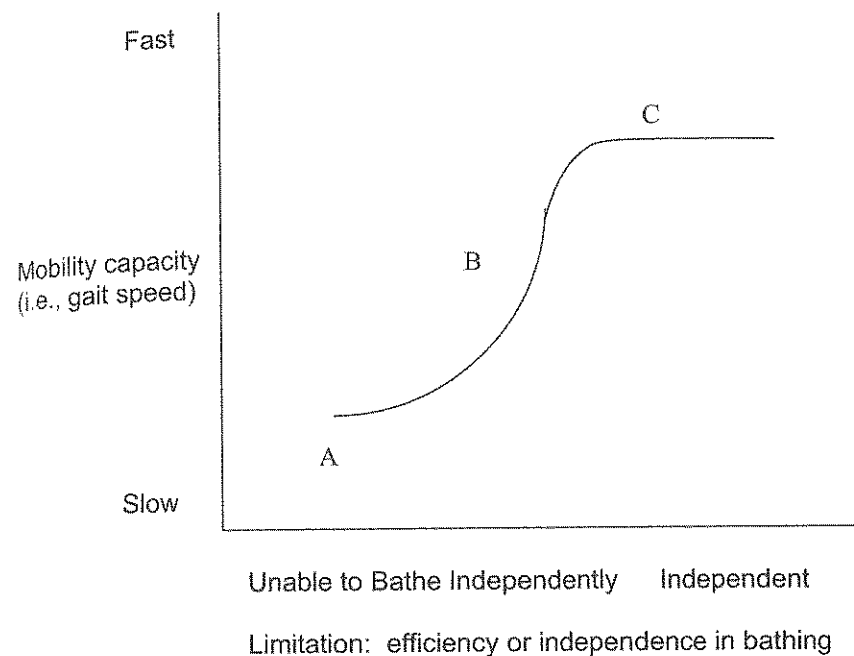


Figure 5.4 Hypothetical relationship between mobility capacity and bathing disability.

Identification of these thresholds may be clinically important, because these indicate the point on a continuum of ability, physical or cognitive, when capacity has implications for limitations. The thresholds also help set goals for intervention and rehabilitation. For example, a clinical trial seeking to prevent or reduce activity limitations by improving strength would not show benefit if targeted to individuals in region C of the curve. These individuals are already beyond the threshold where improvements in strength will affect performance of daily tasks. Similarly, only with large improvement in capacity could we expect to see reduction in limitations in region A. By contrast, people along region B of the curve might be the best target for such a trial. In this group, even small changes in underlying capacity can be expected to translate into increases in independence and efficiency.

Buchner et al. (1997) have shown the relevance of these considerations in a clinical trial of exercise to reduce the incidence of falls. The trial was part of the FICSIT initiative, “Frailty and Injuries: Cooperative Studies of Intervention Techniques.” The study recruited elders with extensive functional limitation; all were unable to do an eight-step tandem

gait test without errors, and all were below the 50th percentile in knee extensor strength based on norms for weight and height. A program of endurance and strength training led to increases in isokinetic strength and aerobic capacity, but no improvements in gait speed or balance. This lack of consistent benefit (reduction in measures of impairment, no benefit in measures of functional limitation) already suggests that selection criteria for the study were too stringent. People recruited for the study were likely near or within region A of the curve shown in Figure 5.4, so that improvement in underlying capacity might not lead to reduction in limitations. Indeed, in this study 1-year fall rates in the intervention group were 42%, better than the control group rate of 60%, but no different than the risk of falls typical of older people living in the community (Tinetti, Speechley, & Ginter, 1988). Buchner concludes that "the eligibility criteria selected a sample on the verge of substantial decline, and exercise prevented this decline." A more efficient design would have selected a less impaired sample.

