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Diabetes Foot Self-care Practices in a Rural, Triethnic Population

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Abstract

Purpose—The purposes of this study were to assess the level of foot self-care performed in a rural, multiethnic population of older adults and to identify factors associated with foot self-care.

Methods—The Evaluating Long-term Diabetes Self-management Among Elder Rural Adults study included a random sample of 701 African American, Native American, and white adults from 2 rural North Carolina counties. Participants completed in-home interviews, 5 foot self-care practices from the Summary of Diabetes Self-Care Activities (SDSCA), functional status measures, and measures of education and support for foot care.

Results—Foot care practices/behaviors reported at least 6 days/week ranged from 35.6% for inspecting shoes to 79.2% for not soaking feet. Four independent predictors of the SDSCA summary foot care index score were observed: having been shown how to care for feet ($P < .0001$), female gender ($P = .03$), having had a doctor check nerves in feet in past year ($P = .02$), and not receiving support caring for feet ($P = .0425$).

Conclusions—These findings indicate that educating patients about foot self-care may encourage routine foot care but that those dependent on either formal or informal support to perform foot care do so less frequently than those who perform it independently.

Diabetes mellitus and chronic diabetes complications place an enormous burden on the health care system and health care resources. More than 18 million Americans, or 6.3% of the population, have diabetes.¹ Diabetes contributes substantially to morbidity and mortality, with foot complications being among the most serious and costly complications of diabetes. Foot ulcerations often lead to amputation if not detected early and managed properly among persons

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with diabetes.² About 60% of all lower extremity amputations in the United States are performed on persons with diabetes.³ About 84,000 people with diabetes have lower extremity amputations each year.¹

It is estimated that the risk of diabetes-related foot complications can be reduced by 49% to 85% by proper preventive measures, patient education, and foot self-care.⁴ However, the degree to which a person is able to perform diabetes foot self-care is likely to be influenced by a number of factors, including personal health, access to medical care and foot care education, and formal and informal support. Similarly, certain segments of the population may be more likely to not receive appropriate medical foot care and not perform diabetes foot self-care, including the elderly, ethnic minorities, and persons in rural communities. Inappropriate care may explain the ethnic disparity in diabetes-related lower extremity amputations seen in the United States,⁵ which is a target issue for Healthy People 2010.⁶

This study will examine the foot self-care behaviors of older adults in a rural triethnic community. Specifically, the following questions will be addressed: (1) What is the level of foot self-care being performed in this population? and (2) What demographic, health, medical care, and support characteristics are associated with foot self-care behaviors?

Methods

Study Description

The Evaluating Long-term Diabetes Self-management Among Elder Rural Adults (ELDER) study, a 4-year study funded by the National Institute on Aging and the National Center for Minority Health and Health Disparities, is a population-based, cross-sectional survey designed to comprehensively assess the self-care strategies of older rural adults (age ≥ 65 years) with diagnosed diabetes and the impact of these strategies on diabetes control. Participants for the study were selected from two counties in central North Carolina. The counties were selected because they are largely rural, have large numbers of ethnic minorities and persons living below the poverty level, and the investigative team has developed strong ties in these communities. The study began in 2001, with recruitment of participants conducted between May and October 2002. The study was approved by the Institutional Review Board of the Wake Forest University School of Medicine.

Participant Recruitment and Selection

The overall goal of the study was to recruit a random sample of community-dwelling older adults with type 2 diabetes in the 2 study counties, with equal representation from African American, Native American, and white men and women. First, a sampling frame was selected using Medicare claims records from the Center for Medicare and Medicaid Services (CMS). Consideration for the sampling frame was established based on a person living in the study counties and having at least 2 out-patient claims for diabetes (ICD-9 250) between 1998 and 2000. From each gender-ethnic group in the sampling frame, a random sample was selected and contacted to solicit their participation in the survey. Letters from CMS and from the study team were sent asking for their participation in the study. The letters were followed up with a phone call or personal home visit from the study team to confirm diabetes status and further assess eligibility (resident of study counties, age ≥ 65 , English speaking, member of 1 of the 3 targeted ethnic groups, physically and mentally able to participate in survey) and willingness to participate in the study.

Of the 1222 persons who were contacted, 313 were disqualified for the following reasons: reported that they did not have diabetes ($n = 118$), lived outside study counties ($n = 51$), lived in a nursing home ($n = 84$), age not ≥ 65 years ($n = 2$), did not speak English ($n = 1$), failed

Mini-Mental State Exam ($n = 5$), and deceased ($n = 52$). The eligibility of an additional 122 persons was unable to be assessed for the following reasons: refused participation and screening ($n = 48$), physically ($n = 8$) or mentally ($n = 14$) unable to participate in screening, and unable to locate ($n = 52$). For those who met the eligibility criteria after the telephone or in-person contact, 86 were not interviewed for the following reasons: refused participation ($n = 74$) or study staff determined that the participant was physically ($n = 6$) or mentally ($n = 6$) unable to participate. The final sample included 701 individuals who completed the survey. Thus, the overall response rate among participants known to be eligible was 89%.

