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Barriers to Non-Insulin Dependent Diabetes Mellitus (NIDDM) Self-Care Practices Among Older Women

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Objectives: Noninsulin dependent diabetes mellitus (NIDDM) constitutes a significant threat to the health and well-being of older women. Appropriate self-care, the cornerstone of glycemic control, is reported to be modest. We aimed to investigate barriers to recommended self-care for NIDDM. **Methods:** A total of 51 African American and White women age 65 and older, completed the Diabetes Self-Care Barriers Assessment Scale for Older Adults, ethnomedical protocol, and other instruments during in-depth interviews. **Results:** African American women were more likely than their White counterparts to indicate financial, pain, and visual barriers to self-care. Both African American and White women expressed a reluctance to check blood sugar and to exercise; however, most indicated that they regularly followed medication recommendations and visited their physician. **Discussion:** This study extends our knowledge of the existence of self-care barriers by providing a qualitative, in-depth perspective detailing how these barriers often prevent optimal self-care behaviors and, conceivably, successful glycemic control.

Approximately 14.9 million individuals in the United States have noninsulin dependent diabetes mellitus or NIDDM (also known as Type 2 or adult onset diabetes), estimated to comprise between 90% and 95% of all diabetes cases. Nearly 800,000 new diagnoses of NIDDM occur annually, contributing to a steady increase in the

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incidence and prevalence of NIDDM over the past 35 years (National Institute of Diabetes and Digestive and Kidney Disease [NIDDK], 2000). It is estimated that NIDDM was responsible for slightly more than 160,000 deaths, or more than 3% of total deaths, in the U.S. population in 1994. In addition to being one of the 10 most common leading causes of death, NIDDM is a leading cause of peripheral vascular disease leading to amputations, cerebrovascular and cardiovascular disease, retinopathy and eventual blindness, and end stage renal disease (Harris, 1995). Finally, NIDDM exerts a heavy cost on the health of our nation's elders as well as significant financial expenses associated with hospitalizations, home health visits, medication costs, and other types of care. Depending on the cost components considered, estimates of the annual direct costs of NIDDM range (in 1990 dollars) from \$13 billion to \$22 billion (NIDDK, 2000).

Although NIDDM is a disease of widespread prevalence in the United States, not everyone is at equal risk of receiving such a diagnosis. Diabetes mellitus is more common among older individuals, females, and African Americans (Harris, 1995). NIDDM disproportionately affects older individuals, with approximately 10% to 12% of those aged 65 or older diagnosed with diabetes, compared to 2.8% of the general adult population (Centers for Disease Control, 1991). Put another way, 43% of all cases of NIDDM occur among those age 65 or older (NIDDK, 2000). Within this older population, women are significantly more likely than men to have diabetes (National Center for Health Statistics [NCHS], 1995; NIDDK, 2000). Finally, there are significant differences in diabetes prevalence according to ethnicity, with African Americans being 1.7 times as likely to have NIDDM as the general U.S. population (NIDDK, 2000). Among women, African Americans are more than twice as likely as Whites to be diagnosed with diabetes, amounting to 51 cases of diabetes per 1,000 African American women, compared to 23 per 1,000 White women (Horton, 1995). Not only are African American women more likely to be diagnosed with NIDDM, they are also two and a half times as likely as their White counterparts to die from diabetic complications (NCHS, 1995).

Efforts to address this high prevalence of diabetes-related morbidity and mortality often focus on nonadherence or noncompliance with biomedically recommended self-care regimens (Sullivan, 1998). Although investigators have cited the complexity of self-care regimens,

the enormous behavioral changes required to adhere to recommendations, and the lifelong duration of the self-care regimen as deterrents to optimal self-care, we currently have inadequate data on patient perceptions of barriers to self-care behaviors (Morris, 1998).

DIABETES SELF-CARE

Self-care, generally considered the predominant form of health care, has been conceptualized as “activities undertaken by individuals to promote health, prevent disease, limit illness, and restore health. The critical component of this definition is that self-care practices are lay initiated and reflect a self-determined decision-making process” (Stoller, 1998, p. 24). Such a broad characterization of self-care necessarily involves a variety of activities, ranging from recognizing and responding to symptoms, to seeking information, to managing diagnosed conditions through home appliances, over-the-counter medications, and home remedies or implementing changes in activities (e.g., increasing exercise or avoiding smoking; Clark et al., 1991; Dean, 1986; Kart & Engler, 1994).

Although the great breadth of activities that fall under the self-care defy simple and succinct characterizations of research findings, there appear to be general trends in self-care behavior. Previous research has demonstrated that the likelihood of engaging in self-care behaviors in response to illness is associated with female gender, feelings of perceived control over one's health, and perception of symptoms as less serious, more bothersome, or both (Kart & Engler, 1994; Stoller, 1998). On the other hand, the tendency to engage in self-care behavior has not demonstrated a relationship with age, marital status, education, retirement status, or living arrangement (Haug, Wykle, & Namazi, 1989; Kart & Engler, 1994). Other researchers have revealed extensive individual variability in interpretation of symptoms and decisions about how to manage chronic illness. This variation is based, in part, on lay knowledge about illness and treatment and beliefs about self-care formed over time and experiences through interactions with informal supports and professional health care providers (Berman & Iris, 1998).

Although the majority of existing literature on health behavior focuses on professional medical treatment, evidence indicates that

most individuals attempt to prevent, contain, or manage illnesses on their own (Stoller, 1993) or in conjunction with advice received from health care professionals, family members, or other personal relations (Kart & Engler, 1994). For people with NIDDM, self-care remains at the core of control and containment of the disease (Lo & MacLean, 1996). Unlike acute health problems that elicit behavior to alleviate symptoms, self-care for a chronic illness such as NIDDM requires maintenance of self-care regimens for the remainder of one's lifetime, both in the presence and absence of current symptoms (Stoller, 1998). Although individuals with NIDDM may be able to avoid use of insulin through careful self-care, they need to continue to monitor and control blood glucose regardless of treatment recommendation. Because long-term and appropriate self-care behavior is crucial to the successful management of NIDDM, it is essential to understand barriers to such self-care behavior.

Biomedical recommendations for diabetes self-care encompass a broad range of activities but generally fall within the following six areas: diet, blood glucose monitoring (BGM), exercise, medication, foot care, and interaction with health care providers (Polly, 1992; Tu & Barchard, 1993). Figure 1 provides a description of these major elements of standard diabetes self-care and the corresponding items on the instrument used in this study to understand barriers to self-care.

Despite the well-known benefits of engaging in a recommended self-care regimen, research remains unresolved on the frequency and correlates of recommended self-care practices. The Behavioral Risk Factor Surveillance System for North Carolina revealed that 83% of respondents with NIDDM performed blood glucose monitoring and more than 93% had visited a health care provider for diabetes care in the past year (Bell, Passaro, Lengerich, & Norman, 1997). Other researchers have suggested that self-care activities vary extensively according to the nature of the activity itself, with taking of medication often occurring as recommended and exercise frequently falling below recommended levels. For example, results from one study showed that 97% of respondents with diabetes always or usually took their insulin, whereas only 41% always or usually exercised (Ruggiero et al., 1997).

Because of the importance of self-care activities to achieve and maintain desirable blood glucose levels, researchers increasingly have

Explanation of importance to glycemic control	Items in DSCB-OA
<p><u>Diet</u> In NIDDM, the body produces some insulin necessary for conversion of glucose to energy, but does not use the insulin or glucose properly. Without consuming recommended portions and types of foods, glucose builds up in the blood, leading to high blood sugar. Eating healthy foods and losing weight helps the body control blood glucose.</p>	<ul style="list-style-type: none"> • Eating 3 meals a day and snacks makes me gain weight. • Feeling hungry makes it hard for me to stay on my diet. • I eat more than I should because I enjoy eating.
<p><u>Blood glucose monitoring</u> Blood glucose monitoring (BGM) alerts the individual to the amount of sugar in the blood to insure that the blood sugar level does not go too high (hyperglycemia) or too low (hypoglycemia).</p>	<ul style="list-style-type: none"> • Checking blood sugar as often as I should is troublesome. • I always know when my blood sugar is high or low, so there's no need to check my sugar. • The strips are too expensive for me to check my sugar as often as needed. • Checking my blood sugar would not help me control my diabetes.
<p><u>Exercise</u> Not only does exercise tend to keep weight down, which can enhance the efficacy of insulin, it literally lowers blood sugar.</p>	<ul style="list-style-type: none"> • It is hard to do regular exercise. • Problems with my feet interfere with exercising. • When I walk, my legs hurt.
<p><u>Medication</u> Oral agents (pills) or insulin (injections) lower blood sugar. It is essential that these medications are taken at the right dosage & times, and balanced with exercise and dietary intake.</p>	<ul style="list-style-type: none"> • My diabetic medication requirements are too costly. • I feel better when I take my diabetes medication.
<p><u>Foot care</u> Individuals with poorly controlled diabetes often experience neuropathy or nerve damage. Such damage can cause slower healing and a lack of sensation. If infections do not heal quickly and are not noticed, gangrene may occur, leading to amputation.</p>	<ul style="list-style-type: none"> • It is hard for me to reach my feet to see them well. • It is hard for me to find a provider/physician to visit regularly for my diabetes care.
<p><u>Health Care Provider (HCP) interaction</u> HCPs monitor blood glucose, advise, educate, prescribe appropriate medication and lifestyle regimen, and supervise proper care of the feet, eyes, teeth, skin, blood vessels, kidneys and nerves.</p>	

Figure 1. Major elements in diabetes self-care and corresponding Diabetes Self-Care Barriers for Older Adult (DSCB-OA) Instrument items.

Source. National Institute of Diabetes and Digestive and Kidney Diseases (2000) and Tu and Barchard (1993).

begun to investigate correlates of perceived barriers to NIDDM self-care behaviors (Chipperfield, 1993). For example, Lukkarinen and Hentinen (1997) found that the following personal characteristics were associated with problems in NIDDM self-care: lower education and socioeconomic status, higher level of depression, male gender, being unmarried, and younger age (30-49 years old). However, although it is useful to identify general characteristics that relate to

poor self-care behaviors, it may be of greater utility from a public health perspective to identify and understand mutable characteristics that represent barriers to optimal self-care. Barriers amenable to interventions may include lack of financial access to health care resources, lack of knowledge of optimal self-care practices, and improperly treated pain and disability that may impede self-care functioning.

Furthermore, although the studies cited above have begun to illuminate our understanding of some of the predictors of differences in diabetes self-care, we currently lack an in-depth understanding of obstacles or barriers to diabetes self-care (Wdowik, Kendall, & Harris, 1997). To promote optimal self-care behavior, it is important to understand the degree to which elders with diabetes integrate self-care recommendations into their lives as well as the barriers that prevent such integration. Currently, the dearth of research on self-care is particularly noteworthy for older adults, despite the disproportionately high prevalence of diabetes among elders (Lo & MacClean, 1996). Perhaps even more problematic is the minimal research on the most vulnerable groups with NIDDM, including women and, in particular, African American women. Not only are women disproportionately likely to have NIDDM and to live with the disease significantly longer than their male counterparts, they also tend to operate with more comorbidity and fewer economic resources, two factors that might complicate self-care (Horton, 1995). Self-care practices among ethnic minority groups are also insufficiently understood. In particular, the extent to which ethnicity may affect self-care behavior via differences in understandings of illness, symptom management, and strategies for containing disease is an area that merits further research attention (Stoller, 1998). To address these deficits, this article explores barriers to diabetes self-care regimens, with the goal of identifying obstacles to optimal diabetes self-care.

*RESEARCH QUESTIONS, THEORETICAL
FRAMEWORK, AND APPROACH*

We sought to understand which diabetes self-care behaviors were problematic and why older women perceived these self-care behaviors as difficult. Specifically, our study was framed around the following questions:

1. What do older women view as barriers to engaging in diabetes self-care behaviors?
2. Do perceived barriers differ according to sociodemographic variables such as ethnicity, education, and poverty status?
3. What is the nature of these self-care barriers?

This study draws its theoretical framework from the work of self-care scholars (Gitlin, 1998; Leventhal, Leventhal, & Robitaille, 1998; Stoller, personal communication, 1999). Our framework, illustrated in Figure 2, suggests that personal and contextual factors exert a primarily influence on the health knowledge and psychological and material or structural factors that shape self-care barriers. As indicated by the framework's arrows, personal, psychological, informational, and material influences are linked and interrelated rather than constituting discrete categories. The various instruments and activities undertaken during the interviews directly correspond with each of the factors included in the figure.

A complementary research design is an ideal approach to examining these questions through the framework illustrated above. Whereas structured instruments may reveal the distribution of self-care barriers and the correlation between these barriers and sociodemographic characteristics, their exclusive use fails to capture a more profound understanding of how such factors undermine self-care. Thus, this study uses quantitative strategies to "produce factual, reliable outcome data" combined with qualitative methods to "generate rich, detailed, valid process data that usually leave the study participants' perspectives in tact" (Steckler, McLeroy, Goodman, Bird, & McCormick, 1992, p. 2). This project emphasizes and employs qualitative findings to explicate quantitative results.

Method

SAMPLE

Fifty-one community-dwelling women with an average age of 74 years ($SD = 6.4$, age range = 65-95 years), approximately half of whom were African American (53%) and half of whom were White (47%), were recruited from a preexisting panel of 1,200 older adults.

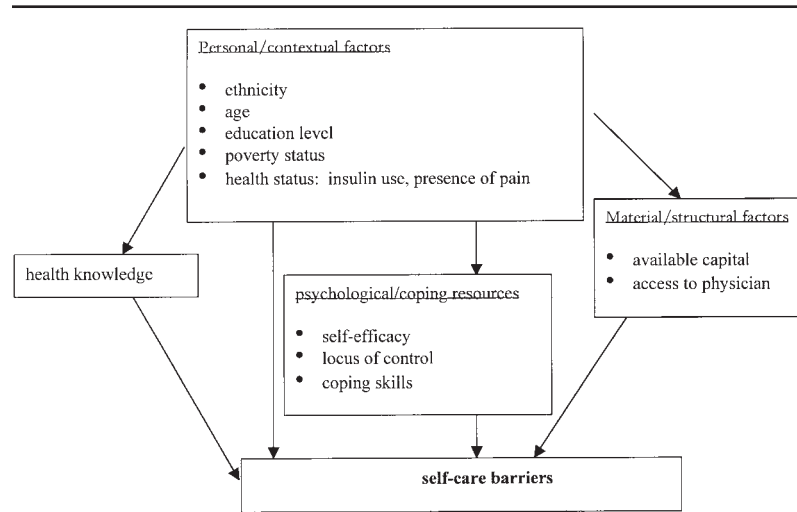


Figure 2. A theoretical framework to illuminate self-care barriers modified.

Source: Gitlin (1998), Leventhal, Leventhal, and Robitaille (1998), and Stoller (personal communication, 1999).

This panel of elders was participating in a study sponsored by the National Institute on Aging (NIA) examining ethnic and residential differences in health status, long-term care, and other issues relevant to the health of elders. These 1,200 elders were recruited through a two-stage disproportionate sampling approach. During the first stage, a 7-minute telephone screening identified 5,254 older adults (74.4% of those contacted) who agreed to participate in future telephone and in-person interviews as well as a clinical examination. During the second stage, 1,524 elders were contacted to recruit a stratified, random sample. Of these individuals, 78.7% ($n = 1,200$) agreed to future contacts (Peek, Henretta, Coward, Duncan, Dougherty, 1997). These individuals met the following inclusion criteria: (a) living in a household with a working telephone; (b) residing in one of four counties in northern Florida; (c) not residing in an institutional setting; (d) being capable of engaging in a cogent telephone conversation, as judged by the interviewer; and (e) being able to speak English. During this second stage, data were collected on disease diagnoses (including diabetes) and sociodemographic information (i.e., ethnicity, education, poverty status).

From this list of 1,200 elders, we recruited African American and White women who had been diagnosed with diabetes for at least 1 year. This minimum postdiagnosis period was chosen because it better approximates typical self-care activity than the initial “super compliant” or vigilant period immediately following diagnosis (Lieberman, Probart, & Schoenberg, 1990). Fifty-six individuals were contacted via telephone and invited to participate in the study, and this process continued until we interviewed approximately equal numbers of African American and White elders and reached theoretical saturation (Trotter & Schensul, 1998). Of those contacted, 91% agreed to participate (final sample size = 51). Of those 5 who did not participate, 2 had entered nursing homes, 1 had died, and 2 individuals declined due to failing health. With such a high response rate, it is unlikely that our results were biased by the 2 eligible individuals who declined to participate.

Following human subjects approved protocol, the investigator arranged for a visit to the respondent’s home or a mutually acceptable site. During this visit, a face-to-face interview was conducted that lasted 1.5 to 2 hours. To identify barriers to self-care practices, respondents completed the Diabetes Self-Care Barriers Assessment Scale for Older Adults (DSCB-OA) (Tu & Barchard, 1993). The DSCB-OA was chosen both because it is one of few existing diabetes self-care assessment instruments and because it has been validated among a population very similar to our sample (lower income older African American and White women from the southern United States).

To complement the DSCB-OA instrument, we conducted in-depth ethnomedical interviews. A modified questionnaire (available by contacting the first author) guided these interviews and was based on the work of Kleinman, Eisenberg, and Good (1978).

To examine whether biomedical knowledge about NIDDM influenced self-care behaviors, we also administered the Diabetes Knowledge Test (DKT) developed by the Michigan Diabetes Research and Training Center (Davis, Hess, & Harrison, 1987; Hess, Davis, & Harrison, 1986). The DKT contains 23 items, consisting of 14 general diabetes knowledge items and an additional 9-item subscale designed to be administered solely to those using insulin. For the present study, respondents completed the general test segment only, as too few participants ($n = 17$) used insulin to conduct meaningful statistical

analyses. The DKT was selected because it is one of the few existing measures of diabetes knowledge with demonstrated reliability and validity (Fitzgerald et al., 1998; Hess & Davis, 1983). For the general knowledge segment of the DKT, Cronbach's α in two samples of diabetic patients being treated by community providers and at a local health department were .70 and .71, respectively. The DSCB-OA exhibited adequate reliability as indicated by its high internal consistency ($\alpha = .75$). Because of the relatively low educational status and limited visual acuity of the informants, interviewers read the instruments to informants.

ANALYSIS

Quantitative Analyses

To examine responses to the DSCB-OA instrument, we began with univariate summaries of predictor (insulin use, education, poverty status, diabetes knowledge) and outcome variables (DSCB-OA scores). DSCB-OA scores were computed by summing individual item responses (0 = *strongly disagree*, 3 = *strongly agree*), with possible total scores ranging from 0 to 45. Higher scores reflected greater perceived barriers to self-care. Variables were dichotomized into the following categories: ethnicity = African American/White; education = below eighth grade/eighth grade and above; insulin use = yes/no; and poverty status = below poverty level/at or above poverty level. During the baseline screening for the panel of 1,200, interviewers determined poverty status by asking the size of household and whether total income for the household in the previous year was above, at, or below the standard federal poverty threshold. With regard to education, respondents indicated one of six responses to represent their highest level of education completed. However, because responses were skewed toward lower education levels with relatively few respondents having completed any education beyond high school, responses were dichotomized into education levels below eighth grade/eighth grade and above.

The original data set contained missing DSCB-OA items. On further examination, it became evident that most (47 of 51) of these items

were not actually missing but not applicable, because some respondents did not engage in those particular self-care behaviors. For these missing items, qualitative interviews with respondents were able to inform quantitative analyses. Specifically, Items 1 through 4 on the DSCB-OA refer to checking blood sugar; respondents who did not monitor glucose levels indicated that these items did not apply to them. Failure to monitor blood glucose levels was considered a barrier to self-care, and each of these “not applicable” items was scored as a value of 3, indicating a high barrier to diabetes self-care. Similarly, DSCB-OA Items 13 and 14 referred to taking diabetes medication. If respondents reported that these items were not applicable because the respondents were controlling their diabetes without use of medications, the missing items were scored as a value of 0, indicating no barrier to diabetes self-care. The remaining four missing DSCB-OA values were imputed with the *Statistical Package for the Social Sciences* (1997) expectation maximization procedure that uses a maximum likelihood estimation algorithm (Arbuckle, 1996; Graham, Hofer, & Piccinin, 1994).