The nonlinear relationship between underlying capacity and activity limitations also appears to hold for cognitive capacity. Figure 5.5 is a scatterplot of limitations (reported by caregivers) by number of errors by care recipient on a cognitive screening measure, derived from a sample of caregivers to elders with a diagnosis of Alzheimer's disease. Scores ranged from 24 (best score: independent all the time in 12 tasks) to 0 (worst score: dependent all the time in all 12 tasks assessed). Elders completed a 15-item cognitive screening test, which included items from a series of brief cognitive status tests (CARE-Diagnostic Screen; Gurland et al., 1995). These items assess a person's orientation, short-term memory, attention, and language ability. The scatterplot stratifies by number of comorbid conditions to better isolate the effect of cognitive capacity on dependence in daily activities.

The least-squares regression lines shown in Figure 5.5 were derived using a curvilinear regression model. The R^2 for the model in subjects without other comorbid conditions (thick line, $n = 78$) increased from 0.41 to 0.52 with introduction of a quadratic term, suggesting that the nonlinear curvilinear model offers a better fit. By contrast, in the two groups with other concurrent disease, linear models provided an adequate fit. Subjects with cognitive impairment in the absence of other comorbid disease are not likely to have reported limitations until they made five or more errors on the cognitive screen. This relationship should be compared with that of subjects with cognitive deficit and one or two or more comorbid conditions. They report greater dependency at every

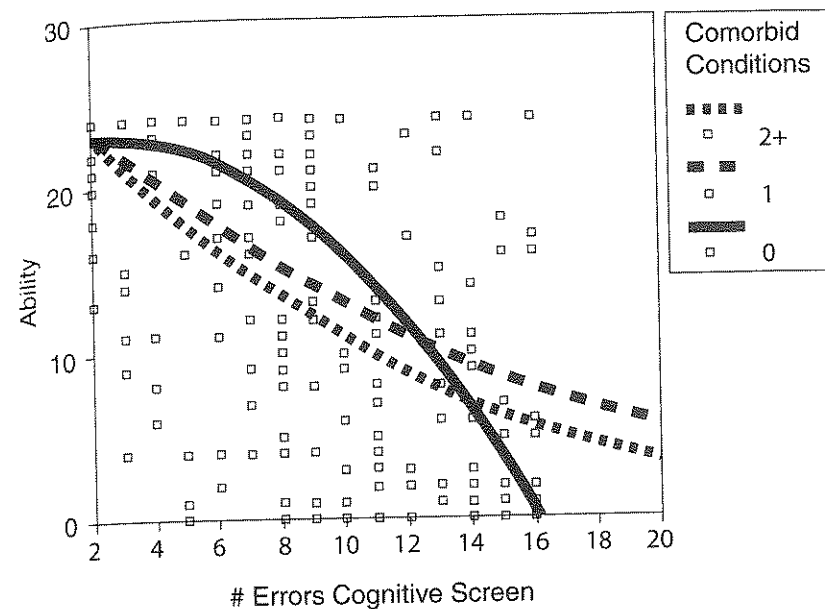


Figure 5.5 Relationship between disability and cognitive status.

level of cognitive ability. We conclude that the relationship between cognitive impairment and activity limitations may follow that demonstrated for physical indicators and disability.

The Role of Accommodations

Both the ICF language and the Nagi disablement model support questions about the compensatory processes and environmental modifications that prevent reduced capacity from resulting in activity limitations or participation restrictions. Four major types of accommodations exist: change in how the activity is performed (e.g., frequency, duration, or positioning), uptake of assistive technology, changes to the environment to support performing the activity, and reliance on help from another person. Although much attention has focused on the latter, in particular, caregiving to older adults, these other types of accommodations that may facilitate independent performance of activities have only recently come into focus.

Perhaps the most common—yet least studied—accommodation is simply altering the frequency of a task or changing the way a task is

performed (Weiss, Hoenig, & Fried, 2007). This is the first and most basic adaptation. If a shoulder range-of-motion limitation makes it difficult for someone to wash his or her hair, the first response probably will be a reduction in the frequency of hair washing or a change in bathing routine, such as washing hair only when someone is available to help. These are effective modifications for mild-to-moderately severe functional limitation. With progression of functional limitation, completing ADL tasks may become impossible without further modifications, either alteration of the physical environment (washing hair in the sink rather than shower, use of a grab bar or bath stool, use of walk-in shower stall), or recourse to personal assistance (regular help getting into the tub, balance support, and personal assistance with the application of shampoo).