For these analyses, the sample size was reduced from 701 to 698 and further to 688 for the foot care measures. The first reduction was due to an exclusion of 3 participants who did not fit the 3 ethnic categories, bringing the sample size to 698. The second reduction to 690 observations was due to exclusion of those participants who were double amputees ($n = 8$) and therefore skipped out of the foot care questions. Two participants did not provide sufficient information to calculate a foot care index score, which reduced the sample to 688 (Table 1). Variables with data from fewer than 688 participants are noted in the tables, which results largely from missing data for those variables.

Study Measures

Participation in the study involved a 1½-hour interview conducted by local, trained interviewers. Survey data were recorded on paper forms, data entered into EpiInfo (version 6.0, CDC, Atlanta, Ga), and analyzed using SAS Statistical Software (version 8.2, SAS Institute, Inc, Cary, NC).

The primary outcome for this study is foot self-care as measured by the Summary of Diabetes Self-Care Activities (SDSCA).⁷ The SDSCA assesses the level of patient self-care for diet, exercise, blood sugar testing, medications, and foot care during the previous week. If the participant was sick during the past 7 days, they were asked to reflect on the past 7 days when they were not sick. This instrument shows good internal and test-retest reliability and can be generalized to various patient populations with diabetes.⁷

For foot self-care, study participants were asked 5 questions from the SDSCA to identify the number of days in the past week that they performed positive foot care practices (washed their feet, dried between their toes after washing, checked their feet, and inspected the inside of their shoes) or negative foot care practices (soaked feet). Each of the foot self-care questions was scaled from 0 to 7 based on the number of days in which the participants indicated their performance in the specific foot self-care tasks. The foot-soaking item was reversed scored and added to the remaining questions. The mean of these 5 items indicates the level of foot self-care. The number of days for each foot care measure was also categorized across 4 groups (0 days, 1-2 days, 3-5 days, and 6-7 days) for descriptive purposes.

Demographic and health predictor measures for foot self-care used in this report include gender, self-identified ethnicity, age, level of formal education, poverty status, duration of diabetes, current use of diabetes medications, physical and mental health, and history of neuropathy or amputation. Age was used as a continuous and categorical variable. Education level was dichotomized to less than high school graduate or at least high school graduate. A poverty status measure was created using 3 categories: receiving Medicaid, not receiving Medicaid and annual income less than \$25,000/year, and not receiving Medicaid and annual income greater than \$25,000/year. Diabetes duration was used as a continuous variable and was categorical (<10 years or ≥ 10 years). Diabetes medication use was classified as either no medication, oral agents only, or insulin with or without oral agents. Physical health is the physical component score (PCS) subscale of the SF-12; mental health is reported as the mental component score

(MCS) subscale of the SF-12.^{8,9} Both PCS and MCS were used as continuous variables and as dichotomous variables (<50 or ≥50).

In addition to the demographic and health predictors listed above, 3 other categories of variables were considered: medical care, education, and support. Medical care included 3 questions pertaining to whether the participant had seen a doctor for a diabetes-related care in the past year, whether a doctor had checked the nerves in their feet in the past year, and whether they had seen a podiatrist in the past year. Education included 3 questions pertaining to whether the participants had attended a diabetes self-management education class in the past year, whether they had received information on how to care for their feet, and whether someone had shown them how to care for their feet. Support included 1 question on whether the participants had received any formal or informal support to assist them in caring for their feet. Each question in these 3 categories was considered as dichotomous (yes or no).

Statistical Analysis

Demographics, health characteristics, and foot care behaviors were summarized using counts and percentages or means and standard deviations. Because the distribution of the foot care index score was skewed, it was summarized using percentiles rather than means and standard deviations overall and within subgroups. Using percentiles provided a detailed description of the skewed distributions and a set of reference scores for comparison across subgroups and for clinical practice. Associations between the foot care index score and potential predictors were evaluated for statistical significance using multiple linear regression modeling on all available nonmissing data for each model. The following categorical variables were tested as potential predictors: gender, ethnicity, education through high school, poverty status, age group, diabetes medication, history of neuropathy or amputation, and indicators for having seen a doctor for a diabetes visit, having seen a doctor who checked the nerves in their feet, having seen a podiatrist, having attended a diabetes class, having received information on how to care for feet, having been shown how to care for feet, and having received support for their foot care—all within the past year. In addition, log duration of diabetes and the SF-12 physical and mental component summary scores were tested as potential predictors as continuous variables.