To examine whether significant differences existed for diabetes self-care barriers (DSCB-OA) based on education level, poverty status, and ethnicity, we tested the individual relationship between each of the variables and total DSCB-OA score using *t* tests and the relationship between poverty status and education using a chi-square test. *t* tests and chi-square tests were also used to determine whether differences existed between ethnic groups for poverty status, education, insulin use, and diabetes knowledge (DKT) between ethnic groups. Finally, we conducted a multiple regression analysis to examine effects of education level, poverty status, and ethnicity on diabetes self-care barriers.

Qualitative Analyses

Responses to the ethnomedical questionnaire were transcribed verbatim from tape-recorded sessions. Transcripts were read multiple times to ensure researcher familiarity. Two researchers independently coded the transcripts and met on a frequent basis to engage in open coding and to devise a codebook and coding scheme. We used a

constant comparison method to identify thematic clusters and patterns (Glaser & Strauss, 1967). In addition, extraneous remarks made during administration of the DSCB-OA were attached to the transcripts and coded following the above protocol. Repeated identical coding of the transcripts by the two researchers resulted in an interrater reliability of .91 (the number of concurring codes divided by the number of total codes; Bakeman & Gottman, 1986).

Results

QUANTITATIVE FINDINGS

Sample characteristics may be found in Table 1. Results from bivariate analyses (*t* tests) revealed significant differences on DSCB-OA scores based on ethnicity, education, and income. As shown in Table 1, the average DSCB-OA score was 25.1 for African American respondents and 16.0 for White respondents ($t = 7.37, p < .001$). With respect to education, the average DSCB-OA score was 25.4 for respondents with less than an eighth grade education and 18.5 for respondents who had attained at least an eighth grade education ($t = 4.23, p < .001$). Analyses of DSCB-OA scores by poverty level revealed an average score of 22.5 for respondents below poverty level and 16.7 for respondents at or above poverty level. No relationship was found between education and poverty status ($\chi^2 = 1.70, ns$). In sum, these significant differences in barriers to self-care revealed that greater barriers were reported among respondents that were African American, less educated, and living below poverty level.

Bivariate analyses also revealed significant differences between ethnic groups for education ($\chi^2 = 5.67, p < .05$), poverty status ($\chi^2 = 9.26, p < .01$), and DKT score ($t = -2.61, p < .05$). As shown in Table 1, 50% of African American respondents and 20% of White respondents reported having less than an eighth-grade education. Nearly 81% of African American respondents and 56% of White respondents indicated that their income was below poverty level. Percentage of correct responses on the DKT were 36.3% and 47.0% for African American and White respondents, respectively. Cronbach's α for the DKT among this sample was .67, consistent with previously reported alphas

Table 1
Sample Characteristics

Characteristic	African American	White	Total Sample
	(n = 27, 53%)	(n = 24, 47%)	(n = 51, 100%)
Age (range: 65-95)	74.8	73.4	74.1
Poverty Status (% below poverty level)	81	56	68.5
Education (% below eighth grade)	50	20	33
Insulin use (%)	38.5	28.0	33
DSCB-OA score (range: 9-31.49)	25.1	16.0	20.8
DKT (range: 14%-86% correct)	36.3	47.0	41.6

Note. DSCB-OA = Diabetes Self-Care Barriers Assessment Scale for Older Adults; DKT = Diabetes Knowledge Test.

ranging from .60 to .80 (Fitzgerald et al., 1998; Hess & Davis, 1983). No difference was noted between ethnic groups for reported use of insulin ($\chi^2 = 1.42, ns$). The percentage of respondents who reported insulin use was 38.5% and 28.0% for African Americans and Whites, respectively. Table 2 provides means for responses to individual DCSB-OA items based on ethnicity.

Results from a multiple regression analysis examining the effects of education, poverty status, and ethnicity on DSCB-OA score were significant ($R^2 = .63, F = 25.95, p < .001$). Education level (beta = $-0.30, t = -3.2, p < .001$) and ethnicity (beta = $-.57, t = -5.53, p < .001$) were both significant predictors of DSCB-OA scores, whereas poverty status was not (beta = $-0.13, t = -1.23, ns$). These results indicate that education and ethnicity were significant predictors of DSCB-OA scores, such that respondents who were African American and had less education were more likely to report increased barriers to diabetes self-care.

QUALITATIVE FINDINGS

The transcribed interviews provide insights into the experiences of self-care behavior among older women with diabetes. Furthermore, these data were able to capture why the groups identified by the quantitative analyses experienced more barriers to diabetes self-care than did other groups. Themes that emerged from the transcripts

Table 2
Mean Scores for Diabetes Self-Care Barriers Assessment Scale for Older Adults (DSCB-OA) Individual Items According to Ethnicity

<i>Item</i>	<i>African</i>	<i>White</i>
	<i>American</i>	
	(n = 27, 53%)	(n = 24, 47%)
1. Checking blood sugar as often as I should is troublesome.*	2.07	1.25
2. I always know when my blood sugar is high or low, so there is no need to check my sugar.	1.44	0.83
3. The strips are too expensive for me to check my sugar as often as needed.*	2.30	1.33
4. Checking my blood sugar would not help control my diabetes.	1.30	1.64
5. It is hard to do regular exercise.*	2.07	1.04
6. Eating 3 meals and snacks makes me gain weight.	1.81	1.58
7. Feeling hungry makes it hard to stay on my diet.	1.47	1.54
8. I eat more than I should because I enjoy eating.	1.85	1.38
9. It is hard for me to reach my feet to see them well.*	1.44	0.83
10. Having as many health problems as I do, it is difficult to do everything for my diabetes.	0.96	0.76
11. Problems with my feet interfere with exercising.*	2.04	0.98
12. When I walk, my legs hurt.*	2.22	1.00
13. My diabetic medication requirements are too costly.*	2.00	0.83
14. I feel better when I take my diabetes medication. ^a	0.65	0.83
15. It is hard to find a provider/physician to visit regularly for my diabetes care.*	1.52	0.21

Note. DSCB-OA items are scored as follows: 0 = *strongly disagree*, 3 = *strongly agree*. Higher scores reflected greater perceived barriers to self-care.

a. Item 14 was reverse scored.

*Significant differences ($p < 0.01$) found between ethnic groups.

correspond to several domains of self-care barriers, including financial challenges, lack of access to quality care for diabetes, and pain and disability that inhibit self-care behaviors.

Financial Challenges to Self-Care

Lack of monetary resources constitutes a barrier to diabetes self-care for many of the women in our sample. The qualitative portion of our interviews corroborates the findings from the DSCB-OA,

which revealed an inability to check blood sugar due to the expense of the equipment. As a 70-year-old White woman noted,

It's simply too much money to be buying those test strips. You can get the machine pretty cheap with all those rebates. But where they get you is the strips, and my insurance don't cover it. I simply can't come up with the money to do that [test blood sugar].

In addition to these financial barriers included on the DSCB-OA, informants discussed how limited resources prevents purchasing appropriate foods and taking medication as recommended. One 77-year-old African American woman acknowledged that she does not choose the foods she is supposed to because of the expense associated with higher quality food. She stated,

Being on a fixed budget like I am, I have to think about what will last, what I can carry with me when I walk from the store, what the coupons cover and all that. I'd like to fill my shopping cart full of fruits and vegetable and all, but that stuff's high! High! So, looks like I stick to the breads, soups, crackers and all.

Of the individuals expressing that financial barriers prevented them from engaging in certain self-care behaviors, 70% were African American, and 90% lived below the poverty level.

Lack of Access to Quality Medical Care for Their Diabetes

Although all of the informants in our sample were enrolled in Medicare, Medicaid, or both, which generally paid for most of their health care services, many expressed the perspective that regular visits to a health care provider for diabetes care were a challenge. Specifically, many of the informants referred to a lack of continuity of care, poor quality of care, difficulty securing appointments, and logistical obstacles to being seen by their physician. Of those who indicated these obstacles, 65% were African American, 54% had less than an eighth-grade education, and 78% lived below the poverty level.

First, about 15% of those interviewed indicated that they fail to obtain appointments with the same practitioner, undermining their de-

sire for a consistent and reliable practitioner. As one 76-year-old African American woman from a rural community noted,

I don't want to say anything bad about this place [the local public health clinic where she receives routine diabetes care three times a year], but I wish that I'd see that same doctor that I saw the last time. Seems you just get to know someone, then they're gone. Maybe living out here doesn't suit them or something. I don't know. I just know that I have to start all over again every visit, telling them what's going on, how I feel. You know. Sometimes I feel like I'm the teacher and they's the student! Like I say, you have to start all over, practically educating them. They just ask a couple of questions. I can't trust 'em because they don't know me.

Whereas this informant suggested that her routine care is compromised by lack of continuity of health care providers, other informants were more explicit in their concern about the quality of care received. All but one of the informants who expressed this opinion received medical care from public health clinics. One White 68-year-old maintained, "They don't treat you real good there. Sometimes I wonder if they know what they're doing." Another respondent noted, "Everything looks a little dirty. I don't even like going into the waiting room or the exam room because I'm wondering what I'll catch in there!" Other informants expressed similar concerns about cleanliness, knowledgeable staff, and proper record keeping.

Another barrier expressed by a sizable portion (35%) of the informants was difficulty obtaining appointments. Irrespective of the location of their medical care, many expressed the opinion that regular visits had to be scheduled far in advance, otherwise one would never receive an appointment. "I see this as a problem," noted a 72-year-old White woman who has been visiting the same physician for 32 years. She continued,

Some days are good days and some are real bad, and I'd rather go when I'm not feeling so hot so they can tell me what's wrong—if I'm doing something or if they can do something about it. But going to an appointment that you scheduled six months ago is a bad idea.

Other women noted that the long waiting period constituted a barrier to receiving medical care.

Finally, a sizeable subgroup of the sample (20%), particularly those who were older and had lower incomes, indicated that there were logistical barriers to prevent their receipt of care. Key among these barriers was inadequate transportation to the office of the health care providers. As one White 82-year-old woman noted,

I'd like to make those appointments. I try to be sure that someone knows I need to go and sometimes I'll even hire someone to carry me. But sometimes I just can't spend the money to do that and I'll feel real bad, but I'll have to cancel the appointment and wait until the next time. I know I shouldn't do that, but I really ain't got no choice.

Pain and Disability That Inhibit Self-Care Behaviors

As noted in the quantitative results displayed in Table 2 (Items 5, 9, 11, and 12), informants expressed several domains in which discomfort and physical incapacitation inhibits optimal self-care behavior. Impaired vision constituted a major problem for many of the women in our sample, frequently limiting their ability to engage in self-care behaviors such as exercising, driving to their physician's office, or reading food labels that might have informed them about nutritional content. Consistent with the quantitative findings, those who expressed this perspective tended to be African American (68%), poor (72%), and less educated (52%).

A 68-year-old White woman explained her frustration with impaired vision as follows:

I don't know if it's just that I'm getting older or if I'm losing my sight owing to my sugar, but it's scary sometimes when I go out walking. I used to walk three miles at a time. I loved that—just getting out and walking. But it's gotten to where I'm scared, what with not being able to see cars or dogs or anything coming my way.

Others noted that checking their feet on a daily basis had become impossible. "It don't seem to matter the light. I have given up on checking my feet because I just can't see. My doctor better just do that," noted a 74-year-old participant.

In addition to diminished vision, many informants (25% of the entire sample and most of the African American participants) pointed to

pain or foot or leg problems that interfere with their ability to exercise. One 78-year-old African American woman discussed pain as a barrier to exercise.

Now I was never one of those who you'd see constantly moving around. Going, going, like there was no tomorrow. When I was younger, when I had to get things done I'd move, but I never was one for exercising, to tell the truth. But, now here comes the doctor and he's telling me that I need to start moving around, taking walks, making some movement. I hate to tell him that it ain't going to happen, what with all of this stiffness and arthritis in my knees and ankles. It hurts so bad I'm doing good just to stand.

Discussion

It is estimated that only one in five patients under the care of a physician for diabetes maintains normal glycosylated hemoglobin (Diabetes Control and Complication Trial Research Group, 1993), providing evidence of the lack of success of treatment regimens, including self-care. Most research efforts have focused on understanding the association between glycemic control, adherence to treatment regimen, demographic variables, knowledge about NIDDM, personality measures, and medical history. Few studies have inquired directly about the patient's perception or the emic conceptualizations of self-care (Hunt, Valenzuela, & Pugh, 1998). This study has attempted to identify potential barriers to optimal self-care, particularly focusing on barriers older women perceive when attempting to manage their diabetes.

The quantitative analysis revealed that ethnicity (being African American) and education (having less than an eighth-grade education) were significantly associated with a greater number of barriers to diabetes self-care behaviors. It is somewhat surprising that poverty status was not a predictor of DSCB scores, whereas education and ethnicity were predictors of self-care barriers. Several reasons might account for this lack of significance between poverty status and the number of self-care barriers. First, it is possible that the modest sample size in combination with the generally high poverty level (68.5% of the total sample below poverty level) rendered insignificant the association between self-care barriers and poverty. In other words,

there were too few participants above poverty level to use income as a predictor of diabetes self-care barriers.

Second, it is conceivable that even those participants reporting incomes above the poverty level do not have sufficient resources to circumvent barriers to diabetes self-care. Contextual and life history data obtained through the qualitative interviews reveal the scarcity of resources in which most of the women in the study live. Only a few of the study participants enjoyed relatively high status occupations (i.e., schoolteacher, a hospital administrator, and mayor) or live in well-to-do families. Rather, most of the participants, including those with incomes above poverty level, described former occupations or roles that rendered them prone to economic insecurity. Thus, it is possible that a more sensitive indicator of available resources would have detected differences in diabetes self-care barriers according to economic status.

The limited number of items directly related to financial barriers to diabetes self-care may offer a final explanation for the lack of significance between poverty status and the number of self-care barriers. Only three items of the fifteen DBCB-OA items (Items 3, 13, and 15) directly tap financial barriers. Thus, although most of the participants live below the poverty level, the quantitative assessment of their barriers to optimal self-care may not adequately reveal the extent to which poverty prevents self-care.

The qualitative findings, however, were more successful in eliciting barriers to self-care, including inadequate finances, lack of access to medical care, and pain or disability. The informants' descriptions of these barriers highlight that although patients may wish to engage in optimal self-care behaviors, they often lack the means and ability to do so. The woman citing inadequate transportation and money necessary to purchase more fresh fruits and vegetables is a clear example of having sufficient knowledge but insufficient resources. Although it is beyond the realm and responsibility of health care providers to provide transfer payments or to subsidize incomes, it behooves the health care community to investigate reasons behind less than optimal self-care rather than assuming a lack of will or education.

Indeed, results from this investigation indicate that most participants are aware of basic self-care recommendations, although their knowledge of more esoteric diabetes information may be limited.

Although much of the existing research indicates that harboring knowledge is a necessary precursor to optimal self-care, most studies also document little correlation between knowledge alone and metabolic control (Coates & Boore, 1996).

The lack of access to medical resources was an anticipated barrier to recommended diabetes self-care among this low-income population. Specifically, participants discussed problems inherent in a lack of continuity of care and barriers to obtaining recommended office visits. The lack of continuity of care discussed frequently by respondents may be characteristic of public health clinics and, ultimately, may undermine high-quality medical care. The constant struggle to secure a ride to the physician's office presents another potential barrier to self-care.

Finally, citing pain or disability, many of the participants reported barriers to their self-care coming from their own bodies. Such reports require consideration of key questions, including the following: Which actions can be taken to prevent or at least delay diabetic retinopathy? What sorts of recommendations might we pass along to elders to reduce their arthritis pain so that the pain does not preclude needed exercise? Addressing these concerns and obvious impediments to self-care might go a long way in promoting an elder's ability to undertake and maintain an exercise regimen. Again, it is crucial to look for the proximate cause rather than relying on assumptions that lack of education or will is the most pressing barrier to optimal self-care.

LIMITATIONS AND FUTURE DIRECTIONS

Although this investigation moves us closer to understanding self-care activities of individuals with NIDDM, several study design limitations bring forth recommendations for future investigations. First, as previously stated, one of the primary instruments used in this study, the DSCB-OA has been subjected to minimal validation. We addressed this concern by administering the instrument to a sample similar in personal characteristics (age, ethnicity, socioeconomic status, gender, residence) to the population for which the DSCB-OA was originally validated. Furthermore, we supplemented the DSCB-OA with in-depth interviews. Although the interviews largely corrobo-

rated the instrument's findings, the ultimate utility of the DSCB-OA instrument is conditional on further validation studies.

Second, although it was not the intention of this study to describe the relationship between barriers to self-care, self-care activities, and glycemic control, such information would be useful. Do these perceived barriers to self-care activities actually influence glycemic control? We would assume that there would be a direct association between perceived impediments to optimal self-care and glycemic control, but we lack an understanding of the degree to which barriers are experienced and the mechanism involved in this relationship. For example, does a "strongly agree" response on the item "When I walk, my legs hurt" necessarily mean that the respondent no longer walks, thereby abandoning exercise? It would be helpful to understand these biobehavioral relationships between actual and perceived barriers to self-care, self-care activity, and glycemic control.

Finally, the range of variables that we were able to examine was limited by the modest sample size of this study. To examine the association between barriers to self-care and other potentially important factors such as marital status, living arrangements, residence, and psychosocial constructs such as locus of control would require a larger sample size. However, because diabetes self-care barriers remain a relatively underexplored topic, we elected to gain greater understanding of reasons for these barriers rather than to examine other correlates of barriers to self-care behaviors. Such insights are most fruitfully obtained by allowing the participant to establish domains of importance rather than "imposing a predetermined interpretive grid on the self-care practices of elderly people" (Abel & Sankar, 1993, p. 4). Obtaining these insights generally involves qualitative strategies, or at least complementary orientations, that involve a modest number of individuals. However, with greater background and understanding of these barriers, greater attention can be paid to examining the associations of such barriers and other variables in future studies.

With increasing life expectancy and improved medical management of disease, elders may expect to experience a greater frequency of chronic disease. As previous research indicates, most attempts to contain and manage chronic disease stem from the patient rather than the health care provider. In this investigation, we have highlighted several areas of diabetes self-care that individuals perceive as problematic

and reasons that underlie these perceptions. With continued efforts aimed at understanding self-care activities, we move closer to assisting those with chronic illness to enhance their management skills, improve their health and functioning, and achieve a higher quality of life.

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The Physical Functioning Inventory:

A Procedure for Assessing Physical Function in Adults

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The Physical Functioning Inventory, an instrument designed to assess changes in how and how often activities are performed in persons reporting difficulty with a task as well as in those who do not, is described. The measure is designed for adults. Interrater and test-retest reliability were assessed with active participants in the Baltimore Longitudinal Study of Aging (BLSA). Percentage agreement ranged from 63% to 100%. The instrument was also given to 392 inactive BLSA participants as part of a follow-up telephone interview. Fifty-eight percent of the respondents reported no difficulty in performing a task, yet reported a change in how or how often they performed that task. The results indicate that the instrument is reliable and effective in detecting early stages of disability in activities of daily living, instrumental activities of daily living, and mobility. The instrument is somewhat less reliable for moderate and strenuous physical activities.

Many self-report instruments that measure physical function or functional status in adults are designed specifically to assess ability within a narrow range of age or function, or are designed for certain

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populations such as those with specific medical diagnoses. Also, they are often used to evaluate prognosis, rehabilitation, and recovery of function (Branch & Meyers, 1987). Other instruments assess multiple domains of function, but primarily by tapping into the most severe stages of functional loss (i.e., dependency or difficulty). Some of these instruments have been used to describe functioning of older community-dwelling adults; few cover the full range of function for any task (e. g., the National Health Interview Survey, Fitti & Kovar, 1987).

Existing instruments primarily assess difficulty and/or independent performance in specific tasks of personal care and household management or the degree of assistance required to perform them (Jette, 1987). Also assessed are mobility and upper extremity functions (Nagi, 1976; Rosow & Breslau, 1966). As indicated by Czaja, Weber, and Nair (1993); Fried, Herdman, Kuhn, Rubin, and Turano (1991); and Verbrugge and Jette (1994), these outcomes do not tap other facets of task performance that may also identify important changes in function, such as adaptations to minimize or prevent disability or changes in the frequency of task performance. In situations where the goal is to examine transitions in behavior over a wide range of ages and abilities, instruments that ascertain only difficulty and dependence may not be sensitive to intermediate steps in the course of functional change.