More subtle forms of behavioral adaptation involve drawing on other faculties to compensate for reduced capacity in another area. For example, older persons with severe balance deficit (impairment) who still perform well in daily tasks, such as vacuuming or cooking, have presumably relied more on other faculties to prevent the balance disorder from disabling them in these daily tasks. We know very little about these processes, although efforts from kinesiology and neuroscience are underway to specify this effect. A simpler example is seen in the elder with mild cognitive impairment who uses other brain regions, visualized in functional magnetic resonance imaging, to perform better than expected in certain memory tasks. This elder probably uses mnemonics or other strategies to perform the memory task and, hence, draws on other relatively spared domains of brain function. Such subtle changes may suggest that a person's capacities might be increased through recruitment of remaining, relatively spared abilities. This process is less well explored than any of the other behavioral accommodations described here, but may be at least as important. It suggests far more extensive use of rehabilitative technologies to teach older people (and, indeed, anyone facing reductions in capacity) how to reorganize the way they do tasks by drawing on other remaining abilities.

One challenge for defining the population with activity limitations, already mentioned, is that people who have made successful adaptations of this sort may not report difficulty with the task. After all, they are successfully performing the task and have, to a great extent, overcome the change in capacity that might have otherwise caused this difficulty. Behavioral changes that individuals make to compensate for changes in underlying capacity may then be an important clue for clinicians to look for

in predicting who will develop limitations—or who might benefit from an intervention to prevent this process from unfolding. For example, people reporting no difficulty with ADL, but who also say they have reduced the frequency of these ADL tasks, have lower grip strength, gait speed, dexterity, and balance scores, and a higher risk of developing ADL limitations (Fried et al., 1996).

Also widespread is the use of assistive technologies and environmental modifications. Cornman and colleagues (2005) have found, for example, that estimates of assistive device use across several national surveys range from 14% to 18% for the population of adults aged 65 and older, and range from 39% to 44% for the 85 and older population. Devices are used most often for mobility and bathing, and less often for toileting and transferring. However, questions about such devices are often restricted to individuals who report difficulty with daily activities and, therefore, omit a potentially sizeable group—those who use assistive devices but report no difficulty with daily activities. If this group is included the prevalence of both device use—and of those at risk for developing limitations because of reductions in capacity—are significantly higher.

The fact that assistive technology may in many cases bridge the gap between capacity and the environment is not surprising. Using the 1994–1995 Disability Supplement to the NHIS, for example, Verbrugge and Sevak (2002) show that equipment only or equipment with personal assistance is more likely to reduce difficulty than personal assistance alone. To explain this result, they point out “First, equipment is designed for the task, can be modified to suit the individual, and is generally on hand when needed. . . . Second, equipment maintains an individual's self-sufficiency. This can foster pride and keen perception of task improvements.” This is an important result and suggests the need for further development of assistive devices. However, it is also worth recognizing the limits of equipment use in the case of cognitive disability, a major source of disability in late life (see Chapter 6).

An Example of Accommodations: Bathing

We can tie these insights on disability and efforts to mitigate the effects of reduced capacity with a closer look at a particular activity. A good candidate is bathing. As we have seen, it is the most prevalent ADL limitation and one that lends itself to a variety of accommodations and the use of compensatory processes.

In a study of nearly 200 older adults, all aged 70 and older, with mild to moderate activity limitations (reported difficulty in one to three domains of upper extremity, lower extremity, IADL, and ADL function, but not all four), 9.5% reported they had difficulty with bathing (Albert, Bear-Lehman, Burkhardt, Merete-Roa, & Noboa-Lemonier, 2006). These self-reports were quite stable. In the whole sample, less than 2% changed their self-report between a telephone interview and an in-home assessment. Respondents reported a variety of sources for their difficulty bathing, including fear of falling and concern about balance, pain, weakness, swollen legs (edema), and shortness of breath. People who reported difficulty bathing were more likely to report they had changed the frequency of bathing and the way they bathed. For example, of those reporting difficulty bathing, 87.5% said they had changed the way they bathe during the past 12 months. In people who did not report difficulty bathing, only 24.8% reported a change in the way they bathe. Thus, reports of difficulty and attempts to modify environments to mitigate difficulty go hand in hand.