A forward stepwise selection procedure was used to select predictors to include in the final model. Statistical significance was defined as $P < .05$, except that $P < .10$ was used to keep predictors in the model after each forward step. The higher P value was used to increase the chance of including predictors that are important in influencing both the selected set of predictors and the effects of the statistically significant predictors. Confidence intervals were calculated at the 95% level of confidence. All analyses were performed using SAS Statistical Software version 8.2 (SAS Institute, Inc, Cary, NC).

Results

The demographic and health characteristics of the sample are displayed in Table 1. The ethnic distribution was 31.4% African American, 42.7% white, and 25.9% Native American. Approximately 49% of the sample was female, consistent with the design of the study. The mean age ($\pm$ standard deviation) of the sample was 74.1 ± 5.39 years, and the mean duration of diagnosed diabetes was 12.4 ± 10.98 years.

To address the first research question for this study regarding the level of foot self-care being performed in the study population, the frequency and percentage of respondents reporting the number of days on which they performed foot self-care behaviors is reported in Table 2. The foot self-care behaviors performed with the highest frequency on 6 to 7 days were washing the feet (75.6%) and not soaking the feet (79.2%). Conversely, 23% of participants reported not checking their feet at all, and 54% did not inspect their shoes before wearing them.

The second research question posed in this study was to examine the health, demographic, health care, medical care, and support characteristics associated with foot care in the study population. Foot care index scores, overall and by demographics, health, health care, education, and support characteristics are presented in Table 3. The overall median score was 5.2, with the 25th and 75th percentiles being 4.2 and 5.8, respectively. Among the demographic predictors, median scores were higher for women compared to men, African Americans compared to whites and Native Americans, persons with less than a high school education versus those with at least a high school education, and, among persons <75 years of age compared to those ≥ 75 years. In the univariate model (Table 4), only gender was significantly associated with foot care index scores.

For health characteristics, median foot care index scores were greater for persons with diabetes duration ≥ 10 years compared to those with diabetes duration <10 years and persons with MCS <50 compared to persons with MCS ≥ 50 . None of the health characteristics were significantly associated with foot care index scores in the univariate model (Table 4).

For the medical care characteristics, median foot care index scores were higher for persons who had seen a doctor for diabetes-related care in the past year versus those who did not, those who had had a doctor check the nerves in their feet in the past year versus those who had not, and those who had seen a podiatrist in the past year versus those who had not. The first 2 of these 3 were significantly associated with the self-care index score in the univariate model (Table 4).

For the education and support characteristics, median foot care index scores were higher for persons who had attended a diabetes self-management education class versus those who had not, persons who had received information on how to care for their feet versus those who had not, and persons who had been shown how to care for their feet versus those who had not. Persons who had received support caring for their feet had a lower median foot care index score compared to persons who had not received support. In the univariate model (Table 4), receiving information on caring for their feet and being shown how to care for their feet were significantly associated with foot care index scores.

The independent effects of the demographic, health, medical care, and support characteristics were assessed, and results of the multivariate model from this analysis are presented in Table 5. Four factors were significantly associated with foot care index scores in the model: gender, being shown how to care for the feet, having had a doctor check the nerves in the feet in the past year, and receiving support for caring for the feet. The support characteristic was inversely associated with foot care index scores, that is, receiving support was inversely associated with foot care index scores.

Discussion

In this study, we examined the foot self-care practices of older adults with diabetes living in a rural, ethnically diverse community. The percentage of the sample adhering to recommended foot care practices, defined as performing the practice at least 6 days per week, ranged from 35.6% for inspecting shoes to 75.6% for washing the feet and 79.2% for not soaking the feet. This demonstrated a wide distribution of adherence for the individual activities that should be performed when caring for the feet. Most concerning was that 28% of the sample reported checking their feet fewer than 3 days per week and that 60% checked inside their shoes fewer than 3 days per week. At least three quarters of the participants in this study had foot care index scores lower than the 6 to 7 range, demonstrating the need for health care providers and educators to continually remind their patients who have diabetes to perform foot self-care.

Four factors were independently associated with foot self-care scores. Women were more likely than men to engage in foot self-care activities. This finding is consistent with data from the Behavioral Risk Factor Surveillance System (BRFSS), which shows that the prevalence of diabetes foot self-care is approximately 10% higher for women compared to men.¹⁰ People who were shown how to care for their feet had higher foot care summary scores than those who were not. The participants in this study who had the nerves in their feet checked by a health care professional demonstrated higher foot care index scores compared to those that did not have the nerves in their feet checked. This finding supports the idea that proper patient education and medical care can improve preventive foot self-care and might help reduce amputations.