This article describes the Physical Functioning Inventory (PFI), an instrument designed by scientists at the National Institute on Aging and The Johns Hopkins Medical Institutions. Results from a reliability study and a telephone survey of almost 400 adult men and women are presented. The purpose of the PFI is to describe the heterogeneity of age-associated declines in function in mostly healthy and community-dwelling adults across a wide range of ages. To express such

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heterogeneity and decline, an instrument must (a) be sensitive to early changes in performance of specific tasks, (b) describe the variety and heterogeneity of adaptations made by persons to continue to accomplish particular activities in the face of declines in ability, (c) assess function across a range of activities beyond personal care and household management, (d) be relevant for use with both younger and older healthy community-dwelling adults and persons with existing limitations in function, and (e) be appropriate for use in longitudinal studies of aging to enhance the understanding of the natural history of functional change with age.

To address the five requirements listed above, the PFI includes activities of daily living (ADL), instrumental activities of daily living (IADL), and more demanding activities, including mobility, moderate activity, and vigorous exercise. To be appropriate for younger and older community-dwelling adults, it covers a wide range of tasks. For each task, the PFI includes probes designed to detect several dimensions of changes in physical functioning: dependency, difficulty, and modification and/or frequency change of task performance. The changes in how or how often a task is performed define two aspects of a preclinical state proposed by Fried et al. (1991) as “a state of early identifiable functional loss, occurring due to impairment, and which precedes recognition of difficulty with task performance” (p. 288). The PFI examines modifications made by adults in the way tasks are performed even though the individual perceives no difficulty in performance (i.e., preclinical disability). There is evidence that changes in method and/or frequency of task performance identify individuals at such an intermediate stage of function prior to onset of disability and identify a subset of older adults who are at high risk of developing difficulty in mobility (Fried, Bandeen-Roche, Chaves, & Johnson, 2000; Fried et al., 1996). Overall, this instrument was designed to provide a continuum of outcomes, be appropriate for a wide range of ages and levels of health, and study longitudinal change across the adult age range. It is intended to be used as a survey instrument or a clinical questionnaire that characterizes individual adaptations to limitations in physical functioning.

Method

DESCRIPTION OF THE PFI

The PFI measured performance on 22 tasks in the categories of ADL, IADL, mobility, and moderate and strenuous activity. Tasks were selected from these four categories to cover a wide range of activities, including activities that are commonly assessed in other instruments. The three ADLs were bathing or showering, dressing, and using the toilet. The 11 IADLs were light housework, lifting or carrying 10 pounds, preparing meals, using the telephone, getting to places out of walking distance, shopping for personal items, giving oneself medication, managing money, driving, reaching and getting down a 5-pound object from just above the head, and opening jars that have been previously opened. The five mobility tasks were walking up 10 steps, walking one half mile, walking one third of a block, walking around the house, and stooping, crouching, or kneeling. Moderate activity included activities such as golf, bowling, vacuuming (as an example of heavy housework), and gardening. Strenuous exercise included activities such as racquetball, jogging, heavy construction work, and aerobic exercise. So that responses were comparable, examples of strenuous and moderate activities were provided to give reference standards to respondents' self-definition of strenuous or moderate activity. The last task in the PFI was an open-ended query to respondents about the most strenuous task they performed. For some, this was very vigorous exercise, such as running; for others, it was walking across their living rooms.

Probe sequence. Self-reported physical function was assessed with a sequence of 3 to 9 probes for each of the 22 tasks. The probes, their sequence, and response options are detailed in the appendix.

The initial probe for all tasks was, "Do you have difficulty [performing task]." Depending on the participant's response, the following paths were possible. A respondent reporting difficulty was asked these additional probes: degree of difficulty, whether and what type of assistive devices were used, and whether help from another person was required. These questions are standardized to the National Health Interview Survey Supplement on Aging (Fitti & Kovar, 1987). In

addition, respondents were asked, for each task, whether and what type of modifications had been made in the way the task was performed and whether the frequency with which the task was performed had changed (and whether it had increased or decreased). In the PFI, a modification is a change in the way an activity is performed, such as using a sponge on a stick to wash one's feet, leaning to perform an activity, or using a special device to open jars. Finally, the participant was asked the number of months or years the task had been difficult to perform or modifications had been made, and the symptoms and the medical conditions the individual associated with the difficulty, modification, or other changes in task performance.

A respondent who reported no difficulty with a task was asked at least two additional probes to identify possible early changes in functioning: whether any modifications had been made to the way in which the task was performed and whether the frequency had changed. If the answer to all three probes was no, the probe sequence for that task was complete. If the respondent replied yes to either the modification or the frequency change probe, he or she was asked for how long the change had occurred and the symptoms and conditions that he or she thought were the basis for these changes, if any.

A respondent who reported no longer performing a task due to difficulty or not performing a task although being able to (i.e., the lack of performance was not related to health) was asked for how long he or she had not done the task and whether there were any associated symptoms and conditions. A respondent who reported never having done a task was asked if there were any associated symptoms and conditions as the basis for this. Tasks that were not performed for non-health-related reasons were coded as such and were not counted as being performed with difficulty or related to health.

Task sequence. Each respondent was asked about the 22 tasks in the same sequence. However, three skips in the task sequence were incorporated to minimize participant burden. First, if the individual reported no difficulty walking a half mile, the probe sequences for walking one third of a block and walking around the house were not asked. Second, the probe sequence for moderate activity was not asked if strenuous activity was reported as performed without difficulty. Third, the probe sequences for tasks 11 through 19 (see the

appendix) were skipped for respondents younger than 55 years old who reported no difficulty, no health-related modifications, and no health-related frequency changes for tasks 1 through 8. All respondents were asked about the first eight tasks because these tasks were sensitive to functional changes in respondents of all age groups in pilot studies at the Baltimore Longitudinal Study of Aging (BLSA). The rationale was that the first eight tasks are more difficult than the next nine and participants with no difficulty with the first eight should report none with the next nine. When this occurred, values of 0 (no difficulty, no modification, and no change in frequency) were assigned to tasks 11 through 19. Data from this study support the decision. Sixty-three of the 140 respondents younger than 55 years did not qualify for the skip of the nine tasks (11 through 19 in the appendix). Even in this group of 63 respondents who were impaired in performance of at least one task, four or fewer respondents indicated health-related difficulty or change in tasks 11 through 19. Therefore, it was with confidence that negative responses were assigned and unless indicated, assigned values were used in the following analyses.

STUDY SAMPLE

The BLSA is an open-panel study in which community-dwelling adults are constantly recruited. Participants in the BLSA return to the Gerontology Research Center every 2 years for a 2½ day visit. During each visit, medical, physiological, and psychological assessments are made by National Institute on Aging (NIA) physicians and scientists to describe normal physiological and behavioral aging processes.

The PFI was reviewed and tested frequently during its development by administering the instrument to active BLSA participants and persons who were on a waiting list to join the study. These reviews allowed examination of patterns of responses and outcomes and feedback on interview length and interpretation of probes. The PFI can be used either in a paper-and-pencil or computer-administered format, in person, or over the telephone. In both face-to-face and telephone situations, the PFI takes between 15 minutes and 1 hour to complete, depending on the number of difficulties reported and, correspondingly, the age of the respondent.

RELIABILITY STUDY

Respondents and procedure. Interrater and test-retest reliability of the PFI were measured. For the interrater reliability study, the respondents were 50 active research participants in the BLSA. The average age was 55 years, ranging from 24 to 84 years. Ninety-four percent were White, 58% male, 51% married, and 78% had at least a bachelor's degree. Ninety-two percent rated their health as excellent or good.

Forty-seven BLSA participants were in the test-retest reliability study. The average age was 53 years, ranging from 24 to 89 years. Ninety-four percent were White, 47% male, 59% married, and 77% had at least a bachelor's degree. Eighty-seven percent rated their health as excellent or good.

The participants completed the PFI during their regular 2½ day visit to the Gerontology Research Center. The interviews were conducted face-to-face using the computer-administered format. For interrater reliability, one interviewer gave the PFI on the first day of the visit and a second interviewer gave it on the second day. For test-retest reliability, the same interviewer gave the PFI on the first day and again on the second day of the visit. The interviews were completed during a 24-month period.

Interrater and test-retest reliability were assessed using kappa and average percentage agreement between the two raters or the same rater on two occasions for three probes used in each of the 22 items: self-reports of difficulty in doing the task, modifications in the way the task was performed, and changes in the frequency with which the task was performed.

TELEPHONE INTERVIEW

Respondents and procedure. Of the inactive BLSA participants, 392 completed telephone interviews as part of a follow-up procedure to ascertain current status of these research participants. Inactive participants were those who had not returned to the study center for at least 3 years or who had formally withdrawn from the study. Deceased participants were not included in the count of inactive participants.

Structured telephone interviews were designed to update demographic information and reasons for inactive status and to obtain health, cognitive, and functional status.

The respondents ranged in age from 25 to 100 years ($M = 64$ years). Seventy percent of the respondents were married, and 68% had at least a bachelor's degree. Eighty-five percent of the respondents lived in private residences, and 15% lived in senior citizens' housing, life-care communities, nursing homes, or convalescent homes. Eighty percent of the respondents rated their health as excellent or good and only 4% rated their health as poor.

Respondents were asked the reasons they had not returned to the study. Twenty-two percent said the most important reason they had not returned was that they were too busy. Other reasons included distance from study site (21%), health reasons (18%), and expense (10%).

Results

RELIABILITY

*Interrater reliability.*¹ Of the 22 tasks assessed, percentage agreement was greater than 80% for 21 tasks for the difficulty probe, 21 for the modification probe, and 19 for the frequency change probe. Four of the five tasks for which percentage agreement was less than 80% were in the strenuous and moderate activity category. For six of the analyses, across the three probes, kappa could not be calculated due to lack of variability in the responses. This occurred in four of the tasks for the difficulty probe for dressing, using the telephone, getting to places out of walking distance, and giving oneself medication, and in one task for the modification probe for giving oneself medication. In all of those tasks, percentage agreement was more than 90%, however. For the remaining tasks, about 54% had kappa values of .60 or greater. In most instances, kappa values of less than .60 were associated with percentage agreement more than 80%.

*Test-retest reliability.*² As with interrater reliability, percentage agreement was calculated for each task on three probes. Percentage

agreement was greater than .80 for all 22 tasks with the difficulty probe, 21 tasks with the modification probe, and 20 tasks with the frequency change probe. The three tasks with reliability estimates below .80 were in the strenuous and moderate activity category. The kappa for the frequency probe for reopening jars could not be calculated; however, percentage agreement for that item was 96%. For 72% of the remaining tasks, kappa was .60 or greater. As with interrater reliability, for most tasks for which kappa was below .60, percentage agreement was more than 80%. For example, the kappa for the difficulty probe for lifting or carrying 10 pounds was .38 and the percentage agreement was 94%.

TELEPHONE INTERVIEW

Description of physical functioning in inactive BLSA participants. The frequency distributions of responses to the question, "Do you have difficulty . . ." are presented in Table 1. Difficulty in task performance was reported most frequently in the categories of mobility and strenuous and moderate activity. Respondents could also indicate that they no longer performed a task due to difficulty; this occurred most frequently with strenuous and moderate activity, walking a half mile, and driving. The response categories "could do but don't" and "never did" provided respondents the opportunity to give reasons not related to health. Table 1 shows that these categories were most frequent for meal preparation, housework, managing money, and strenuous activities.

In Table 2, modifications and frequency changes for each task are presented separately for respondents who reported performing the task with and without difficulty. Many respondents, despite reporting no difficulty in performing a task, reported having altered their method of task performance due to underlying health changes. Overall, 58% of the respondents reported such a modification in one or more tasks (59% for men, 57% for women). For each task, at least 60% of the respondents who reported performing the task with difficulty reported modifying the way in which they performed it. For those respondents who reported performing tasks with no difficulty, modifications were reported most frequently in the mobility and

Table 1
 Frequency Distribution by Task of Responses to, "Do You Have Any Difficulty . . . ?" (in percentages)

Task	Difficulty ^a	No Difficulty ^b	No Longer Do ^c	Could But Don't ^d	Never Did ^e
ADL					
Bathing, showering (379)	8.44	86.54	5.01	0.00	0.00
Dressing (378)	11.38	85.45	3.17	0.00	0.00
Using the toilet (378)	5.29	93.12	1.59	0.00	0.00
IADL					
Driving (391)	4.35	80.31	12.53	1.28	1.53
Reaching above head (381)	6.30	86.35	5.77	1.31	0.26
Reopening jars (382)	2.88	92.67	2.62	1.83	0.00
Light housework (388)	3.09	85.05	6.70	3.87	1.29
Lifting or carrying 10 pounds (383)	6.01	84.86	8.36	0.78	0.00
Preparing meals (377)	1.59	83.82	7.16	5.31	2.12
Using telephone (376)	9.57	88.56	1.60	0.27	0.00
Getting to places out of walking distance (373)	3.75	90.88	4.29	1.07	0.00
Shopping for personal items (377)	3.45	87.27	7.43	1.59	0.27
Giving self medication (371)	2.16	89.76	6.74	1.35	0.00
Managing money (376)	2.66	83.51	7.71	4.52	1.60
Mobility					
Walking up 10 steps (387)	17.57	76.23	5.43	0.78	0.00
Walking one half mile (379)	8.71	75.99	13.98	1.32	0.00
Walking one third block (384)	5.47	90.36	3.91	0.26	0.00
Walking around house (385)	3.12	94.03	2.86	0.00	0.00
Stooping, crouching, kneeling (387)	32.82	57.88	8.53	0.52	0.26
Strenuous/moderate					
Strenuous activity (377)	6.63	28.83	36.07	14.06	14.85
Moderate activity (376)	10.64	75.53	12.77	0.80	0.27

Note. ADL = activities of daily living, IADL = instrumental activities of daily living.

a. Difficulty with the task (currently perform).

b. No difficulty with the task (currently perform).

c. No longer do the task due to difficulty doing it.

d. Could do it but do not for nonhealth reasons.

e. Never did it.

strenuous activity categories. For many of the tasks, changes in how often a task was performed were reported by more than 50% of the respondents who reported performing the task with difficulty. Changes in how often tasks were performed were reported by more

Table 2
 Percent of Respondents Indicating Modifications or Frequency Changes by Difficulty and Task

Task	Perform Task With Difficulty		Perform Task Without Difficulty	
	Modified ^a	Frequency Change ^b	Modified	Frequency Change
	% (n) ^c	% (n)	% (n)	% (n)
ADL				
Bathing, showering	94 (32)	28 (32)	8 (326)	2 (325)
Dressing	83 (42)	15 (40)	4 (322)	1 (322)
Using the toilet	75 (20)	13 (16)	6 (350)	1 (349)
IADL				
Driving	75 (16)	50 (16)	18 (312)	18 (310)
Reaching above head	74 (23)	39 (23)	5 (328)	1 (327)
Reopening jars	73 (11)	27 (11)	3 (350)	3 (350)
Light housework	75 (12)	92 (12)	5 (330)	10 (330)
Lifting or carrying 10 pounds	73 (22)	52 (23)	5 (322)	4 (322)
Preparing meals	100 (6)	80 (5)	3 (316)	9 (316)
Using telephone	69 (36)	53 (32)	5 (333)	3 (330)
Getting to places out of walking distance	100 (14)	85 (13)	7 (339)	7 (338)
Shopping for personal items	85 (13)	83 (12)	4 (329)	7 (329)
Giving self medication	63 (8)	13 (8)	2 (333)	1 (333)
Managing money	60 (10)	40 (10)	3 (314)	1 (312)
Mobility				
Walking up 10 steps	82 (68)	56 (66)	22 (294)	10 (294)
Walking one half mile	91 (33)	75 (32)	11 (287)	11 (283)
Walking one third block	100 (21)	80 (20)	5 (346)	2 (346)
Walking around house	100 (11)	64 (11)	6 (346)	1 (357)
Stooping, crouching, kneeling	84 (125)	52 (124)	15 (221)	6 (218)
Strenuous/moderate				
Strenuous activity	72 (25)	80 (25)	18 (106)	33 (106)
Moderate activity	79 (39)	72 (39)	6 (283)	8 (284)

Note. ADL = activities of daily living, IADL = instrumental activities of daily living.

a. Respondents reporting a health-related modification to the way the task is performed.

b. Respondents reporting having cut back or given up task performance.

c. In all columns and tasks, *n* represents the total number of respondents for that cell. For example, of the 32 respondents who reported difficulty with bathing or showering, 94% have modified their task performance and 28% have made a frequency change. Of the 326 who did not report difficulty, 8% have modified and 2% have made a frequency change.

than 10% in driving, walking a half mile, and strenuous activity among those who performed the tasks without difficulty.

For examination of age differences, the 392 respondents in the telephone interview were divided into four age groups: 25 to 54 years, 55 to 69 years, 70 to 84 years, and 85 to 100 years. The data for men and women were combined because initial examination revealed no statistically significant differences wherever there were sufficient numbers to justify calculation of the statistic. Age differences were analyzed for reporting difficulty (see Table 3), and age patterns were explored for reporting health-related modifications (see Table 4) and reporting health-related frequency changes (see Table 5). To be included, a respondent must have answered either yes or no to the difficulty question for every task in the category (i.e., the respondent was currently performing every task in the category either with or without difficulty). Significance tests are not included for Tables 4 and 5 due to the small number of respondents in some of the cells.

The number of tasks with which respondents reported difficulty was calculated for each age cohort by task category (see Table 3). The percentage of respondents reporting difficulty with one or more tasks in a category generally increased with age. The data in Table 3 also show an increasing percentage of respondents reporting difficulty with one or more tasks in a category from ADL to IADL to mobility. The baseline number of respondents currently performing strenuous or moderate activities was substantially less than the number for the other task categories. The prevalence of difficulty in strenuous and moderate activity was generally lower than the prevalence of mobility difficulty in each age group, except the 85- to 100-year-olds.

Table 4 shows the frequency of health-related modifications by age cohort and by presence or absence of reported difficulty. With increasing age, there was an increase in the percentage of respondents who reported modifications for ADLs, IADLs, and mobility tasks for those who reported performing the tasks without difficulty, and in IADLs and mobility tasks for those who reported performing tasks with difficulty. No age patterns were seen with strenuous and moderate activity. The percentage who reported health-related modifications was low compared with other categories.

Similarly, Table 5 presents data for age patterns in the frequency with which tasks were performed. This includes respondents who reported cutting back or giving up performance of these tasks. There were fewer clear age patterns for frequency changes than for

Table 3
 Percentage of Respondents in Four Age Cohorts Reporting
 Difficulty^a in One or More Tasks Within Task Categories

Task	Age in Years				χ^2 ^c
	25 to 54 % (n) ^b	55 to 69 % (n)	70 to 84 % (n)	85 to 100 % (n)	
ADL	3.1 (130)	11.8 (76)	24.8 (117)	41.7 (36)	41.75
IADL	10.7 (121)	5.5 (55)	38.7 (75)	50.0 (10)	36.77
Mobility	24.2 (132)	35.4 (65)	56.8 (88)	61.1 (18)	28.01
Strenuous or moderate activity	11.4 (79)	15.4 (26)	33.3 (21)	66.7 (3)	11.00

Note. ADL = activities of daily living, IADL = instrumental activities of daily living.

a. Difficulty is defined as reporting difficulty with a task currently performed.

b. In all columns, *n* represents the total number of respondents for each cell (e.g., 3.1% of one hundred and thirty 25- to 54-year-olds reported difficulty with one or more ADL).

c. $p < .05$ for all.