If we look only at people who said they had no difficulty bathing, we find further evidence that environmental modification is a response to changes in underlying capacity. People who reported they had changed the way they bathe showed lower grip strength, slower gait speed, and less efficient performance on the AMPS assessment (the occupational therapy assessment described above) than people who reported no change. We find this pattern even when we restrict the sample further to people who report they have not changed the frequency with which they bathe. People who have changed the way they bathe score more poorly on the measures. Thus, changes in behavior, indicated by changes in frequency and mode of performing the ADL, are clearly related to degree of capacity.

In the same sample, we also investigated one facet of compensation in the face of reduced capacity. We established the poorest balance group by examining the distribution of scores on a series of progressively more difficult static stances. Those in the lowest tertile (or third) showed a great range of motor performance in the AMPS assessment. In fact, nearly half scored above the cutting score on the motor dimension, indicating an ability to live independently despite poor balance. Of those with poor balance but good motor performance, 13.3% reported difficulty bathing. By contrast, nearly 40% of people with poor balance and poor motor performance reported difficulty bathing. Thus, some elders in the poor balance group were able to draw on other abilities to achieve reasonable motor performance despite balance deficit. These el-

ders were also less likely to report bathing difficulties. We need to know more about this process.

PUBLIC HEALTH INTERVENTIONS TO MAXIMIZE LATE-LIFE FUNCTIONING

To this point we have considered disability and aging from three vantage points. The demography literature teaches us that, although activity limitations may be declining, not all groups have benefited equally, and continued declines in prevalence will be important to achieve as the large Baby Boom cohorts begin to retire this decade. Epidemiology has pointed to a list of important risk factors—from biological, to medical, to social and behavioral to environmental—that increase individuals' chances of developing activity limitations. Clinicians have added important insights about how accommodations and compensatory strategies may be individualized to bridge gaps between an individual's capacity to perform activities and their desire to perform both essential and valued activities. The public health and aging professional's interest cross cuts these disciplines as it seeks to establish public programs to ensure maximization of functioning among older adults. Here, we illustrate this sprawling literature by reviewing one especially important and promising avenue—fall prevention programs, and follow this with a discussion of how to compare the likely effects of interventions at the population level.

Preventing Falls

Falling is a common event among older people. Approximately 30% of people aged 65 and older residing in communities and 40% of people aged 80 and older fall each year (Tinetti et al., 1988). According to the Web-based Injury Statistics Query and Reporting System, available at <http://www.cdc.gov/injury/wisqars/index.html> and shown here in Table 5.4, in 2006, nearly 17,000 people aged 65 years or older died because of falls, up from 10,000 in 1999.

The number of reported injuries because of falls in this population exceeded 1.8 million. Approximately one in four older people who fall experience either a severe injury (e.g., fracture, trauma to the head, serious lacerations, joint dislocation) or limitation. Among those who sustain hip fractures, recuperation from depressive symptoms, cognitive loss,

Table 5.4

FALL-RELATED DEATHS AND INJURIES, 2001–2006, 65+ AND 85+ POPULATION

YEAR	# DEATHS	CRUDE DEATH RATE	# INJURIES	CRUDE INJURY RATE	POPULATION
<i>65 and Older Population:</i>					
2001	11746	33.25	1,642,533	4649.12515	35,329,945
2002	12961	36.42	1,640,080	4608.48203	35,588,294
2003	13820	38.44	1,822,590	5069.980707	35,948,651
2004	15028	41.4	1,851,602	5101.258967	36,296,965
2005	15917	43.32	1,802,172	4904.367212	36,746,273
2006	16747	44.95	1,840,564	4940.703674	37,253,065
<i>85 and Older Population:</i>					
2001	5366	121.47	504,704	11425.32486	4,417,415
2002	6020	132.41	503,708	11079.13089	4,546,457
2003	6436	136.5	554,978	11770.56146	4,714,967
2004	6993	144.26	555,070	11450.80042	4,847,434
2005	7561	149.57	545,958	10800.07957	5,055,128
2006	8052	152.33	573,804	10855.21849	5,285,976

From Web-based Injury Statistics Query and Reporting System (WISQARSTM).

and upper-body limitations generally occurs within a few months; however, lower body functioning takes on average a year or so to regain pre-fall status (Magaziner et al., 2000). Some older adults who fall also curtail activities because of a fear of falling again. As a result, individuals who experience falls have two or three times the relative risk of developing activity limitations as those who do not fall.

There are many known risk factors for falling. Tinetti et al. (1998), for example, found in a cohort of community-dwelling adults age 70 and older that sedative use, cognitive impairment, functional limitation in the lower extremities, poor reflexes, abnormalities of balance and gait, and foot problems were all risk factors for falling. An important finding from this study was the important role of environmental and ergonomic

factors in falls. While 77% of the falls occurred at home, in a familiar environment, 44% of the falls involved modifiable home hazards. In these falls, people tripped over objects or slipped on stairs. Also, most falls involved particular kinds of activities, mainly those that displaced a person's center of gravity. These activities included getting up or sitting down, bending over or reaching, or stepping up or down. These particular environmental and ergonomic factors, along with medical risk factors identified in this effort, suggest a number of interventions to reduce the risk of falling.

Over the past two decades, a series of randomized clinical trials have shown that the risk for falls can be reduced. In a review of 40 such fall prevention trials, the most effective interventions were multifactorial falls risk assessments with management programs (Chang et al., 2004). Exercise programs alone were also effective in reducing the risk of falling, but not as effective as multifactor approaches. For example, one of the early, yet most notable, intervention studies linked reduction in the risk of falling to modification of particular risk factors. In the trial conducted by Tinetti and colleagues (1994), the Yale FICSIT trial, 35% of the intervention group fell, compared with 47% of controls, over a 1-year period. In this trial, one inclusion criterion was use of four prescription medications, a risk factor for falling, and a target of this multifactorial intervention. As part of the intervention, medication use for people in the intervention group was evaluated and adjusted, as needed. Sixty-three percent of the intervention group continued to take four or more medications, compared with 86% of controls. The trial also showed that many other risk factors for falling were modifiable, including balance impairment, difficulty with toilet transfer, and gait impairment. Each was modified through a combination of behavioral training, exercise program, or environmental change. The prevalence of impairments in the intervention group declined relative to controls; and this reduction appears to have been responsible for the reduction of falls.

A reanalysis of the data (Tinetti, McAvay, & Claus, 1996) showed that improvements in balance and reduction in blood pressure (to lower fall risk associated with orthostatic hypotension) were associated with lower rates of falling. Also, the reanalysis showed that fall risk declined in both treatment and control groups according to degree of reduction in a composite measure of fall risk. In the treatment group, the average number of risk factors declined by about one (of seven different risks), but this degree of risk factor reduction was enough to reduce falls by approximately 35% (Buchner, 1999). Together, these

findings suggest that altering or eliminating specific risk factors for falls can reduce fall risk.

In other developed countries these types of tailored programs have been packaged with community-focused interventions, with reasonable success (McClure et al., 2005). Specific interventions varied but generally involved a combination of community-wide education, reduction in risks in homes and communities, training of health care personnel, and/or visits to the homes of high-risk individuals. A review of five prospective community trials with matched control communities suggested that, despite methodological limitations, fall-related fractures potentially could be reduced by 6%–33%.

In the United States, public health efforts to prevent falls have greatly expanded since the FICSIT trials. The AoA, for example, has been providing grants to states to mobilize the aging, public health, and nonprofit networks at the state and local level (see Chapter 3). Four evidence-based fall prevention programs have been included in these grants in more than a dozen states: Matter of Balance, Stepping On, Tai Chi, and Step by Step. In partnership with AoA, the CDC has funded evaluations of these fall prevention packages, and has also independently funded projects to translate this research into practice and to disseminate findings to communities. With respect to the latter, CDC has compiled a compendium of successful interventions for public health practitioners and community-based organizations, which covers exercise programs, home modification programs, and multifactor fall prevention programs (Stevens & Sogolo, 2008).