Table 4
 Percentage of Respondents in Four Age Cohorts Reporting a Health-Related Modification
 in One or More Tasks Within Task Categories by Presence or Absence of Difficulty

Task	Age in Years			
	25 to 54 % (n) ^a	55 to 69 % (n)	70 to 84 % (n)	85 to 100 % (n)
ADL				
With difficulty	0.0 (4)	0.0 (9)	27.6 (29)	40.0 (15)
Without difficulty	3.2 (126)	6.0 (67)	27.3 (88)	22.2 (18)
IADL				
With difficulty	8.3 (12)	33.3 (3)	46.4 (28)	80.0 (5)
Without difficulty	12.2 (107)	26.9 (52)	28.3 (46)	50.0 (4)
Mobility				
With difficulty	18.8 (32)	39.1 (23)	53.1 (49)	45.5 (11)
Without difficulty	16.3 (98)	21.4 (42)	35.1 (37)	57.1 (7)
Strenuous or moderate activity				
With difficulty	0.0 (9)	0.0 (4)	16.7 (6)	0.0 (2)
Without difficulty	15.7 (70)	14.3 (21)	35.7 (14)	0.0 (1)

Note. ADL = activities of daily living, IADL = instrumental activities of daily living.

a. In all columns, *n* represents the total number of respondents for each cell (e.g., 3.2% of the one hundred and twenty-six 25- to 54-year-olds who reported no difficulty with one or more ADLs reported modifying).

modifications. Age patterns for frequency changes in ADLs, mobility tasks, and strenuous/moderate activities performed without difficulty

Table 5
Percentage of Respondents in Four Age Cohorts Reporting a Health-Related Frequency Change in One or More Tasks Within Task Categories by Presence or Absence of Difficulty

Task	Age in Years			
	25 to 54 % (n) ^a	55 to 69 % (n)	70 to 84 % (n)	85 to 100 % (n)
ADL				
With difficulty	25.0 (4)	0.0 (9)	0.0 (27)	0.0 (12)
Without difficulty	0.0 (126)	0.0 (67)	2.3 (87)	10.5 (19)
IADL				
With difficulty	0.0 (12)	0.0 (3)	14.3 (28)	20.0 (5)
Without difficulty	4.7 (107)	7.8 (51)	8.9 (45)	0.0 (3)
Mobility				
With difficulty	6.7 (30)	9.5 (21)	21.3 (47)	0.0 (9)
Without difficulty	1.0 (98)	2.4 (41)	18.9 (37)	0.0 (6)
Strenuous or moderate activity				
With difficulty	11.1 (9)	0.0 (4)	0.0 (7)	0.0 (1)
Without difficulty	2.9 (70)	4.8 (21)	35.7 (14)	0.0 (1)

Note. ADL = activities of daily living, IADL = instrumental activities of daily living.

a. In all columns, *n* represents the total number of respondents for each cell (e.g., 0% of the one hundred and twenty-six 25- to 54-year-olds who reported no difficulty with one or more ADLs reported making frequency changes).

were observed. A larger percentage of adults aged 70 years and older compared with adults younger than 70 years, who reported no difficulty in performing these tasks, reported cutting back on how often they perform them. The observed age pattern for ADLs performed with difficulty was due to one respondent in the 25- to 54-year-old age group.

For each task for which difficulty or changes in how or how often the task was performed was reported, respondents were asked to identify what they believed were the associated medical conditions. The aging process was one of the top three conditions associated with difficulty or preclinical disability in all task categories. Arthritis was cited for ADLs, IADLs, and mobility tasks. Others were incontinence for ADLs, eye disease for IADLs, heart disease for strenuous/moderate activity, and problems with back or neck for mobility and strenuous/moderate activity.

The number of specific health conditions reported by age cohort across tasks was calculated. Respondents could report up to 4 con-

ditions for each task queried (84 possible). The number of medical conditions reported by respondents increased with each age category. Three percent of respondents aged 25 to 54 years old reported 3 or more medical conditions, whereas 13% of 55- to 69-year-olds, 27% of 70- to 84-year-olds, and 46% of 85- to 100-year-olds reported 3 or more conditions.

EXAMPLES

The qualitative data from the following cases illustrate the variety of adaptations to physical limitations made and show how the responses to the PFI were scored.

Example 1: ADL. A 94-year-old man reported no difficulty using the toilet, including getting to and from the toilet. Despite reporting no difficulty using the toilet, he did report making a health-related modification in the way he uses the toilet; specifically, he now uses the washbasin to help pull himself up. He reported doing this for the past 2 years due to pains in his legs and shoulders that he associated with heart disease. In terms of the three probes reported in this article, these responses were scored as modification for health-related reason with no difficulty in the task and no change in frequency.

Example 2: IADL. An 86-year-old woman reported no difficulty preparing her own meals; however, she has changed what she cooks, preparing frozen entrees and vegetables and cooking simpler meals. She reported cooking less frequently overall. These changes have been made for 1 year due to weakness and fatigue that she associated with aging and her cancer. These responses were scored no difficulty, health-related modification, and decrease in frequency.

Example 3: Mobility. The 94-year-old man from the ADL example above also reported having a lot of difficulty walking up 10 steps. He wore glasses and used handrails to climb the stairs. He required help from another person if rails were not available. He had decreased the frequency with which he climbed 10 steps. The changes had been made for 2 years. He reported symptoms of weakness and fatigue, which he attributed to a heart condition that required insertion of a

pacemaker. These responses were scored difficulty, health-related modification, and frequency change.

Discussion

The PFI was designed to measure a broad spectrum of physical functioning, from dependency and difficulty to preclinical changes, across a wide range of activities. Probes for modifications or adaptations and frequency changes were included to make the instrument sensitive to subtle changes in function in adults with varying abilities. Thus, the PFI may permit assessing some aspects of the heterogeneity of causes and outcomes of age-associated loss of ability. The results of the evaluations of the PFI reported here indicate that it is a useful instrument for studying physical function in community-dwelling adults of all ages.

RELIABILITY

Our intention was to examine reliability of responses for each task at each major point in the probe sequence for which responses from all participants were available. The reliability studies were conducted during one 2½-day visit to the Gerontology Research Center; it is possible that having only 1 day between administrations may have enhanced the reliability estimates. Percentage agreement was quite high in most tasks across all three probes. Collapsing across all tasks, percentage agreement was similar for the difficulty, modification, and frequency change probes (interrater: 92%, 92%, and 89%, respectively; test-retest: 97%, 92%, and 91%, respectively). Although the kappa statistic was low for several probes in several tasks, percentage agreement was high. This was consistent with more limited reliability assessment performed previously on the same questions in a different volunteer population (Fried et al., 1996). In most schemes, kappa values above .60 reflect at least good agreement (Byrt, 1996). For those tasks for which kappa was calculated, about 54% were .60 or greater. Often, when chance agreement is high, a low kappa results from the correction process for chance (Feinstein & Cicchetti, 1990). One outcome is a negative kappa, which results if percent agreement is less

than percentage agreement expected by chance. For example, in the present study, percentage agreement by chance for the difficulty probe for opening jars that have already been opened was 94.16%, percentage agreement was 94% and kappa was $-.03$.

The category of moderate and strenuous activity had relatively low levels of reliability. This may have occurred, in part, because the contexts for those activities were less specific than those for the other items. The examples used to characterize the categories are similar to those used in other instruments on self-reported physical activity, and the data from the present study indicate that respondents distinguished the two categories (see Table 1). However, the wide range of referents used as examples, particularly for moderate activity, resulted in more variability in estimating difficulty with and adaptation to the task. Reliability for these items may be increased through additional work to refine and more clearly define these categories.

Reports of the reliability of other instruments (cf. Cairl, Pfeiffer, Keller, Burke, & Samis, 1985; Jette, 1987; Jette et al., 1986) are generally presented for categories of responses and use different probes than those used in the PFI. For example, Jette (1987) reported test-retest and interobserver reliability scores for the Functional Status Inventory. For degree of difficulty (none to severe), both reliability measures were assessed with intraclass correlation coefficients. Test-retest coefficients ranged from $.69$ to $.88$ for gross mobility, home chores, personal care, hand activities, and social/role activities. Interobserver reliability ranged from $.71$ to $.82$. Reliability as measured by percentage agreement in the current study indicates comparable reliability estimates.

TELEPHONE INTERVIEW

In all four task categories, the percentage of individuals who reported difficulty with one or more tasks increased with age (the one exception was the 55- to 69-year-olds in the IADL category). This finding is consistent with those obtained in other studies (cf. Dawson, Hendershot, & Fulton, 1987). The percentage of respondents who reported modifications of method of task performance with no reported difficulty increased with age for all but the strenuous and

moderate activity category. Although one might expect more changes in how moderate and strenuous activities are performed by older as compared with younger adults, it may be that those older adults who report doing moderate/strenuous activity are still able to do so without difficulty or problems. The number of respondents who reported that they were currently performing strenuous or moderate activity was quite a bit lower than that for the other task categories. Moderate and strenuous activities as defined in the PFI are less essential than ADL, IADL, and mobility activities, so those who still engage in them may be doing so because they still can.

Alterations in frequency of task performance with no reported difficulty increased with age for all but the IADL category, possibly due to the small sample size in some conditions (e.g., there were only three people in the 85- to 100-year-old group who performed IADLs without difficulty). Both of these types of changes are possible indicators of preclinical disability, as defined by Fried et al. (1991). Modifications of method with reported difficulty increased with age for IADLs and mobility tasks; alterations in frequency did not significantly increase with age for any category. The results of this study extend beyond previous findings by documenting the percentage of respondents who report having changed how and how often they perform these tasks, and are supportive of findings in other populations (Fried et al., 2000; Fried et al., 1996; Williamson & Fried, 1995). Norburn et al. (1995) found changes in patterns of behavior in the absence of reported difficulty among adults aged 65 years and older. We found that adults younger than 65 years also report modifications and frequency changes in the absence of difficulty.

Previous reports have recommended new directions for the study of physical function and disability. For example, Applegate, Blass, and Williams (1990) suggested that functional assessment instruments be more finely scaled and assess a wider range of performance. An instrument not doing so may be insensitive to subtle changes in function. Likewise, Verbrugge (1991) and Verbrugge and Jette (1994), proposed that human activity beyond ADL and IADL should be examined. We addressed these concerns in the PFI by assessing a wider range of activities. Data from this study suggest a hierarchy of task categories: Difficulty and health-related modifications were reported most often in tasks of mobility, followed by IADL and ADL. No

attempt was made to order the specific activities within each category. This finding adds to the concept of a hierarchy of ADL and IADL as discussed by Spector, Katz, Murphy, and Fulton (1987) and Suurmeijer et al. (1994), who demonstrated that an expanded IADL-ADL scale allows a broadened description of functioning in community-dwelling elders and changes in functioning during a longer time span. The current research suggests that in the concept of a hierarchy of physical functioning, there is evidence of a hierarchy of ADL, IADL, and mobility for both difficulty with task performance and modifications in activities where no difficulty is reported.

Finally, these data support other studies that showed an association of arthritis with physical functioning (Ettinger, Davis, Neuhaus, & Mallon, 1994; Ettinger, Fried, et al., 1994; Fried, Ettinger, Hermanson, Newman, & Gardin, 1994; Guccione et al., 1994; Verbrugge, 1991), along with heart disease, eye disease, and incontinence.

GENERAL DISCUSSION

One possible concern about the generalizability of the results is the demographic characteristics of the BLSA population. The age trends in the results of the present study and previous studies are similar, a finding to be expected because the core questions used have been used in many other studies. The unique feature of the PFI is the queries about adaptation to difficulty. One of the present authors has used successfully a version of the PFI in a separate study of male and female volunteers and reported reliability statistics very similar to the present results (Fried et al., 1996).

One of the goals of research on age-associated limitations in physical functioning is to design personal or environmental interventions that will minimize the impact of such limitations on independent functioning in late life. Verbrugge and Jette (1994) have proposed that a disability or functional limitation represents a gap between demands of a task and the capabilities of a person, and that this gap, in many cases, can be closed by redesign of the task or environment. Because the PFI provides information on the types of modifications that people make in adapting to task demands, it has the potential to help identify the types of environmental interventions, or changes in task

performance, that may succeed in closing this gap. Used in this way, the PFI could improve the usefulness of the human factors analysis of task demands described by Czaja et al. (1993). In their task analyses of ADL and IADL activities, they identified movements, postures, and grips involved in several tasks and assessed the task requirements by measuring the weights and dimensions of products and the heights and reach requirements of work and storage spaces. The limitation of the approach of Czaja et al. (1993) is that it does not tailor the intervention to the person's needs. In contrast, the questionnaire approach used in the PFI permits defining the individualized changes used by the person. Ideally, both kinds of information should be used to plan environmental modifications.

Based on the results of the studies reported here, the PFI has been incorporated into the testing of active BLSA participants to be administered longitudinally. It will also be included in follow-up studies of inactive participants to allow comparisons of active and inactive BLSA participants. Research plans include longitudinal examination of the PFI data for predicting outcomes, including mortality, morbidity, and disability. The work of Crimmins and Saito (1993) indicated that older adults can show improvement or decline of function, and points to the importance of change in functioning in addition to present status. The PFI was designed to enhance detection of change in functioning. Longitudinal follow-up using the PFI will help determine whether those who initially report making modifications have a different natural history than those who do not make modifications.

APPENDIX

Baltimore Longitudinal Study of Aging (BLSA), Longitudinal Studies Branch (LSB), Gerontology Research Center (GRC), National Institute on Aging (NIA)

PHYSICAL FUNCTIONING INVENTORY

I am now going to ask you questions about whether you have difficulty doing specific activities in your daily life. I will also ask whether you have modified or changed the way that you do each activity so that you can continue to do it successfully. Please think about how you currently do each task and whether you are doing anything differently now compared to how you did it before. Modifications can include the use of assistive devices, like using a cane or handrails or wearing glasses, doing an activity more slowly, needing the help of another person, or any other change. Do you have any questions?

IF YES TO A			IF 0 OR 1 TO A		IF YES OR DON'T DO TO A OR YES TO E OR G			
A	B	C	D	E	G	I	J	K
Do you have . . . ?	How much difficulty do you have. . . ?	Do you need any assistive devices to . . . , including (READ RESPONSES BELOW)	Do you need the help of another person to . . . ?	Have you modified (changed) the way you . . . to continue to do it successfully?	Have you changed how frequently you . . . ?	For how long have you modified or had difficulty or been unable to do this activity? (LATTER TAKES PRECEDENCE)	What are the main symptoms that cause you to modify, have difficulty, or prevent you from doing the activity? (SEE CARD 1)	What are the main conditions that cause you to modify, have difficulty, or prevent you from doing the activity? (SEE CARD 2)
0. No (GO TO E) 1. Yes (GO TO B) 2. No longer do the task due to difficulty doing it (GO TO H) 3. Could do it but don't for nonhealth reasons (GO TO I) 4. Never did it (GO TO J) 8. Don't know/refused (GO TO NEXT TASK)	1. Some 2. A lot 3. Unable to do by myself 8. Don't know	0. No 1. Glasses, contacts 2. Hearing aids 3. Special devices (tongs, rubber grips, etc.) 4. Changes in your home or car (ramps, rails, elevator, hand gears, etc.) 5. Cane, walker, braces 6. Wheelchair 7. Other 8. Don't know	0. No 1. Yes, supervision, someone to stand by (subject 75%) 2. Yes, a little help 3. Yes, a moderate amount of help (subject 50%) 4. Yes, a lot of help (subject 25%) 5. Yes, another person does it completely for me (subject 0%) 8. Don't know	0. No (GO TO G) 1. Yes, changed the way I do it for health reasons (GO TO F) 2. Yes, changed the way I do it for nonhealth reasons (GO TO G) 8. Don't know. F. (SEE BOTTOM OF PAGE)	0. No (IF NO TO A AND E AND G, GO TO NEXT TASK) 1. Yes, cut back 2. Yes, given up frequently 3. Yes, do it more frequently 8. Don't know H. (SEE BOTTOM OF PAGE)	(ROUND TO NEAREST YEAR OR <6 months = 00 6-12 months = 01 Don't know = 88)	(CODE PRIMARY REASON FIRST)	(CODE PRIMARY REASON FIRST)

(continued)

APPENDIX continued

		<i>IF YES TO A</i>			<i>IF 0 OR 1 TO A</i>			<i>IF YES OR DON'T DO TO A OR YES TO E OR G</i>		
Do you	A CIRCLE	B	C	D	E	G	I	J	K	
have any	CORRECT									
difficulty	ANSWER									
INSERT	0 1 2 3 4 8	—	— — — —	—	—	—	—	— — — —	— — — —	
TASK										
HERE										
F										
IF YES TO E:		1	_____							
How have you modified		2	_____							
or changed the way you do . . . ?		3	_____							
(different methods, clothes, etc.)		4	_____							
(GO TO G)										
H										
IF 2 TO A AND * TASK										
How do you . . . ? (SEE CARD 3)										
(GO TO I)										

**TASKS, WITH INSTRUCTIONS
FOR QUESTION A, IN ORDER ASKED**

Do you have any difficulty . . .

1. Walking up 10 steps?
2. Driving?*
3. Reaching for and getting down a 5-pound object (like a bag of sugar) from just above your head?*
4. Stooping, crouching, or kneeling?*
5. Opening jars that have been previously opened?*
6. Doing light housework (sweeping, straightening up, doing dishes)?*
7. Lifting or carrying something as heavy as 10 pounds (like a full bag of groceries)?*
8. Walking half a mile (about 5 to 6 blocks)?

GO TO QUESTION 20 IF MEET AGE CONDITIONS

9. (SKIP TO 11 IF NO TO 8A) Walking 150 feet, about one third of a block?
10. Walking around your home?
11. Bathing or showering (getting in and out of tub, standing in shower, reaching parts of body)?*
12. Dressing yourself? (Do you have trouble with buttons, fasteners, zippers)?*
13. Preparing your own meals?*
14. Using the toilet, including getting to and from the toilet?*
15. Using the telephone?*
16. Getting to places out of walking distance?*
17. Shopping for personal items?*
18. Giving yourself medications?*
19. Managing your own money, such as paying bills?*
20. Have you ever done physical activities comparable to strenuous ones such as racquetball, jogging, heavy construction work, swimming, or aerobic exercise?

**(IF NO, CIRCLE 4 IN 21A AND GO TO
QUESTION 21J; IF YES, GO TO QUESTION 21A)**

21. Do you currently have any difficulty doing these or comparable activity(ies)?
22. (SKIP TO 23 IF NO TO 21A) Do you have any difficulty doing activities comparable to moderate ones such as golf, bowling, vacuuming, or gardening?
23. What is the most strenuous activity that you do?
FILL IN ACTIVITY _____
Do you have any difficulty doing this activity?

An open-ended response to the question "How do you . . ." (see Card 3) was asked if a response of "no longer do the task due to difficulty" was given to tasks with an *.

CARD 1 (Used for Question J)
SYMPTOMS

1. Shortness of breath
2. Diminished cardiovascular function/reduced endurance
3. Diminished muscle tone/reduced strength
4. Chest pain/discomfort
5. Stiffness (specify where: _____)
6. Back pain
7. Calf pain with walking
8. Pain, other site (specify where: _____)
9. Fear of pain/avoiding pain
10. Lightheadedness/dizziness
11. Weakness/fatigue
12. Difficulty walking
13. Unsteady on feet
14. Afraid of falling
15. Difficulty seeing; in general
16. Difficulty seeing at night in dim lights
17. Difficulty seeing when there is glare
18. Difficulty hearing normal conversation
19. Difficulty hearing in noisy room
20. Preventing a problem I am at risk for (specify: _____)
21. Other: _____
22. Nonhealth reason (specify: _____)
77. No reason
88. Don't know

CARD 2 (Used for Question K)
CONDITIONS

1. Heart disease
2. Atherosclerosis
3. Stroke
4. High blood pressure
5. Lung disease/breathing problems
6. Arthritis—hands, arms, shoulders (specify where by circling area)
7. Arthritis—hips, knees, feet (specify where by circling area)
8. Osteoporosis
9. Hip fracture
10. Hip replacement
11. Problem with back or neck
12. Paralysis
13. Eye disease
14. Cancer

15. Injury
16. Diabetes
17. Overweight
18. Incontinence
19. Memory problems
20. Mental illness
21. Old age
22. Other: _____
23. Nonhealth reason (specify: _____)
77. No reason
88. Don't know

CARD 3
QUESTIONS TO BE ASKED FOR H FOR TASKS WITH *

2. How do you get to places to which you used to drive?
 3. How do you reach and get objects that are above your head?
 4. How do you get things that are on the floor or low to the ground?
 5. How do you get jars open (such as ketchup, plastic milk bottle lids)?
 6. How does the housework get done?
 7. How do you move something as heavy as 10 pounds?
 11. How do you bathe (or shower)?
 12. How do you get dressed?
 13. How do you get your meals?
 14. How do you use the toilet?
 15. How do your calls get made?
 16. How do you get to places out of walking distance?
 17. How does your shopping get done?
 18. How do you get your medications?
 19. How is your money managed?
-

NOTES

1. Complete tables of percentage agreement and kappa are available from the authors.
2. See Note 1.

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Does the Source of Support Matter for Different Health Outcomes?