A companion guide for community-based organizations offers practical advice for planning, development, implementation, and evaluation of fall prevention programs (Stevens & Sogolo, 2008). In addition to providing essential program components (e.g., education, exercise, medication management, vision assessment, and home hazard identification), the guide also provides tips to communities on building and maintaining partnerships that will foster sustained prevention programs. Like the AdvantAge Initiative described earlier, critical ingredients for a successful and sustained fall prevention program involve community building, leadership and resources, and flexibility.

Comparing Potentially High-Impact Interventions

How does one go about comparing potentially high-impact interventions at the population level? That is, if one were to attempt to maximize the

population's functioning, what approaches would be most effective? An interdisciplinary team recently tackled this question (Freedman et al., 2006) and identified critical information needed to compare the effects of interventions at the population level. Their framework drew on the notion of illness trajectories, that is, that individuals follow one of several prototypical experiences in terms of declines in function at the end of life, and that interventions might alter these trajectories or the demands placed on individuals by the environment. Their exercise started with the simple goal of reviewing the literature to identify the interventions with the greatest potential to reduce disability prevalence in the older population.

Their plan to compare interventions was complicated by several factors. First, most randomized studies evaluate interventions in terms of their influence on one or more proximate risk factors for disability, rather than on disability itself. Thus, to assess short-run effects, they considered three pieces of information—the prevalence of the risk factor of interest, the effect of the intervention on the targeted risk factor, and the relationship between the risk factor and the disablement process. Second, a variety of measures of functioning were found in the literature, and many studies evaluating interventions omitted measures of functioning altogether and instead focused on more proximate outcomes (e.g., leg strength or balance). Thus, the effects of interventions on the progression of activity limitations in many cases cannot be calculated precisely. Third, because interventions may influence not only disability, but also length of life, their short- and long-term effects may differ. Despite these complications, however, the investigators were able to assess the *relative* magnitude of effects on the prevalence of activity limitations by comparing interventions according to the following dimensions: the size and selectivity of the intervention's target population, the risk of disability associated with the risk factor addressed by the intervention, the effect of the intervention on the targeted risk factor, and the influence of the intervention on length of life and competing risks.

The team implemented this strategy for three potentially high-impact strategies: physical activity, depression screening and treatment, and fall prevention. Because of the large population at risk for falling, the demonstrated efficacy of multicomponent interventions in preventing falls, and the strong links between falls and activity limitations, they concluded that in the short run, multicomponent fall-prevention efforts would likely have a higher impact than either physical activity or depression screening and treatment. However, they stressed that

“longer-term comparisons [could] not be made based on the current literature and may differ from short-run conclusions, since increases in longevity may temper the influences of these interventions on prevalence” (p. 493).

More generally, although there are a number of promising approaches to facilitating functioning in later life, there are real challenges to widespread implementation of high-impact interventions. Here, we outline five such challenges:

1. Disablement and functioning are complex processes with multiple risk factors at work. In general, multifactor interventions that are tailored to individual needs seem to work better than single interventions, but public health and aging programs are not always equipped to individualize services.
2. Ideally, public health and aging interventions need to be developed at multiple levels—not just aimed at the individual, but also at the families and communities in which people live. As we have seen, some examples of fall prevention interventions combine individual- and community-based approaches, but on the whole these have not been adopted in the United States.
3. Identifying the appropriate target population and window of time for targeting an intervention is critical to its success. The curvilinear relationship between underlying capacity and activity limitations complicates this targeting effort.
4. Attention throughout the process to the issue of sustainability and/or adherence is critical for long-term success.
5. Finally, the complex interactions between functioning and length of life complicate the equation. Interventions can influence both but will only reduce the prevalence of activity limitations and/or participation restrictions if the intervention lengthens active life at least as much as it lengthens life expectancy. These relationships are very difficult to predict and more research is needed to link interventions to disability and mortality outcomes.