Findings From the Normative Aging Study

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Objectives: This study investigated the differential relationships between different types and sources of social support and physical and mental health. **Methods:** Using data from the Normative Aging Study, 1,386 older men (median age = 62.7 years) were categorized into four groups separately for frequency of interaction with networks and perceived support. **Results:** More than half the sample reported high levels of support from both sources. One-way ANOVAs revealed that those with high perceived support from both sources reported better physical health and fewer depressive symptoms than those with low support from both sources or high support from family alone. Similarly, those with high perceived support from both sources had lower levels of depressive symptoms than those with low support from both sources, but frequency of contact was unrelated to physical health. **Discussion:** In general, those with high support from both family and friends reported the highest level of well-being.

Many studies have reported a beneficial effect of social support on mental and physical health in adults, including the elderly (Berkman,

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1984; Berkman & Syme, 1979; Chipperfield, 1996; Choi & Wodarski, 1996; Commerford & Reznikoff, 1996; Cutrona & Russell, 1987; Friedman, 1993; Glass, Matchar, Belyea, & Feussner, 1993; Henderson et al., 1997; House, Robbins, & Metzner, 1982; Krause, 1987a; Matt & Dean, 1993). Measures of social support usually include support from both family and friends; however, there is an indication that friendship roles are not interchangeable with close kin roles. For example, contact with one's children may not have the same effect as contact with friends (Arling, 1976; Wenger, 1990). Studies have found that interaction with friends and with family can produce different and distinctive patterns in reliability of support (Seeman & Berkman, 1988), satisfaction with support (Rook, 1987), morale (Crohan & Antonucci, 1989), arousal and affect (Felton & Berry, 1992; Larson, Mannell, & Zuzanek, 1986), depression (Potts, 1997), and psychological distress (Dean, Kolody, & Wood, 1990; Matt & Dean, 1993). For example, Cantor (1979) found that family, both partners and children, were the first choice of the elderly when requesting tangible aid. However, when in need of help with social issues, such as loneliness, friends were the preferred support providers.

Several reasons have been proposed as to why these two relationships differ. One is the sense of continuity with the past that friends can provide (Lewittes, 1989). Children may make less adequate companions because unlike peers, they do not share the same history and life perspective with their parents (Arling, 1976). A second reason is that friendships tend to be a matter of choice rather than of birth. People choose friends because of shared interest and desire for contact (Crohan & Antonucci, 1989; Lee & Ishii-Kuntz, 1987; Wood & Robertson, 1978). The relationship itself can help well-being: To be a friend means that one is desirable as a friend (Arling, 1976). Finally, friendships share a form of reciprocity that may be absent in family relationships. Voluntary assistance allows the elder to feel a sense of competence in the ability to reciprocate in a friendship without the sense of obligation that may color assistance given and received within the family (Crohan & Antonucci, 1989; Wenger, 1990).

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Different sources of support may have a differential impact on the well-being of elderly adults. Some studies have found that family relationships, frequently measured as relationships with children, are most important in the physical well-being of the elderly. Elders who are ill experience a greater benefit from family support than from friend support in the areas of life satisfaction, emotional well-being (Friedman, 1993), and adjustment (Primomo, Yates, & Woods, 1990). However, the ability to reciprocate has a greater impact on friendships than family relationships. Satisfaction in a friendship is curvilinear, with satisfaction being poorest when too much or too little reciprocity is perceived as present. Satisfaction with child relationships, on the other hand, is greatest when elders receive more assistance than they give (Rook, 1987). This differential relationship between reciprocity with children and friends may explain why families are more important to elders in times of illness. Elders could have higher satisfaction when receiving support from family members, which in turn could lead to higher general life satisfaction. Receiving assistance from friends could actually lower satisfaction if the elder could not reciprocate due to poor health.

Other studies have found that friends have a greater effect on morale than families do. Frequency of contact with friends is a better predictor of morale than contact with children (Lee & Ishii-Kuntz, 1987). Arling (1976) showed that the impact of friendship on morale was mediated through loneliness so that elderly widows with more friends had higher morale and lower loneliness, whereas quantity of family relations in the same subjects was unrelated to morale. Finally, support from friends is more strongly related to feelings of self-worth in some elderly (Felton & Berry, 1992).

A similar pattern has been reported by researchers working with adolescents facing diabetes. Family members gave more instrumental support than friends for such activities as insulin injections, nutrition, and glucose monitoring. Conversely, friends supplied more emotional support in coping with the disease (LaGreca, Auslander, Greco, & Spetter, 1995).

These results appear to confirm a pattern of differential importance in source of support. Those studies that find family members to be of primary importance focus on physical needs or problems, such as adjustment during illness. On the other hand, studies that find greater

support from friends appear to be studies that look at such psychological issues as loneliness and morale in healthy individuals. On the basis of this pattern, it could be hypothesized that social support from family members, specifically children, would be more strongly associated with physical health, whereas support from friends would be more strongly associated with psychological health.

The studies cited thus far looked at either physical or psychological outcomes, but did not look at both in the same population. Thompson and Heller (1990) examined both physical and psychological outcomes in women with varying degrees of support from both family and friends. They also measured perceived support and frequency of interaction. They found that having lower perceived support from the family was associated with worse psychological health. Having lower frequency of interaction levels of social support from friends or from family was associated with lower levels of functional health as measured by activities of daily living (ADL) scores. Lower frequency of interaction levels of support from both family and friends were associated with lower levels of both physical and psychological health.

These findings showed that lower levels of perceived family support were related to lower psychological health, whereas lower levels on frequency of interaction support from either friends or family were related to lower functional health. This contradicts the pattern previously noted. One possible reason for this discrepancy is that only women were sampled in this study, whereas previous studies used a combination of women and men. Differences between women and men were reported by Antonucci and Akiyama (1987), who found that women had a greater number of sources of support, and that both perceived and frequency of interaction support had a greater impact on women than men.

A second reason for the difference in support patterns from family and from friends may be the way the support variables were constructed. Thompson and Heller (1990) combined the social support information from family and friend sources to examine a social isolate group with low levels of support from family and friend sources. They did not look for interaction between levels of family and friend support. A reported finding regarding high levels of family support does not differentiate between those with high levels of both family and friend support versus those with high family support but low friend

support. The same is true of findings reported for those with high levels of friend support. If the different sources of social support produce a differential pattern of health outcomes, then levels of support from both family and friend sources should be compared simultaneously.

PRESENT STUDY

The present study attempts to look more specifically at the differences between those with various levels of perceived support and frequency of contact from family and friends and the relationship with mental and physical health using archival data from the Normative Aging Study (NAS).

Based on the pattern observed in the literature, it is hypothesized that this sample will show differences in mental and physical health when grouped by level and source of social support. As Table 1 indicates, those with high levels of social support from both family and friends, or high support primarily from family, are hypothesized to have higher scores on physical health measures than those in the other groups. Also, those with high levels of support from both family and friends, or high support primarily from friends, will have higher scores on mental health measures compared with those of the other groups. Finally, those with low levels of social support from both family and friends will be lower on measures of both mental and physical health than all other groups. We further expect that frequency of contact will be more strongly associated with physical health and perceived support with mental health.

Method

SAMPLE AND PROCEDURE

The original NAS panel was selected between 1961 and 1968 on the basis of absence of any serious mental or physical diseases (Aldwin, Spiro, Levenson, & Bossé, 1989). In addition, they were selected on the basis of specific health criteria and for geographic stability, which was defined as those with family ties in the area. About half the sample was blue-collar. In 1988, a survey was mailed to the

Table 1
Predicted Patterns of Physical and Mental Health Based on Source of Support

<i>Friend Support</i>	<i>Family Support</i>	
	<i>High</i>	<i>Low</i>
High	Good physical and mental health	Good mental health
Low	Good physical health	Poor physical and mental health

NAS panel to examine social support and health (see Bossé, Aldwin, Levenson, & Ekerdt, 1987, for more details). The men in this sample ranged in age from 43 to 91 years old ($M = 62.7$ years, $SD = 7.8$ years). The sample consisted of 1,209 male participants in the NAS, although missing data sometimes resulted in slightly fewer respondents for some analyses. They were predominantly White, with a mean income range of \$30,000 to \$34,999 in 1986. Analysis of educational level indicated that a little less than half (41.8%) did not earn a college degree. An additional 4.1% had earned an associates degree, whereas 25.5% had earned a bachelor's degree. Finally, 13% of the participants had earned a graduate degree.

MEASURES

Data were taken from the Social Survey II, a mailed survey administered in 1988 to gather information on social support, health, and stress levels. Selected questions were used to address the hypotheses for the current study.

Social support. Because the NAS men were selected on the basis of social ties to the area, we used very stringent cutoffs for designating high levels of both perceived support and frequency of interaction. Perceived social support was assessed using two standard questions. One addressed the ability of each respondent to rely on family in a crisis, the other to rely on friends in a crisis. Each question was rated on a 5-point scale. Those who answered 1 (*a lot*) or 2 (*completely*) were assigned to the high perceived support group, whereas those answering *not at all*, *a little*, or *somewhat* (3-5, respectively) were assigned to the low perceived social support group. By combining both levels of

support across the two support sources, four groups were produced: those with high levels of perceived support from both sources, those with high levels of perceived support from family but low support from friends, those with high perceived support from friends but low support from family, and those with low perceived support from both friends and family. For the correlational analyses, however, the Likert-type scoring was kept, but reversed, such higher scores indicated greater reliance on family and friends.

In a similar manner, the frequency of the interaction social support variable was constructed from two questions regarding the frequency with which respondents had contact with family and with close friends. It has been shown that children are more involved in giving instrumental assistance to elders other than family members (Johnson & Catalano, 1983; Troll, 1994), so contact with children was used as the family support measure. Each question was rated on a 6-point scale. Those who selected *nearly every day* or *once a week* were assigned to the high interaction group. Those who chose *once or twice a month*, *every 2 or 3 months*, *once or twice a year*, or *never* were assigned to the low interaction group.

To examine the differential relationships between support from family and friends on the various measures of health and well-being, we divided the NAS men into four groups: high support from both family and friends, high support from family only, high support from friends only, and low support for both. This was done separately for both perceived support and frequency of interaction.

Physical health. Two physical health measures were used. The first asked the respondents to name any health problems or concerns they had experienced in the past 3 months. The responses were then coded for severity based on the Seriousness of Illness Rating Scale (SIRS) (Wyler, Masuda, & Holmes, 1968), as modified by Bossé et al. (1987) ($M = 36.80$, $SD = 40.97$). This provided a measure of severity and discomfort level of current medical conditions being experienced by the respondents. The second measure was self-rated health. Each subject was asked to rate his health from 1 (*very poor*) to 5 (*excellent*) ($M = 4.07$, $SD = .72$).

Mental health. The depression subscale of the Hopkins Symptom Checklist (SCL-90-R) was used as the measure of mental health (Derogatis, 1983). This subscale consists of 13 items, scored on a 5-point scale, with higher scores denoting a higher level of depressive symptoms ($M = .34$, $SD = .43$).

Results

We first examined the zero-order correlations among the variables in the study. Examination of the skewness and kurtosis of the social support variables indicated that the distributions were not normal. Therefore, correlations among the variables used in this study are presented for the reader's interest (see Table 2) and must be interpreted with caution.

For the most part, the correlations were in the expected directions. Perceived support from family was moderately correlated with that from friends ($r = .33$, $p < .001$), but reports of frequency of interaction with friends and family were independent ($r = .03$, ns). Also, individuals with high levels of self-rated health were less likely to report illnesses that were rated to be serious (SIRS) ($r = -.41$, $p < .01$) and were less likely to report depressive symptoms ($r = -.30$, $p < .01$). Furthermore, age was weakly associated with higher frequency of interaction support from family ($r = .14$, $p < .01$), poorer self-rated health ($r = -.11$, $p < .01$), and more serious illness ($r = .08$, $p < .05$), but not with depressive symptoms ($r = -.01$, ns).

We had predicted that perceived support from friends would be positively associated with mental health and frequency of interaction support (from family and friends) would be associated with physical health, but our results were only partially supported in these preliminary analyses. Perceived support from both family and friends was negatively correlated with depressive symptoms at identical levels ($r = -.13$, $p < .01$). However, none of the frequency of interaction support measures was significantly associated with the physical health measures, but frequency of interaction support from friends was weakly inversely associated with depressive symptoms ($r = -.07$, $p < .05$). Interestingly, perceived support from friends was associated with

Table 2
Correlations Among Social Support, Health Outcomes, and Age

	1	2	3	4	5	6	7	8
1. Perceived support, family	—							
2. Perceived support, friends	.33**	—						
3. Frequency of interaction	.15**	.01	—					
4. Frequency of interaction	-.01	.15**	.03	—				
5. Self-rated health	.05	.10**	-.03	-.01	—			
6. SIRS	-.01	-.00	.04	.02	-.41**	—		
7. Depressive symptoms	-.13**	-.13**	.04	-.07*	-.30**	.26**	—	
8. Age	-.01	.04	.14**	.03	-.11**	.08*	-.01	—

Note. SIRS = Seriousness of Illness Rating Scale (Wyler, Masuda, & Holmes, 1968).
 * $p < .05$. ** $p < .01$.

better physical health ratings ($r = .10$, $p < .01$). Thus, relationships between social support and the outcomes are quite modest, which is consistent with results reported in other studies of social support (see Antonucci, 1990). From these analyses, it would appear that the type of support is more highly associated with both mental and physical health than is the source of support, but analyses contrasting combinations of the two variables might yield interesting information.

As mentioned earlier, we created four groups: men with high support from both family and friends, high family support but low support from friends, high support from friends but low family support, and low support from both sources. As Table 3 suggests, the NAS men enjoy high levels of social support from both their family and friends. Table 3 shows the numbers and percentage of total respondents in each of the four groups. It can be seen that even though stringent cutoff criteria were used to classify participants as having high social support, the majority of respondents reported that they had high support from both family and friends on both perceived support (60%) and frequency of interaction (55%) measures. It is interesting to note that 203 men (17%) had infrequent interaction with both sources. Very few individuals in this sample had high perceived support only from friends (7%) or low frequency of interaction support from both sources (7%). Nonetheless, the sample size was sufficiently large to analyze even these rare types ($n = 84$ and 82 , respectively).

Table 4 indicates that there were significant differences between the perceived social support groups in both self-rated health, $F(3,$

Table 3
Cell Sizes and Age Means for Source of Support

	Source of Support			
	Both Family and Friends	Primarily Family	Primarily Friends	Neither Family nor Friends
Perceived				
<i>n</i>	618	304	84	203
%	60	25	7	17
Mean age ^a	62.5	63.0	62.1	63.2
Frequency of interaction				
<i>n</i>	660	327	140	82
%	55	27	12	7
Mean age ^b	62.1 _a	62.4 _a	65.0 _b	65.3 _b

Note. Subscript pairs denote significant differences between groups, using Duncan's post hoc tests set at $p < .05$.

a. $F(3, 1382) = .65$, not significant. b. $F(3, 1205) = 8.78$, $p < .001$.

1205) = 4.65, $p < .01$, and depressive symptoms, $F(3, 1205) = 10.50$, $p < .001$. Duncan's post hoc range tests ($p < .05$) showed that those with high support from both family and friends had better self-rated health and lower depressive symptoms than those with low support from both groups, who scored the worst for both self-rated health and depressive symptoms. Interestingly, the two groups with high support from only one source did not differ significantly from each other, although they were often different from the very high or very low groups. However, the groups did not differ in the rated severity of their health problems (SIRS, $F(3, 1205) = .04$, *ns*).

In terms of frequency of interaction, the groups differed significantly only in depressive symptoms, $F(3, 1205) = 3.12$, $p < .05$. Whereas the group with high support from both family and friends reported the fewest depressive symptoms, Duncan's post hoc analysis showed that this only achieved significance for the comparison between that group and the one whose members reported high support primarily from family. Again, there were no differences between the groups for seriousness of physical symptoms (SIRS, $F(3, 1205) = .76$, *ns*). Nor were there differences between the groups for self-rated health, $F(3, 1205) = .45$, *ns*.

Comparison of the respondents' ages (see Table 3) revealed a significant difference between the frequency of interaction groups, $F(3,$

Table 4
Differences in Physical and Mental Health by Source of Support

Outcome Measures	Source of Support				F
	Both Family and Friends	Primarily Family	Primarily Friends	Neither Family nor Friends	
Perceived support					
Self-rated health	4.13 _a	4.03 _b	4.18	3.94 _b	4.65*
SIRS	36.85	36.26	36.50	37.56	0.04
Depressive symptoms	0.29 _{a,c}	0.35 _{a,d}	0.34 _a	0.48 _b	10.50**
<i>n</i>	618	304	84	203	
Frequency of interaction					
Self-rated health	4.07	4.10	4.04	4.01	0.45
SIRS	35.51	37.08	39.56	41.24	0.76
Depressive symptoms	0.31 _a	0.38 _b	0.37	0.40	3.12*
<i>n</i>	660	327	140	82	

Note. SIRS = Seriousness of Illness Rating Scale (Wyler, Masuda, & Holmes, 1968). Subscript pairs denote significant differences, based on Duncan's post hoc ($p < .05$). * $p < .05$. ** $p < .01$.

1205) = 8.78, $p < .001$. The oldest men were those who had low levels of frequency of interaction support from both sources, or who had high support only from friends. Conversely, those with high support from family or high support from both sources were younger. Thus, age is a potential confound in these analyses. Furthermore, it would also appear that there may be a confound between marital status and the presence (or even frequency of interaction) with children. Thus, we also examined differences in marital status between the groups. Although there were several reasons why men in the study were single (i.e., single, separated, divorced, widowed), there were too few respondents in the single ($n = 22$) and separated ($n = 9$) categories for a valid chi-square analysis. Therefore, the groups were collapsed into two categories, married and nonmarried. Chi-square analysis between the two groups revealed a significant difference only between the frequency of interaction support, $\chi^2(3, N = 1208) = 70.85, p < .001$. Respondents with support primarily from friends were more likely to be single than the respondents in any other group. In addition, those with low support from both sources were also more likely to be single than those with high support primarily from family and those with high support from both sources.

Because differences in both age and marital status were found between support groups, we reran the significant analyses covarying out these factors. There were no differences in the significance of the results. There were still significant differences between the perceived support groups for both depressive symptoms, $F(3, 1203) = 5.72, p < .001$, and self-rated health, $F(3, 1203) = 6.62, p < .01$, and between the frequency of interaction support groups on depressive symptoms, $F(3, 1203) = 1.50, p < .05$.

Discussion

We examined the differential relationships among both source of support (family vs. friends) and type of support (perceived vs. frequency of interaction) and physical and mental health. Based on reports in the literature, we reasoned that support from family (especially frequency of interaction) would be related to physical health, whereas support from friends (especially qualitative support) would be important for mental health.

Contrary to our hypotheses, we found that individuals with a high level of perceived support from family and friends reported lower levels of depressive symptoms than did the social isolates—those who reported low levels of support from both sources. Any support, whether from family or friends, was associated with fewer symptoms. In terms of the frequency of interaction, however, there was some support from the differential hypothesis. Individuals who interacted frequently with both family and friends had lower levels of depressive symptoms than those who interacted primarily with family members. This supports the contention that support from friends is important in matters of mental health (Arling, 1976; Felton & Berry, 1992; Lee & Ishii-Kuntz, 1987).

There was also some support for the differential hypothesis for physical health outcomes. Men who had high perceived support from both family and friends reported better health than those with support primarily from the family. Not surprisingly, the social isolates reported the lowest self-rated health. In general, the severity of physical illness was unrelated to social support.

One possible explanation for why the differential hypothesis was not better supported—especially in contrasts between support primarily from family and primarily from friends—lies in differences between the group sizes. Although the groups with high support from both sources and those with high support primarily from family were both large, the group with high support primarily from friends was comparatively small. This is consistent with Shanas's (1979) report that the majority of seniors are not isolated from their families. In addition, because the current sample was chosen for geographic stability (defined as family ties in the area), there would be few panel members who did not have extensive networks. In a sample with more equal cell sizes, it is possible that both the primarily friend-support and primarily family-support groups would have been significantly different from the groups with high support from both sources.

Another issue relates to the pattern of causal directionality. The literature revealed a pattern that indicated support from family was important in relation to physical health. However, these studies were cross-sectional, and therefore not able to determine the direction of the relationship. Individuals who are ill may find that family support is important because they are unable to maintain friend relationships due to the illness (Pearlin, Aneshensel, Mullan, & Whitlatch, 1996). In this case, health status would be driving the relationship rather than social support necessarily having an effect on health.

The lack of results on the other serious physical health measure is puzzling in light of the many studies that report an association between physical health and social support (Berkman & Syme, 1979; Blazer, 1982; Krause, 1987b). However, few of these studies looked at seriousness of illness (relying rather on self-rated health or mortality status). The NAS men were selected for good health, and this may have weakened the link between psychosocial factors and health outcomes. Furthermore, Aldwin and Levenson (2001) have recently proposed that there may be a differential relationship between stress and type of illness, depending on age. They hypothesized that younger individuals may have acute illnesses when stressed, whereas stress in middle-aged adults may give rise to or exacerbate chronic illnesses such as hypertension or heart disease. It may be that we need to differentiate acute from chronic illnesses, or perhaps social support

is related more to control of chronic illnesses in late life (e.g., King, Reis, Porter, & Norsen, 1993) than their presence.

Another limitation is the restricted measures of social support. In the perceived support measure, two questions were used to ask if the respondent had someone to turn to in time of crisis. The positive versus negative aspects of support were not measured, yet these factors may be important in evaluating the impact of social support on individuals (Rook, 1984; Rook & Pietromonaco, 1987; Ulbrich & Warheit, 1989), as may other factors not measured here, such as quality of the marital relationship.

Finally, primarily White men were used in the current analysis. As indicated earlier, the literature reports that social support may have a different impact on women and men and between ethnic groups (Ulbrich & Warheit, 1989). Therefore, lack of women and ethnic minorities in the sample limits the generalizability of the results.

Future studies examining this issue would benefit from several methodological modifications. First, both women and men should be sampled, as well as members of various ethnic and minority groups. Second, an effort to gain similar cell sizes would eliminate the concern regarding lack of power in any one respondent group. Third, more extensive measures of perceived support, frequency of interaction support, and physical health would allow stronger conclusions based on analysis results.

The current study has pointed out the importance of making finer distinctions in the sources of social support. Looking at support from family and support from friends as complementary but unique influences on health will allow researchers to advance their understanding of how social support enhances health in the aging population.

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Factors Associated With Time to First Hip Fracture

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Objective: To examine the relationship between risk factors associated with first hip fracture ever and its time to first fracture. **Methods:** Data were from the Longitudinal Study on Aging. Of the 7,527 participants, 334 sustained a first hip fracture between 1984 and 1991. **Results:** Results from the Cox proportional hazards model indicate the time to first fracture was inversely related to the number of risk factors involved. The risk factors significantly associated with first fracture were increasing age, female, Caucasian race, history of falls, insufficient exercise, infrequent church attendance (a likely proxy for outside the home activities), hospitalization in the year before the study, and low body mass index. **Conclusion:** As the number of risk factors increases, the estimated time to fracture becomes shorter; thus, the window of opportunity for prevention is smaller. To reduce the incidence of first hip fracture and to prolong the time to first fracture, interventions should focus on modifiable risk factors identified: increasing exercise, increasing outside-the-home activities, and improving or maintaining body mass index.

Hip fracture, one of the most devastating diseases among the elderly, often requires hospitalization, surgical repair, rehabilitation, and

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long-term care, and commonly results in permanent disability (Cummings, Kelsey, Nevitt, & O'Dowd, 1985). The consequence of disability is of paramount concern in public health because it is associated with poor quality of life, dependence on formal and informal care, and substantial costs in acute and long-term care. Demographic characteristics associated with hip fracture among the elderly are well established. Old age and female gender have been found to be associated with hip fracture (Elliot et al., 1996; Wolinsky & Fitzgerald, 1994) and the rate of falls and the likelihood of severe injury including hip fracture from a fall increase with age (Dargent-Molina et al., 1996). Other risk factors are lower bone density (Cummings, Nevitt, & Browner, 1995; Ho, Woo, Ghan, Yuen, & Sham, 1996; Huang & Himes, 1997), low body mass index (Ho et al., 1996; Grisso et al., 1994, 1997; Cano, Galan, & Dilsen, 1993), decreased mobility (Cummings, Nevitt, & Browner, 1995; Dargent-Molina et al., 1996; Grisso et al., 1994, 1997; Ho et al., 1996; Huang & Himes, 1997), lower limb dysfunction or postural sway (Cano, Galan, & Dilsen, 1993; Grisso et al., 1991; Fernie, Gryfe, & Holliday, 1982), the need to use walking devices (Grisso et al., 1994), decreased visual function (Dargent-Molina et al., 1996; Grisso et al., 1991; Huang & Himes, 1997), history of stroke (Grisso et al., 1994), maternal history of hip fracture (Cummings et al., 1995), chronic use of certain medications (Grisso et al., 1991), and history of falls (Wolinsky & Fitzgerald, 1994).

However, little has been reported on the temporal profile of risk factors and their association with time to first fracture. The purpose of this study is to identify the risk factors associated with first hip fracture and time to the fracture so that preventive strategies and timely intervention can be initiated to prevent hip fracture within the window of opportunity. The existence of the Longitudinal Study on Aging (LSOA) data provides the opportunity to measure time to first fracture and to investigate the association between risk factors and time to first hip fracture. Time to hip fracture is measured as the time from the baseline interview to the first hip fracture incident.

Method

DATA

The data for this study were from the LSOA, a joint project of the National Center for Health Statistics and the National Institute on Aging. The LSOA is the 6-year follow-up to the Supplement on Aging (96% participation rate) that was appended to the 1984 National Health Interview Survey (96.4% participation rate). A major purpose of the LSOA was to observe changes in functional ability that accompany aging. Extensive information was collected, including health status, functional abilities, social functioning, living arrangements, and other characteristics. This information was obtained during in-home interviews at baseline in 1984 and through telephone interviews at three subsequent follow-up surveys in 1986, 1988, and 1990; vital status was determined by linking sample persons to the National Death Index. In addition to National Health Interview Survey (NHIS) and Supplement on Aging (SOA) data, the Medicare Automated Data Retrieval System (MADRS) hospital discharge records were linked to LSOA participants, enabling us to identify hospitalization for hip fracture. The LSOA is a well-known study. Details on design and execution of the LSOA can be found in Fitti and Kovar (1987). In this article, we use the unweighted data. It is our intention to investigate factors associated with incidence of first hip fracture and its time to fracture as the study participants age. In this instance, the need to take the weights and the complex design into account is less important. It has been empirically shown that the complex schemes necessary to take the disproportionately stratified multistage cluster sampling design of the LSOA into account have little impact on variance estimation (Fitti & Kovar, 1987) and covariance estimation (Johnson & Wolinsky, 1993). Furthermore, that impact is sufficiently attenuated by the inclusion of age and race as covariates in multivariate models to warrant analyses (Kovar, Fitti, & Chyba, 1992).

STUDY SAMPLE

Of the 7,527 participants in the LSOA, 335 had a hip fracture prior to baseline in 1984 and an additional 39 had unknown histories of hip

fracture prior to the hospitalization for hip fracture. These two subgroups were excluded from the study, thus reducing the total study sample to 7,153.

OUTCOME VARIABLES

There are two outcome variables. First-time fracture ever was identified through the International Classification of Diseases, 9th edition, Clinical Modification (ICD9-CM) (1996) codes of 820.0 through 820.9 from MADRS discharge records from January 1, 1984, through December 31, 1991. First hip fracture was a dichotomies variable. Second, time to hip fracture was measured as the time from the baseline interview to the first hip fracture incident. For persons without fractures, time in the study was computed as the time from the baseline interview to the date of the last interview for survivors or to the date of death for deceased.

PREDICTOR VARIABLES

Six groups of potential fracture-related risk factors were evaluated in this analysis: sociodemographics, physical activities, social activities, health status, medical conditions, and health services utilization.

1. Sociodemographic variables included age, gender, race, and living arrangements. Age was categorized into four groups: 70 to 74 years, 75 to 79 years, 80 to 84 years, and 85 years and older. Living arrangement was dichotomized as living alone versus living with others.
2. In physical activity, participants were asked, "Do you feel that you get as much exercise as you needed, or less than needed?" Exercise was dichotomized as getting as much as needed versus less than needed. The physical functional limitation variable was dichotomized as having no difficulty in either activities of daily living (ADL) or instrumental activities of daily living (IADL) versus having any difficulty in either ADL or IADL. About two thirds of participants reported no difficulty in ADL (a summary score of bathing, dressing, eating, getting in and out of bed/chair, walking, getting outside, and using toilet) or IADL (a summary score of meal preparation, shopping, managing money, using the telephone, and doing heavy housework and light housework).

3. For social activities, both variables in attending church/religious services and getting together with friends/neighbors in the past 2 weeks (a proxy of outside home activities or social functioning) were dichotomized as yes or no.
4. In health status, self-perceived health was dichotomized as excellent/very good/good versus fair/poor. The number of falls in the past 12 months was grouped as zero, one, or two or more falls. In the multivariate analysis, previous history of falls was dichotomized as no fall and one or more falls, because there were few elderly in the survey who had experienced two or more falls in the past year. Hospitalization experience in the past 12 months was dichotomized as zero versus one or more. Experiences in visiting or talking to physicians or physician assistants in the past 12 months were grouped as zero, one, or two or more. Body mass index (BMI) was calculated using body weight in kilograms divided by the square of the height in meters (Garrow & Webster, 1985). The BMI was divided into quartiles based on the distribution in the study sample with the first quartile indicating low BMI; the second quartile, fair BMI; the third quartile, moderate BMI; and the fourth quartile, high BMI.
5. Medical conditions included osteoporosis, arthritis, hypertension, diabetes, cancer, stroke, and heart disease. Heart disease included hardening of the arteries or arteriosclerosis, coronary heart disease, angina pectoris, myocardial infarction, stroke or cerebrovascular accident, or any other heart attack. Comorbidity was measured as the total number of the seven self-reported diseases listed above at baseline. Comorbidity was analyzed both individually and as an aggregate variable.
6. Both health service utilization in hospitalizations in the past 12 months and physician visits in the past 2 weeks were grouped as zero, one, or two or more visits.

DATA ANALYSIS

Frequency distributions, summary statistics, and univariate and bivariate analyses were performed to organize and describe the data. Variables associated with time to first hip fracture that were either medically relevant or significant at the $p < .10$ level were retained for subsequent analyses. Analysis of variance (ANOVA) was used to examine the mean number of days to first hip fracture by various risk factors. Kaplan Meier survival curves and log-rank tests for hip fracture were performed to compare the survival distribution between or among the levels of each variable included in the study.

For the multivariate analysis, we assessed the hazard of a first hip fracture by the Cox proportional hazards regression technique and used the Martingale method to check the proportional hazards assumptions (Therneau, Grambsch, & Fleming, 1990). For hip fracture outcome, we calculated a proportional hazards ratio that used days from the initial interview in 1984 until the date of first fracture for those who sustained an event; those who did not sustain a hip fracture were censored at the end of the observation period—December 31, 1991. Deceased persons were censored at the date of death, which LSOA recorded from the National Death Index. A graphical check of regression coefficients on the proportionality is provided by a complementary log plot over the grouped values of selected variables. Interaction terms included in the model were limited to medically important effect modifiers. A survival curve was plotted using the estimates of regression coefficients from the final Cox proportional hazards model. Relative risks for different combinations of risk factors were obtained by comparing them with the reference group. We also calculated the mean time to fracture corresponding to different combinations of risk factors. All analyses were performed using SAS (SAS, Cary, NC) and S-PLUS (S-Plus, Murray Hill, NJ).

Results

Table 1 shows the comparisons of selected characteristics between hip fracture and non-hip fracture participants. In the hip fracture group, the mean age was 79.5 years with a range from 70 to 95 years; a majority of these hip fracture patients were female (77.0%), almost all of them were Caucasian (97.3%), and 21% lived alone. The hip fracture group was fairly active; 53% reported that they exercised as much as needed, 57% reported that they had no difficulty in performing ADLs and IADLs, 43% reported that they had gone to church or attended religious services in the past 2 weeks, and 65% had get-togethers with friends or neighbors. The hip fracture group was relatively healthy. About two thirds (65%) of the hip fracture group perceived their health as excellent, very good, or good; 67% had no history of falls 1 year prior to baseline; and 65% had low or moderate levels of BMI. As for medical conditions, most hip fracture patients

Table 1
 Comparison of Characteristics of Hip Fracture and Non-Hip Fracture Study Groups

Characteristic	Hip fracture (n = 334) ^a		Non-Hip Fracture (n = 6,819) ^a		p
	n	(%)	n	(%)	
Sociodemographics					
Age					
Mean (SD)	79.5	(5.9)	76.5	(5.5)	.001
Range	70-95		70-99		
Female	257	77.0	4,127	60.5	.001
Caucasian	324	97.3	6,209	92.1	.001
Living alone	70	21.0	1,683	24.7	.12
Physical activities					
Exercise as much as needed	159	53.2	3,701	61.3	.005
No ADLs and IADLs difficulty	188	56.5	4,345	63.9	.006
Social Activities					
Attend religious services past 2 weeks	142	42.5	3,548	52.1	.001
Get together with friends/neighbors past 2 weeks	218	65.3	4,719	69.4	.11
Health status: perceived health as excellent/very good/good	213	64.6	4,574	67.4	.28
History of falls					
0	223	67.4	5,339	78.7	.001
1	53	16.0	729	10.7	
2 or more		55	16.6	720	10.6
Body mass index quartile (kg/m ²)					
1st quartile—low (12.56-21.82)	121	36.7	1,641	24.5	.001
2nd quartile—fair (21.83-24.34)	92	27.9	1,690	25.2	
3rd quartile—moderate (24.35-27.14)	65	19.7	1,664	24.8	
4th quartile—high (27.15-58.65)	52	15.8	1,706	25.5	
Mean (SD)	23.4	(4.1)	24.8	(4.4)	
Medical conditions					
Osteoporosis	13	3.9	221	3.3	.52
Diabetes	21	6.4	697	10.3	.02
Cancer	43	2.9	830	12.2	.73
Stroke	18	5.4	498	7.3	.90
Hypertension	152	45.7	3,072	45.3	.73
Arthritis	187	57.0	3,665	54.5	.37
Heart condition	76	24.3	1,580	23.9	.97
Health service use					
Hospitalized past 12 months					
0	243	72.8	5,441	79.8	.002
1 episode	70	21.0	969	14.2	
2 or more episodes	21	6.3	409	6.0	
Physician visits					
0	45	13.5	1,148	16.8	.13
1	207	62.0	4,245	62.3	
2 or more	82	24.5	1,426	20.9	

Note. ADL = activities of daily living, IADL = instrumental activities of daily living. P values based on Pearson's χ^2 for dichotomous variables, Mantel-Haenszel tests for linear association among ordered polytomies, and *t* tests among interval variables.

a. Total does not add up to the 7,153 interviews completed because of nonresponse to certain items.

had no major diseases. A large number reported that they did not have osteoporosis (96%), diabetes (94%), cancer (87%), or stroke (95%). However, 46% had hypertension, 57% had arthritis, and 24% had heart-related conditions. For health services utilization in the past year, 27% had hospitalization and 87% had at least one doctor visit.

The results of bivariate comparisons between the hip fracture and the non-hip fracture groups (see Table 1) indicate that the hip fracture group was significantly older ($p = .001$), female ($p = .001$), and Caucasian ($p = .001$). Fewer hip fracture patients reported that they exercised as much as needed (53%) as compared with the non-hip fracture group (61%); this difference was statistically significant ($p = .005$). The hip fracture group also had a lower percentage of patients who reported having no difficulty in ADLs and IADLs compared with the non-hip fracture group (57% vs. 64%, $p = .006$). For social activities, fewer in the hip fracture group attended religious/church services than the non-hip fracture group (43% vs. 52%, $p = .001$). In fall experience, the hip fracture group had significantly more persons who experienced one fall (16% vs. 11%) or two or more falls (17% vs. 11%) in the past 12 months than the non-hip fracture group ($p = .001$). As expected, a significantly higher proportion of persons in the hip fracture group had low to fair BMI (64.6% vs. 50%) than the non-hip fracture group ($p = .001$). In comparisons of medical conditions, there were no significant differences between the two groups in osteoporosis, cancer, stroke, hypertension, arthritis, or heart disease. However, in the hip fracture group, there were fewer diabetics (6% vs. 10%) than in the non-hip fracture group ($p = .02$). For utilization of health services, the hip fracture group had a greater number of respondents with one or more hospitalizations in the year prior to baseline than the non-hip fracture group (27% vs. 20%, $p = .002$); there were no differences in the number of physician visits between the two groups.

The Kaplan Meier survival analyses for hip fracture by age, gender, race, number of falls, exercise, attending church services, number of hospitalizations, and BMI were performed. The effect of each risk factor was tested for significance using the log-rank test and all were found to have statistically significant effects ($p < .001$). The survival estimates of fall experience prior to the study indicate that among participants who did not fall in the year before baseline, only 5% sustained hip fractures by the end of the study compared with 9% and

10% of those who had one fall or two or more falls, respectively. Participants with a high BMI (fourth quartile) were less likely to fracture their hips than those who had low BMI (first quartile). At the end of the study, 9% of participants with low BMI had fractured their hips compared with 4% who had high BMI.

Additional bivariate analyses were performed to examine the mean number of days to hip fracture by different risk factors among those who sustained hip fractures (data not shown). The results indicate that age and BMI were significantly associated with time to first hip fracture. The mean number of days to fracture was inversely related to increasing age: 1,802 days (60 months), 1,794 days (59.8 months), 1,386 days (46.2 months), and 1,357 days (45.2 months) for the four age groups: 70 to 74, 75 to 79, 80 to 84, and 85 and older, respectively. Using the age group 70 to 74 years as the reference, the results of this bivariate analysis indicate that the time to first hip fracture was 416 days (13.8 months) sooner for the 80- to 84-year-olds ($p < .001$), and 445 days (14.8 months) sooner for the 85-years-and-older group ($p < .0004$). The difference in time to first fracture between persons in the 75- to 79-year-old group and those in the reference group was minimal (8 days). Patients with low BMI fractured sooner than those who had higher BMI. The mean number of days to first fracture for the low BMI group was 1,506 days (50 months) and the mean for the high BMI group was 1,885 days (62.8 months); the difference was 379 days (12.6 months) ($p < .003$). This finding suggests that participants with low BMI fractured their hips about 1 year sooner than participants with high BMI. The difference in time to fracture was not statistically significant between low to fair or low to moderate groups.