SUMMARY

Language of Disability. The internationally accepted World Health Organization’s International Classification of Functioning, Disability and Health (ICF) provides a useful language for disability research and

public health interventions. Key terms include activity limitation, participation, the environment, and distinctions between capacity and performance. Unlike the Nagi model of disablement, the ICF language is not a dynamic model. To blend the benefits of the ICF language with those of the Nagi model is an important next step for disability and aging research.

Measuring Disability. Difficulty and need for help with activities of daily living have been central measures of interest in the study of public health and aging. New measures capturing the capacity to perform daily activities, the environment, and behavioral accommodations that individuals make to bridge the gap between capacity and the environment are gaining importance in the field.

Disability Trends. The prevalence of activity limitations declined during the 1980s and 1990s and active life expectancy increased. Declines were larger for instrumental activities of daily living than for the more severe activities of daily living, and more advantaged groups experienced larger declines. The reasons for these trends are complex and include shifts in socioeconomic status of the older population, in the distribution of underlying conditions and limitations in capacity that may be related to use of medical treatments, and in the uptake of assistive and other convenience technologies. In recent years this trend may have leveled off, and there are some signs that, in the future, this course may even reverse. Reconciling disparate findings remains an important focus among demographers.

Risk Factors for Functional Loss. Consistent predictors of functional loss included cognitive, vision, and lower body impairments; depression; comorbidity; high/low body mass index; few social contacts; low physical activity; and smoking as consistent predictors of functional loss. In addition, in recent years, our understanding of the biology of disability and the role of inflammation has increased. Studies of environmental factors, especially those focused on neighborhood characteristics that influence late-life disablement, suggest a role for the economic and built environments as well. These latter findings have not yet been translated into multilevel interventions.

Disablement Pathways. Clinicians have documented nonlinear relationships between measures of physical and cognitive capacity and activity limitations. Such findings indicate that there may be zones of opportunity for maintenance or improvement in functioning and other subgroups for whom intervention around underlying capacity may be less productive. Three distinct types of behavioral accommodations

were also discussed in detail: changes in how the activity is performed (e.g., frequency, duration, or positioning), uptake of assistive technology, and changes to the environment to support performing the activity. The latter two are highly prevalent, but less is known about behavioral accommodations. One promising, but poorly understood, type of behavioral adaptation involves drawing on other faculties to compensate for reduced capacity in another area.

Public Health Interventions to Maximize Physical Functioning. Research to date is incomplete in guiding public health practitioners as to which interventions will maximize the functioning of the population in the long run. However, it appears that fall prevention efforts may be a useful place to start for short-term results. One especially promising avenue includes combining individually and community-focused efforts. The design and implementation of interventions to maximize physical functioning holds many challenges. Such challenges include the need to design multifactor, multilevel interventions that are targeted at the appropriate population, that are sustainable, and that lengthen active life expectancy at least as much as life expectancy.

6

Cognitive Function: Dementia

Alzheimer's disease and the other dementias are a major source of morbidity and disability in older people. The medical and supportive care needs of people who have dementia are a major challenge to families, medical care, and every component of long-term care services, not to mention to older people themselves, who perceive declining memory. More and more, they are given a diagnosis of "mild cognitive impairment," often without being told what the diagnosis means for risk of Alzheimer's (Albert, Dienstag, Tabert, Pelton, & Devanand, 2002a). Because the risk of dementia is highly related to age, with diagnosis of dementia occurring in the vast majority of people at the oldest ages, dementia is a central problem in geriatric care. The strong association between age and risk of dementia also makes the study of cognitive deficit and its consequences a key element in the epidemiology of aging.

The Alzheimer's Association reports a prevalence of 5.1 million Americans with Alzheimer's disease (AD) in 2009, with a projected increase to 7.7 million in 2030 (Alzheimer's Association, 2009). About 5%–10% of people aged 65 and older and between one-third and one-half those aged 85 and older meet criteria for the disease. Survival with the disease from the point of diagnosis averages about 8 years, but evidence suggests a very long latency, with progressive cognitive decline over a period of 20 or more years before people come to medical attention and receive