Table 2 presents factors associated with time to first fracture using a proportional hazards analysis. After adjusting covariates in the model, the results indicate that risk factors significantly associated with first hip fracture were increasing age, female, Caucasian race, history of falls, exercising less than needed, not attending church services in the past 2 weeks, hospitalized in the past year, and lower body mass index. Increasing age was associated with a higher risk of hip fracture. Using the 70- to 74-year-old group as the reference, the relative risk (RR) of having a first hip fracture for the age group 75 to 79 years was more than two (RR = 2.1; 95% confidence interval [CI], 1.59 to 2.92); 2.7 for age group 80 to 84 (95% CI, 1.90 to 3.77); and 4.2 for age group 85

Table 2
Cox Proportional Hazards Analysis of Risk Factors Associated With a First Fracture (n = 7,153)

<i>Factor</i>	<i>Estimated β</i>	<i>Risk Ratio</i>	<i>95% Confidence Interval</i>
Age (years)			
70 to 74	—	1.0	—
75 to 79	0.78	2.1	1.59-2.92
80 to 84	1.00	2.7***	1.90-3.77
85 and older	1.49	4.2***	2.89-6.13
Gender (female vs. male)	0.47	1.6***	1.21-2.12
Race (Black vs. White)	-1.27	0.3**	0.13-0.68
History of fall in the past year (1 or more vs. 0)	0.31	1.3*	1.04-1.76
Exercise (less than needed vs. as much as needed)	0.34	1.4**	1.13-1.84
Attend church services past 2 weeks (no vs. yes)	0.33	1.4**	1.11-1.78
Hospitalization in the past year (yes vs. no)	0.38	1.4**	1.12-1.91
Body mass index quartile (kg/m ²)			
1st quartile—low (12.56-21.82)	—	1.0	—
2nd quartile—fair (21.83-24.34)	-0.22	0.8	0.58-1.04
3rd quartile—moderate (24.35-27.14)	-0.48	0.6**	0.44-0.83
4th quartile—high (27.15-58.65)	-0.84	0.4***	0.29-0.59
Living arrangement (alone vs. with others)	-0.24	0.8	0.59-1.04
ADL and IADL limitations (yes vs. no)	0.12	1.1	0.87-1.46

Note. ADL = activities of daily living, IADL = instrumental activities of daily living.
 * $p < .05$. ** $p < .01$. *** $p < .001$.

years and older (95% CI, 2.89 to 6.13). The relative risk was 1.6 for a female to sustain a fractured hip compared with a male (95% CI, 1.21 to 2.12). Being Black was protective of hip fracture as compared with being Caucasian in the study sample (RR = 0.3; 95% CI, 0.13 to 0.68). Participants with a history of one or more falls were 1.3 times more likely to have a hip fracture than those without a history of falling (RR = 1.3; 95% CI, 1.04 to 1.76). Participants who did not attend church services in the past 2 weeks were 1.4 times more likely to fracture a hip (95% CI 1.11 to 1.78). Those who had one or more hospitalizations in the past year were 1.4 times more likely to fracture a hip compared with those who had not been hospitalized (95% CI, 1.12 to 1.91). High BMI was protective of hip fracture. The adjusted RR for high BMI was 0.4 (95% CI, 0.29 to 0.59) and 0.6 for moderate BMI (95% CI, 0.44 to

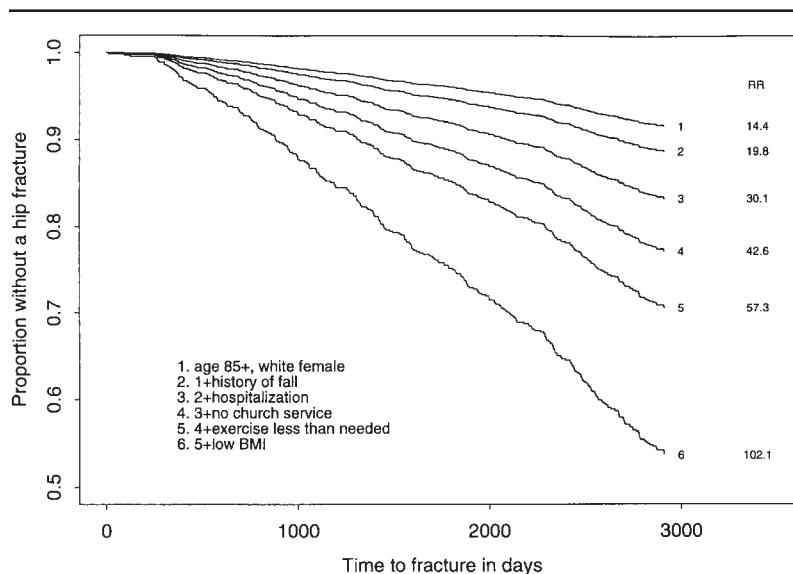


Figure 1. Predicted survival functions from Cox proportional hazards model by significant risk factors.

Note. BMI = body mass index, RR = relative risk.

0.83) when compared with low BMI. There was no statistically significant difference between fair and low BMI groups.

The parameter estimates from the Cox proportional hazards regression model in Table 2 were used to calculate relative risk and predict hip fracture survival time using a different combination of risk factors (see Figure 1) beginning with three risk factors (aged 85 years and older, female, and Caucasian).

Curve 1 in Figure 1 shows the relative risk using the combination of aged 85 years or older and being a Caucasian and female compared with the reference group. The relative risk was 14 times higher relative to Black 70- to 84-year-old males, whereas all the other covariates in the model are constant and the mean time to fracture was 90 days, or about 3 months sooner than the reference group. The second curve shows the contribution of the additional risk factor, history of falls. The relative risk was 19.8 compared with that of Black males aged 70 to 84 years without previous falls, and the time to fracture was 124 days (4.1 months) sooner. The third curve shows the effect to the

model of the addition of being hospitalized. The relative risk increased 30-fold with the time to fracture of 189 days (6.3 months) sooner when compared with that of the reference group. When not attending church services was included in the model (curve 4), the relative risk increased 43-fold, and time to fracture was 264 days (8.8 months) sooner. The relative risk increased 57-fold, and the time to fracture was 348 days (11.6 months) sooner when exercising less than needed was added to the model (curve 5). Finally, when being in the lowest BMI group was added to the model (curve 6), the relative risk increased to 102, and the time to fracture was 580 days (19.3 months) sooner.

Discussion

In this study, we prospectively examined the relationship between risk factors associated with first hip fracture and its time to first fracture using LSOA data. Three features distinguish this study from previous efforts: (a) participants with previous hip fractures before baseline were excluded, (b) relative risks were calculated using an additive combination of risk factors, and (c) the dynamic relationship between risk factors of hip fracture and time to first fracture was demonstrated.

A number of statistically significant and clinically relevant effects were detected. The results of this study suggest that increasing age, being female, being Caucasian, having a history of falling, exercising less than needed, not attending church or religious services in the previous 2 weeks, being hospitalized in the previous year, and having a low BMI are associated with an increased risk of first hip fracture and a shorter time to hip fracture than the comparison group without these risk factors.

Our findings on the importance of demographic characteristics on older age, female, and Caucasian race with hip fracture are consistent with previous studies (Cummings et al., 1985; Jacobsen et al., 1990; Kellie & Brody, 1990; Lauritzen, McNair, & Lund, 1993; Wolinsky & Fitzgerald, 1994). It is important to note that having had these three risk factors present, the relative risk was 14 times higher and the time to first hip fracture was 90 days sooner than the reference group. Although age, gender, and race are not modifiable risk factors, our

study determined some other risk factors that are subject to interventions.

The number of falls in the year prior to baseline was inversely related to the time to first fracture. For those having two or more falls in the year prior to the baseline, the time to fracture was 151 days (5 months) sooner than those who did not have a history of falls. This time information quantitates the risk factor *history of falls* and gives a weight on this risk factor in relation to first hip fracture. The association of occurrence of hip fracture with history of falls prior to baseline is consistent with previous studies (Nevitt & Cummings, 1992; Wolinsky & Fitzgerald, 1994). Fallers often exhibited significantly reduced static balance and performance in walking and stair descent (Woolley, Czaja, & Drury, 1997). An efficient means of identifying potential fallers is through actual performance of a mobility skill, once the levels of swing and balance are determined, then appropriate strategies can be planned.

Attending church or religious services is a proxy variable for outside-of-home activities or social functioning. The time to fracture for those who did not frequently participate in activities outside the home was 47 days sooner than their counterparts. Those who had fewer activities outside of the home in the previous 2 weeks had a higher risk of hip fracture, which may be associated with reduced levels of mobility or lower extremity function. Jaglal, Kreiger, and Darlington (1993) found past and recent physical activity were independently protective of hip fracture after adjusting for other covariates. A fall that occurs during rapid walking has enough forward momentum to carry the faller onto his or her hands or knees instead of onto his or her hip; a fall that occurs while standing still, walking slowly, or slowly descending stairs has little forward momentum and the principal point of impact will be near the hip (Cummings & Nevitt, 1989), often resulting in hip fractures. Regular exercise may increase walking speeds and improve coordination and the ability to break falls.

Exercising less than needed is significantly associated with hip fracture; the time to fracture was 143 days (4 months) sooner than for those who exercised as much as needed. Exercise is being increasingly promoted as a preventive measure in the geriatric population. Regular exercise or exercising as much as needed may prevent the slowing of

gait with age (Spirduso, 1980), and it may decrease the risk of hip fracture by altering the orientation of falls (Cummings & Nevitt, 1989).

Hospitalizations are common for many older adults. For those who had hospitalization 1 year prior to baseline, the time to fracture was 78 days sooner than for those who did not. Previous studies suggest that hospitalizations are accompanied by a decline in ADL skills and mobility (Mahoney, Sager, Dunham, & Johnson, 1994; McVey, Becker, & Saltz, 1989) and a high proportion of hospitalized patients require assistance in walking at discharge (Hirsch, Sommers, & Olsen, 1990); hospitalization often requires prolonged bed rest that can lead to loss of muscle strength and increased body sway, both of which may predispose persons to fall (Campbell, Borrie, & Spears, 1989; Fernie et al., 1982; Mahoney et al., 1994). Adverse effects of treatment during hospitalization and changes in medication may also have an impact on cognitive status and psychomotor ability.

Having a high BMI has a protective effect on the risk of hip fracture; participants who had low BMI sustained hip fractures more than 1 year sooner (379 days) than those with high BMI. The difference in time to first fracture between the two groups was substantial; the estimated time window gives ample opportunity for intervention to change the status quo. Studies have shown that individuals with low BMI have an increased risk of fracture in men and women aged 45 and older (Grisso et al., 1994, 1997; Huang & Himes, 1997; Wolinsky & Fitzgerald, 1994). This detrimental effect has also been found in different cultural settings, such as among Spanish and Turkish women aged 50 years or older (Cano et al., 1993). That higher BMI may protect the skeleton has been postulated in several ways: (a) higher circulating level of adipose-based production of estrogen (Cano et al., 1993; Grisso et al., 1997), (b) higher production of calcitonin (Cano et al., 1989), (c) better cushioning effect of fat tissue covering the hip (Cano et al., 1993; Cummings & Nevitt, 1989), and (d) more sedentary lifestyle than thinner counterparts who may be less likely to fall and sustain a fracture (Kiel, Felson, Anderson, Wilson, & Moskowitz, 1987). To improve or maintain higher BMI level, in addition to medical attentions, the most readily available intervention would be strength training and exercise programs. Regular exercise may have positive benefits in enhancing protective response and maintaining bone mass.

Our findings indicate that as the number of risk factors increases, the relative risk increases dramatically and the window of opportunity for intervention is decreased. Given the information on risk factors for hip fracture, estimated cumulative relative risks, and the known time to first hip fracture, appropriate treatments or intervention programs to benefit individuals at risk of first hip fracture can be planned. With effective prevention and intervention, reducing the expected doubling of hip fracture cases in the next few decades may be possible.

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A Green Prescription Study:

*Does Written Exercise Prescribed by a Physician Result
in Increased Physical Activity Among Older Adults?*

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Objective: To determine if a written exercise prescription increases physical activity when added to verbal advice. **Methods:** Forty-nine community-dwelling older adults supplied their geriatricians with baseline data on their exercise levels using a questionnaire. Participants were randomly placed in a verbal advice only group or a verbal advice plus written prescription, “green” prescription, group. Outcomes were assessed after 6 weeks. **Results:** Both groups showed a significant increase in time spent in physical activity. However, no significant differences between groups due to the effects of the different advice modalities were found. **Conclusions:** Geriatricians can effectively promote physical activity among sedentary older adults through goal-oriented physical activity advice.

Although loss of strength and stamina is often attributed to aging, the real cause for these declines may be inactivity. As persons age, they frequently become sedentary, but this is not a necessary consequence

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of aging. By age 75, about one in three men and one in two women engage in no physical activity (Centers for Disease Control, 1995). The Centers for Disease Control and Prevention defines physical activity as any kind of moderate-intensity activity performed during the course of a typical day. This definition includes a range of occupational, leisure, and routine daily activities such as gardening, walking, and household chores. Among adults aged 65 years and older, walking, gardening, and yard work are the most popular physical activities (Pate et al., 1995). For older adults, such physical activity can become an effective alternative to physical exercise, which tends to be more planned, structured, and vigorous. This practical approach encourages seniors, who often face physical, psychological, and economic barriers, to become more active.

Physical inactivity has been increasingly recognized as an important risk factor for premature morbidity and mortality. Especially threatening to the sedentary senior are obesity and non-insulin-dependent diabetes, both of which are increasing in prevalence (Rowe & Kahn, 1998; U.S. Department of Health and Human Services [USDHHS], 1991). Recent recommendations in the 1996 Surgeon General's Report on Physical Activity and Health make the case that older adults can reap significant health benefits from even quite low levels of physical activity. It is now believed that half an hour of daily moderate physical activity may prolong and improve functional capacity and quality of life (Rowe & Kahn, 1998). The health benefits of staying active are many. They include lowering the risk of heart disease by stabilizing blood pressure and lowering the incidence of adult-onset diabetes through control of blood glucose levels. Other benefits are accelerated weight loss, increased good cholesterol (high-density lipoprotein levels), strengthened bones, lessened anxiety, reduced depression, improved posture, and enhanced muscle tone. In addition, physical activity can help improve flexibility, balance, and strength, all of which are important in preventing falls (USDHHS, 1991; U.S. Preventive Services Task Force, 1996). In 1997, the American Geriatrics Society and the American Academy of Orthopedic Surgeons issued a joint position statement that recommended "that older adults engage in moderate physical activity at least thirty minutes a day regularly" and "that older adults engage in a

variety of daily activities to ensure continued interest and participation in their program.”

Physicians and other health professionals need a variety of strategies to motivate sedentary seniors to become active. One component of such a program is an exercise prescription that enables physicians to quickly prescribe exercise for their patients. A prescription has important symbolic meaning for patients (Swinburn, Walter, Arroll, Tilyard, & Russell, 1998). It indicates that the physician believes enough in the health value of exercise that he or she equates it with a medication that will effectively promote the health of the patient. In addition, the prescription provides the patient with a ready reminder of the exercise to be accomplished.

This article describes a replication study undertaken to determine if exercise prescribed by a geriatrician increases physical activity among sedentary older adults more than verbal advice alone. The study design was adapted to older adults from previous research on middle-aged adults by Swinburn et al. (1998). A goal of the present study was to obtain data for an older cadre of adults, which could then be used to encourage more physicians to provide written exercise advice for their sedentary patients.

Method

SETTING

The study was conducted in a geriatrics ambulatory clinic, which is contiguous to a medical school in rural Appalachia, Ohio. Data were collected during a 28-week period from late February through August 1999.

RECRUITMENT AND QUESTIONNAIRE

During their regular office visits to the geriatrician, adults aged 60 years and older were informed of the study and invited to participate. Those agreeing to participate received verbal and written information about the study and were asked to sign an informed consent. The study was approved by the Ohio University Institutional Review Board.

Three geriatricians completed a training session on the study protocol. Baseline data on the subjects' physical activity levels were collected by two trained research assistants using a questionnaire similar to that used by Swinburn et al. (1998) but modified to better evaluate older adults. Physical activity was defined as either household activity or leisure activity. Household activity included such things as yard work, gardening, mowing the lawn, washing the car, and washing windows. Light interior housework was excluded. Leisure activity included such things as walking, biking, exercise classes, and swimming.

PARTICIPANTS

Exercise baseline data were collected on 76 individuals; 49 (44 women and 5 men) of these individuals were enrolled in the study. Seventeen were excluded because they were already physically active (i.e., they were doing 3 or more hours of moderate physical activity per week). Eight were excluded by their physicians for medical reasons, and 2 later withdrew from the study after baseline data were collected. Participants ranged in age from 62 to 92 years with a mean age of 74 years ($SD = 1.1$). Enrollees were randomly assigned to either the green prescription group ($n = 24$) or the verbal advice only group ($n = 25$) using a table of random numbers.

INTERVENTION

After review of the baseline data, the physician and participant worked together to set goals that would increase the participant's physical activity, mainly through additional walking. This exercise advice was given verbally to all participants by the physicians. Then, the physician opened an envelope that indicated if that patient was in the group to receive further written exercise advice. Those patients placed in this group had their goals written on a green prescription form.

After 6 weeks, telephone interviews were conducted by a research assistant using the same questions used in the baseline questionnaire. The interviewer was unaware of the type of advice given to the

participant. Forty-seven follow-up questionnaires were completed. Two participants did not wish to answer follow-up questions.

STATISTICS

Analyses were conducted with SPSS 10.0 for Windows (Chicago). The Wilcoxon rank test was used to examine differences between the two groups in the change in number of minutes spent performing various activities. Change from inactive to active status or the number increasing, decreasing, or not changing activity levels was assessed by logistic regression. The analysis was also performed on an intention-to-treat basis assuming no change in exercise status for the two participants who withdrew from the study.

Results

Participants ($n = 49$) were randomly placed either in the green prescription group ($n = 24$) or the verbal advice only group ($n = 25$), and 47 were followed up. In both groups combined, the number of people engaging in physical activity increased from 33 to 38. In addition, there was an average increase in duration of activity of 149 minutes per week.

Exercise intensity changed considerably from baseline to follow-up. At baseline, 16 participants were not engaged in any physical activity, whereas the remaining 33 were engaged in 42 activities. Participants were asked to rate the exercise intensity of each activity. Of the 42 activities, 18 were rated as *easy* (little exertion), 20 as *moderate* (some work), 2 as *vigorous* (makes you breathe hard or puff a lot), and 2 activities were not rated. At follow-up, 38 participants were performing 77 separate activities. Of the 77 activities, 12 were rated as *easy*, 46 as *moderate*, 13 as *vigorous*, and 6 were not rated.

Differences between the green prescription group and verbal advice group were assessed in the five ways described in the study by Swinburn et al. (1998). The first analysis compared the change in the number of individuals participating in any moderate-intensity household or leisure activity from baseline to follow-up (see Table 1). In the study by Swinburn et al. (1988), results for middle-aged adults

Table 1
*Baseline and Follow-Up Physical Activity After Written or Verbal
 Exercise Advice in Athens, OH, February Through August 1999*

	Baseline			Follow-Up		
	% Active	Minutes/ Week ^a	Range	% Active	Minutes/ Week ^a	Range
Green prescription (<i>n</i> = 24)						
Household ^b	17	37	8-80	54	180	10-540
Walking	46	75	26-150	58	111	20-315
Leisure (includes walking) ^c	50	110	35-360	67	119	20-315
Total (one or more activities)	63	98	8-360	79	223	10-540
Verbal advice (<i>n</i> = 25)						
Household ^b	32	100	15-240	52	334	20-1,320
Walking	40	68	10-210	60	102	20-400
Leisure (includes walking) ^c	52	60	10-210	64	108	20-400
Total (one or more activities)	72	88	10-270	76	320	25-1,365

a. Mean duration for participants performing the activities.

b. Household includes gardening, mowing lawn, washing car, washing windows, yard work and other moderate-intensity activities; active participants may have been engaging in more than one activity.

c. Other leisure includes biking, swimming, exercise classes; active participants may have been engaging in more than one activity.

Table 2
Response to Written or Verbal Only Exercise Advice—Percentage of Participants

	Increased	No Change	Decreased	p ^a
Green prescription (<i>n</i> = 24)	71	17	12	
Verbal-only advice (<i>n</i> = 25)	68	12	20	.73

a. Green prescription versus verbal-only advice (Wilcoxon rank test).

showed a significantly greater increase in the number of individuals participating in physical activity in the green prescription group. In our study of senior citizens, there was no significant difference between the groups on this measure. Fifteen senior participants in the green prescription group were active at baseline and 19 at follow-up, a 16% change. In the verbal advice only group, 18 participants were active at baseline and 19 at follow-up, a 4% change.

Table 3
Increase in Mean Physical Activity Duration (minutes per week)

	<i>Green Prescription</i>	<i>Verbal-Only Advice</i>	<i>p^a</i>
Middle-aged adults, New Zealand ^b			
Leisure	78	78	.16
Older adults, Ohio			
Leisure	24	38	.75
Household	92	142	.87
Total	116	180	.75

a. Mean value of green prescription versus verbal-only advice (Wilcoxon rank test).

b. Swinburn, Walter, Arroll, Tilyard, & Russell.

A second analysis assessed the physical activity response (increased, decreased, or no change) of the participants from baseline to follow-up (see Table 2). Activity levels changed in the green prescription group as follows: 71% of the participants increased their activity, 17% made no change, and 12% reduced activity. In the verbal advice only group, 68% increased their activity, 12% made no change, and 20% reduced their activity. The difference in the two groups was not statistically significant. These findings were similar to those of Swinburn et al. (1998).

The third analysis assessed the change from baseline to follow-up in duration of time spent in physical activity between the green prescription and verbal advice groups using all participants in each group as the denominator. Substantial increases in physical activity duration occurred in both groups (see Table 3). The increase was not significantly greater in the green prescription group, which is similar to the findings of Swinburn and colleagues (1998). The mean duration of active minutes per week increased from 61 to 177 minutes in the green prescription group, a change of 116 minutes per week. In the verbal advice only group, the mean duration of active minutes per week increased from 63 to 243 minutes per week, a change of 180 minutes per week (see Table 3).

At baseline and follow-up, each participant was asked, "Are you currently doing any regular physical activity to improve or maintain your health and fitness?" In the fourth analysis, self-reported participation in physical activity to maintain health or fitness increased

significantly ($p < .05$) in both groups, increasing from 36% to 65% in the green prescription group and from 32% to 68% in the verbal advice only group. Although the change was substantial in both groups, it was not significantly greater for the green prescription group. In contrast, Swinburn et al. (1998) found a significantly greater increase in the green prescription group on this measure.

The final analysis was a retrospective self-assessment. Participants were asked whether they had increased, decreased, or not changed their activity during the previous 2 months. Thirteen participants (52%) in the green prescription group reported increasing their activity, as did 12 (48%) in the verbal advice group.

Discussion

This study evaluated the effectiveness of combining verbal and written (green prescription) exercise advice versus verbal advice alone in motivating sedentary older adults to become more physically active. The study was modeled after a study by Swinburn and associates (1998), which took place in a general practice setting in New Zealand with middle-aged adults.

On average, it took 14 minutes (range = 9 to 25 minutes) to assess baseline physical activity and give exercise advice in the Ohio study. This included an average of 7 minutes of physician time to provide the exercise advice after a research assistant completed the assessment questionnaire. The entire procedure took only 5 minutes, on average, (range = 2 to 15 minutes) in the New Zealand study (Swinburn et al., 1998). This difference demonstrates the well-known need to take additional time when working with older adults.

In the New Zealand study, verbal advice coupled with the green prescription was found to be more effective than verbal advice alone in increasing the physical activity of middle-aged adults during a 6-week period. Among the participants in the present study, no significant difference was found between these advice modalities on any of the five measures analyzed. However, both modalities did result in increased physical activity among these older participants.

Several factors may account for the different findings. In the Ohio study, the participants had often received written instructions by the

geriatricians on prior visits. Such written information is a common device in this practice to promote compliance by elderly patients with prescribed health regimes. Therefore, the green prescription instructions may have received less attention from a group used to written advice from their physician. Such written advice, however, is uncommon in most busy medical practices and the New Zealand participants may have found such written advice to be so extraordinary that they gave it special attention.

Another factor may simply be the smaller number of participants (49 vs. 456) in the present study. In particular, if the effect of a written prescription for exercise becomes diminished as the age of the participants increases, then a much larger group may be necessary to display this subtle change in behavior.

Table 3 compares the increase in mean physical activity duration for all the middle-aged adults in the New Zealand study (Swinburn et al., 1998) with all the older adults in the Ohio study. Middle-aged adults in the green prescription and verbal advice only groups both increased their duration of leisure activity by 78 minutes per week, whereas older adults in the green prescription group had an increase of 24 minutes (55 minutes at baseline vs. 79 minutes at follow-up) and those in the verbal advice only group had an increase of 38 minutes (31 minutes at baseline vs. 69 minutes at follow-up). Walking accounted for the greatest increase in leisure activity. Twenty-one persons (42%) were walking at baseline and 27 (54%) at follow-up.

Table 3 further shows the importance of including the household activity of older adults in providing a more complete picture of their activity level. When this is included for older adults, the green prescription group had an increase in duration of activity of 116 minutes per week ($p < .01$) and the verbal advice only group had an increase of 180 minutes per week ($p < .05$).

Gardening accounted for the greatest increase in household activity. Whereas only one person was gardening at baseline, 18 (36%) were gardening at follow-up. Because this study took place during a 28-week period, from February through August, which coincided with seasonal changes from winter to spring and into summer, it was important to consider possible seasonal effects. That is, did activity levels increase because the weather improved, thus promoting

outdoor activities? To check for seasonal effects, a repeated measures logistic regression analysis was done on the change in physical activity reported by the participants according to the time of year in which they entered the study. In one analysis, participants were grouped into individual months, February through July, and in a second analysis, they were grouped into seasons, February 18 through April 14 and April 15 through July 15. For each grouping, the subsequent change in activity was noted. In both cases, there was no significant difference between the green prescription cohort and the verbal advice only cohort in the percentage of participants that reported increased physical activity. It does not appear, therefore, that the season of the year in which the data were collected affected the change in physical activity reported by this study. Seasonal effects may be minimal given the short 6-week span between the intervention and the data collection.

Without a control group, it is difficult to determine the relative influences of physicians' verbal advice and their written advice on these outcomes. The inclusion of a control group that received no exercise advice would help answer the question on how much physicians' advice influenced the increase in activity.

Seniors who found it difficult to increase physical activity levels cited chronic health problems being a challenge. For example, impeded mobility ($n = 17, 34\%$) and pain ($n = 6, 12\%$) were frequently mentioned barriers. Other factors included the rural locale, weather, and attitude ("Exercise isn't for me—I'm too old"). In rural communities, sidewalks are often unavailable. This increases the fear of falling and makes walking unattractive as a physical activity. Some seniors worried about their safety when walking on isolated rural county roads. Using the local bike path was an alternative, but rural elders frequently mentioned a lack of transportation as the reason they did not use this resource. These responses clearly show that programs that address these barriers are needed if more seniors are to increase their physical activity. The present results indicate that physicians and other health providers can address the attitude barrier by regularly expressing their confidence in their patients' abilities to become more active.

Conclusions

The current study does not support the greater effectiveness of verbal plus written exercise advice over verbal advice alone in increasing physical activity among older adults. Both interventions were shown to have an impact on promoting physical activity, particularly walking and gardening. Because the authors received so many positive remarks from the study participants about the value of written exercise advice, we still believe this is a promising intervention to pursue. For example, 36 of the 49 participants made such comments as, "It is really good to have things written down when you are older"; "Anything the doctor writes down is motivating"; and "The green prescription is a real good idea." Geriatricians and other physicians have a valued position in the community, and this study illustrates the important role they can play via a variety of interventions in encouraging physical activity among their patients.

The data on household activity help support exercise paradigms that count all moderate-intensity activity as contributing to a fitness program. As the older adult population grows, it becomes increasingly important that researchers continue to seek motivational methods that effectively address the exercise barriers identified in this study. Physicians need to urge their patients to remain active with the same persistence with which they promote other preventive activities.

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Urinary Incontinence in Wisconsin Skilled Nursing Facilities:

Prevalence and Associations in Common With Fecal Incontinence

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Objectives: This article reports the characteristics associated with fecal incontinence (FI) in a nursing home population that are also associated with urinary incontinence (UI). **Method:** A cross-sectional survey composed of data from the Wisconsin Center for Health Statistics' Annual Nursing Home Survey in 1992 and 1993. Demographic characteristics, functional status, and disease histories were correlated with UI. **Results:** Data were available for 18,170 and 17,117 residents respectively, 56% of who were to varying degrees incontinent of urine in each year. Significant positive associations with UI included, in order of adjusted odds ratios: FI, truncal restraints, dementia, female gender, impaired vision, stroke, and constipation. Inverse associations were age, body mass index, tube feedings, and pressure ulcers. Diabetes, heart disease, arthritis, fecal impaction, and race were not associated with UI. **Conclusion:** UI frequently coexists with FI in nursing home residents. FI and UI differ in their association with age, body mass, and gender.

In a recent analysis of risk factors for fecal incontinence (FI) in Wisconsin skilled nursing facilities (SNF), it was found that the most prevalent association was with urinary incontinence (UI), an association that was so common that they were virtually comorbid conditions.

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From the list of associations independently associated with FI described by Nelson, Furner, and Jesudason (1998), we now assess their relationship with UI. In so doing, we hope to determine if FI and UI have risk factors in common and help determine what therapeutic approaches might ameliorate UI.

As part of the Omnibus Reconciliation Act of 1987, federal guidelines for nursing homes were established that included the use of the Minimum Data Set (MDS) (Morris et al., 1990). This is a performance assessment tool used to measure resident deficits and strengths. Estimation of rehabilitative potential and care planning are the goals of the assessment. Assessment is made by direct contact of the nurse with the resident. Various aspects of the MDS have been evaluated for reliability since its inception, including accuracy of identification of residents with UI (Crooks, Schnelle, Ouslander, & McNess, 1995). In the state of Wisconsin, the Department of Health and Social Services and the Wisconsin Center for Health Statistics publish an Annual Nursing Home Survey (ANHS), for which MDS data are collected from SNFs (Wisconsin Center for Health Statistics, 1994). The health data in the MDS have allowed assessment of associations with UI in residents of SNFs and possible identification of risk factors.

Method

Data for 1992 and 1993 are from the Wisconsin Annual Survey of Nursing Homes and were obtained from the Wisconsin Center for Health Statistics. Residents' social security numbers were scrambled to prevent identification of individual residents, although the scrambled numbers remained over time to allow longitudinal tracking of residents. The resident-based data describe residents of SNFs (and not institutions for the developmentally disabled or those with mental diseases or intermediate care facilities) who were in residence on December 31 of the respective year. Assessment of these nursing home residents was carried out by trained professionals using the Health Care Financing Administration's MDS. Provision of resident-based MDS data by nursing homes to the Wisconsin Center for Health Statistics was voluntary. Of the 390 SNFs in Wisconsin, 181 provided resident-based MDS data in 1992, whereas 177 SNFs provided MDS data

in 1993. Approximately 58% of the population reported herein were assessed in both years. The remainder were either new admissions or reported from nursing homes not included in both surveys. The two survey years therefore do not strictly constitute a longitudinal survey. Two cross-sectional surveys are instead presented. Data from both years will be presented to assess the consistency of our findings.

The MDS contains data on demographics, payment sources, advanced directives, cognitive patterns, communication/hearing patterns, vision patterns, physical functioning, continence in the past 14 days, psychosocial well-being, mood and behavior, disease diagnoses, health conditions, medication use, skin conditions, and oral health.

In addition, there are facility-based data collected from all 390 SNFs in Wisconsin that contain some resident characteristics. In a statistical comparison of resident characteristics between the SNFs that voluntarily supplied MDS data and all Wisconsin SNFs of both 1992 and 1993 data, no differences were found in age, gender, length of stay, or payment source. As much as can be determined, the MDS data are therefore derived from a population that did not differ from the entire Wisconsin SNF population.

DEPENDENT VARIABLE

Residents were considered to have UI if they were listed as being frequently incontinent or always incontinent. Residents who were listed as having complete control of their bladder or usually continent/occasionally incontinent were considered to be continent. The validity and reliability of the MDS are somewhat greater, as one would expect when comparing only the two extremes of continence: always wet and always dry (Crooks et al., 1995). However, the sociological consequences of incontinence may also be felt by those who are occasionally incontinent, although probably more so in an ambulatory non-nursing home population (Hunskaar & Sandvik, 1993; Robinson, 2000). By their exclusion from this analysis, only a very severely affected group, who inevitably would not be representative of the incontinent population as a whole, would be selected and important associations missed.

INDEPENDENT VARIABLES

Frequencies and means were determined for the characteristics described in the MDS. Those variables suspected to be contributors to UI or FI were selected for further analysis. Demographic variables included age, gender, and race. Health variables included body mass index in kilograms, history of heart disease, dementia, stroke, depression, vision impairment, arthritis, diabetes, constipation, diarrhea, fecal impaction, and pressure ulcers. Functional status variables included the ability to dress oneself, feed oneself, maintain personal hygiene, locomotion, mobility, use the toilet, and transfer from bed to chair. Other variables assessed were FI (which was defined in a manner similar to that for UI), tube feeding, and trunk restraints. All variables with the exception of age and body mass index were categorized dichotomously. Age and body mass index were treated as continuous variables.

ANALYTICAL APPROACH

Variables found to be significantly associated with FI in a univariate analysis (Nelson et al., 1998) were assessed with multiple logistic regression analysis for their relationship to UI, including FI as an independent variable. Prevalence odds ratios and 95% test-based confidence limits were generated, and risk factors were ranked in order of importance by the odds ratio. All analyses were conducted using SAS for mainframe computers.

Results

In 1992, MDS data were available for 18,170 SNF residents; 71% were women and more than 93% were Caucasian. Fifty-six percent of the residents were reported to have at least occasional UI (10,168); 7,440 (73.2%) of these residents were women and 2,728 (26.8%) were men (see Table 1). The average age of UI residents was 85.9 years, whereas the average age of continent residents was 84.4 years. These are both higher than the average age of nursing home residents in the United States, which is 83 years (DHHS, 1998). Wisconsin has a higher rate of nursing home residence than the United States overall

(6.6% vs. 4.3%) (WCHS, 1994), perhaps reflecting this apparent greater longevity.

In 1993, MDS data were available for 17,117 SNF residents; 72% were women and more than 95% were Caucasian. Fifty-seven percent were reported to have at least occasional UI (9,726); 7,190 (73.9%) were women and 2,536 (26.1%) were men. The average age of continent residents was 83.8 years, and the average age of incontinent residents was 85.2 years. There were 10,328 individuals for whom data were reported in both survey years.

There were 10,328 residents assessed in both 1992 and 1993. The prevalence of UI was 53.9% in 1992 and 61.0% in 1993 in these residents. Of the 10,328 residents, 49.6% were incontinent of urine in 1992 and in 1993.

Table 2 presents the factors significantly associated with UI that were identified in stepwise logistic regression analyses. In both 1992 and 1993, significant positive associations included fecal incontinence, any loss of activities of daily living (ADLs, a separately reported category in the MDS), truncal restraints, dementia, impaired vision, female gender, stroke, and constipation. Inverse associations were seen with age, body mass index, pressure ulcers, and tube feedings. No association was seen with heart disease, arthritis, diabetes, fecal impaction, or race. Depression and diarrhea were inverse associations in 1992 and insignificant associations in 1993.

Among the ADLs, significant associations were seen (see Table 3) with the inability to independently use a toilet, eat, maintain personal hygiene, and dress oneself. Locomotion and transferring were inconsistently associated with UI in the 2 years of the study.

Discussion

UI in a nursing home population is the most severe manifestation of this disability because it has affected the individual sufficiently to cause in many cases his or her withdrawal from family, home, and normal societal interactions. The identification of remediable factors causing or worsening UI in nursing home residents has been stressed in previous reports (Brandeis, Baumann, Hossain, Morris, & Resnick, 1997; Landi, Sgardi, & Bernabi, 1998). Factors reported as potentially

Table 1
Frequency of Urinary Incontinence Strata in Wisconsin Skilled Nursing Homes

	1992		1993	
	No.	(%)	No.	(%)
Continent	8,002	44.0	7,391	43.2
Usually continent	1,834	10.1	1,693	9.9
Occasionally incontinent	1,459	8.0	1,408	8.2
Frequently incontinent	2,733	15.0	2,857	16.7
Incontinent	4,142	22.8	3,768	22.0

Table 2
Comparing Those With Frequent or Total Urinary Incontinence to Those Who Are Not Incontinent, Usually Continent, and Occasionally Incontinent

Variable	1992		1993	
Fecal incontinence	20.5	(18.6-22.6)	17.8	(16.1-19.7)
Trunk restraints	2.5	(2.3-2.8)	2.4	(2.1-2.7)
Dementia	1.5	(1.4-1.7)	1.5	(1.4-1.7)
Impaired vision	1.4	(1.3-1.5)	1.4	(1.3-1.6)
Stroke	1.3	(1.2-1.4)	1.4	(1.2-1.5)
Constipation	1.3	(1.2-1.4)	1.3	(1.2-1.4)
Heart disease	<i>ns</i>		<i>ns</i>	
Arthritis	<i>ns</i>		<i>ns</i>	
Diabetes	<i>ns</i>		<i>ns</i>	
Fecal impaction	<i>ns</i>		<i>ns</i>	
Race	<i>ns</i>		<i>ns</i>	
Age	0.99	(0.98-0.99)	0.98	(0.98-0.99)
Body mass index	<i>ns</i>		<i>ns</i>	
Depression	<i>ns</i>		<i>ns</i>	
Diarrhea	0.7	(0.5-0.8)	0.7	(0.6-0.9)
Male gender	0.8	(0.7-0.9)	0.8	(0.7-0.8)
Pressure ulcer	<i>ns</i>		<i>ns</i>	
Tube feeding	0.6	(0.4-0.7)	0.7	(0.5-0.9)

Note. Adjusted odds ratio (95% confidence intervals).

reversible contributors to UI include urinary tract infection (Landi et al., 1998), bed rails, trunk restraints, chair restraints, and ADL impairment (Brandeis et al., 1997). In this latter study, the MDS was also used to identify associations but with a different focus on associations and a population that lacked specific geographic definition.

Table 3
Comparing Those With Frequent or Total Urinary Incontinence With Those Who Are Not Incontinent, Usually Continent, and Occasionally Incontinent

ADL	1992		1993	
Toilet use	5.6	(4.9-6.6)	6.3	(5.3-7.4)
Eating	3.0	(2.8-3.3)	2.9	(2.7-3.2)
Hygiene	2.0	(1.7-2.5)	1.8	(1.5-2.3)
Dressing	<i>ns</i>		<i>ns</i>	
Bed mobility	1.8	(1.6-1.9)	1.9	(1.7-2.1)
Locomotion	1.2	(1.1-1.3)	1.2	(1.1-1.3)
Transferring	<i>ns</i>		<i>ns</i>	

Note. Adjusted odds ratios (95% confidence intervals). ADL = activity of daily living.

In contrast, the present study presents a population-based SNF estimate of associations with UI. To those associations described above, we can now add constipation, although, interestingly, not fecal impaction; one wonders how they were differentially perceived by the staff entering the data. There is no guidance within the MDS on how these two observations might differ, although constipation may imply frequent straining at stool and impaction, quite the opposite, the rather passive accumulation of large amounts of stool. The insignificant associations are also similar, and rather surprisingly so, in this report and that of Brandeis et al. (1997): heart disease, diabetes, and depression. For instance, it might have been hypothesized that polyuria caused by diuretic therapy or hyperglycemia would cause UI. A limitation of this study is that we did not have access to current medications (such as diuretics) or data on recent urinary tract infections. These analyses are then best viewed as complementary to previous studies of risk factors for UI rather than confirmatory of previous findings.

Comparing FI and UI in the Wisconsin SNF population, besides frequently coexisting, which has been previously noted (Denis et al., 1992; Nelson et al., 1998; Schiller et al., 1982), revealed several associations in common including dependency in ADLs, trunk restraints, dementia, impaired vision, history of stroke, and constipation. FI differed from UI in its positive associations with tube feedings, diarrhea, pressure ulcers, fecal impaction, age, body mass index, and male

gender (Nelson et al., 1998). Although these are important differences, the similarities in association are of greater importance, particularly those related to immobility and restraint (Williams & Finch, 1997). Increased excretory output, whether of urine due to urinary tract infection (Landi et al., 1998) or of feces caused by tube feedings and diarrhea (Nelson et al., 1998), is for each type of incontinence similar stimuli to dysfunction that are equally remediable.

The appropriate rank of age in this list of associations is problematic because age and body mass index alone have been adjusted as continuous variables, the remainder all being dichotomous. The odds ratios thus appear barely significant when in fact age may be a major determinant of risk. Of great interest is that age, in this elderly population, as an independent association is inversely associated with UI but positively associated with FI. This is perhaps the most significant finding of this study, along with the difference in gender association. Implied in this finding is that UI and not age per se is what brings people to nursing homes.

The degree to which any of these associations might be a cause of UI or FI is not possible to determine in a cross-sectional survey such as this study. What can be gleaned from these data are hypotheses concerning what might cause UI, which can then be investigated by analytical epidemiology or interventions. For instance, it may be desirable to determine if restraint of the elderly might have risks that exceed its benefits (Schiller et al., 1982) and to assess the effectiveness of restraints in preventing falls (they often cause them) versus the degree to which restraints cause incontinence. It is also desirable to determine if improved bowel function might diminish episodes of both UI and FI and, especially, if attention paid to global function and mobility might be as efficacious as neuromuscular education related to the urinary sphincter (Burgio et al., 1998). The potential savings in health care costs is huge (Resnick, 1998) if UI and FI were successfully treated and this resulted in a significant number of nursing home residents returning to their homes.

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