Participants who did not receive support caring for their feet had better foot care practices overall than those who were receiving support in the care of their feet. This indicates that those who become dependent on either formal or informal support perform foot care worse than those who perform it independently. This finding may relate to the self-determination theory that patients tend to feel more competent when they are autonomously motivated, and that enhances felt competence and autonomous motivation.¹¹

Several factors that were hypothesized to be significant independent predictors of foot care were determined to have no significant association with foot care index scores: ethnicity, seeing a health care provider for a diabetes-related visit in the past year, seeing a podiatrist in the past year, attending a diabetes class in the past year, higher physical functioning, and higher social support. The finding that ethnic minorities were no less likely to perform foot self-care practices indicates that this rural, predominantly low-income community is somewhat homogenous across ethnic groups with regard to health care access and self-care practices.

No association with seeing a health care provider for diabetes-related care was found. Previous studies have shown that medical care visits that involve checking the feet have been found to influence foot self-care.¹² The findings may indicate that on routine diabetes visits, many primary care providers are not performing foot examinations and are not emphasizing the importance of self-care. Podiatry care had no impact on the level of foot self-care in this population, contradicting the results of some previous studies.¹³ This may be related to the fact that the podiatry care was not defined to be specifically related to diabetes care in this study questionnaire.

It is important to note that the level of diabetes health care reported by these participants was relatively low. About 42.2% had seen a doctor in the past year for diabetes-related care, 43.9% had had a doctor check the nerves in their feet in the past year, and 25.3% had seen a podiatrist in the past year. In 2001, national data from the BRFSS indicated that the rate of annual foot exams by a health care professional for adults with diabetes was 62.3%, much lower than the national goal of at least 75%.¹⁴ This inadequate level of diabetes care increases the risk of diabetes complications in this population.

This study showed that attending a diabetes self-management education class had no impact on the foot self-care index scores. Foot care education has also been found to be a critical factor in preventing foot care complications, making it an important predictor to analyze. Patients who had no formal diabetes education had a 3- to 4-fold increase in lower extremity amputation compared to patients who had received formal diabetes education.^{15,16} The findings may be explained by the fact that the study question asked if the participants had attended a class only in the past year. The researchers also did not ask how many of the classes they attended.

No association between foot self-care and physical functioning was found. Previous research has shown that an important consideration in evaluating foot self-care practices in the elderly is physical limitation due to factors such as reduced visual acuity and poor joint flexibility.

¹⁷ Self-examination of the entire foot requires flexion of the spine, flexion and lateral rotation of the hips, knee flexion, and inversion of the foot. The findings may be reflective of a potential imprecision in assessing physical functioning using the SF-12 in this population or that persons with physical limitations may be performing less than optimal self-care procedures.

Implications for Diabetes Educators

Foot care is an important element of medical management and self-care for patients with diabetes. This study showed low rates of foot self-care in a rural, predominantly low-income population. Emphasis on patient education focusing on foot self-care is necessary to improve these rates in this population. Despite ethnic disparities in diabetes-related foot amputations, this study showed no differences in the level of foot care across 3 ethnic groups in this population, a finding that is not unique to this study. Educators can focus on factors other than ethnicity in improving diabetes foot self-care knowledge and practice.

Activities that require patients to become more actively engaged in their foot care appear to have the outcome of better foot self-care practices. This was demonstrated by activities such as being shown how to care for their feet, having a health care provider actively examine their feet while checking the neurological function, and giving the patient the task to perform foot care independently. This information should encourage health care providers by demonstrating to them that they can have an impact on diabetic foot self-care by showing patients how to care for their feet and by performing a thorough foot examination.

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Table 1

Demographic and Health Characteristics of Evaluating Long-term Diabetes Self-management Among Elder Rural Adults Study Participants, Overall (N = 688)

	Count % or Mean $\pm$ SD	
Demographic		
Ethnicity		
African American	216	31.4
White	294	42.7
Native American	178	25.9
Female	340	49.4
Age, y	74.1	$\pm$ 5.39
Married	342	49.7
Formal education (n = 687)		
<8th grade	279	40.6
9th-11th grade (some high school)	168	24.5
High school diploma/GED	142	20.7
At least some college	98	14.3
Annual household income (n = 633)		
<\$10,000	227	35.9
$\geq$ \$10,000 - <\$15,000	137	21.6
$\geq$ \$15,000 - <\$25,000	130	20.5
$\geq$ \$25,000	139	22.0
Supplemental insurance		
VA, Medicare Part B, HMO, other	630	91.6
Poverty status (n = 660)		
On Medicaid	234	35.5
No Medicaid and income <\$25,000	299	45.3
No Medicaid and income $\geq$ \$25,000	127	19.2
Number of persons in home		
1	213	31.0
2	336	48.8
3 or more	139	20.2
Health		
Diabetes duration, y	12.4	$\pm$ 10.98
Body mass index (kg/m ² ; n = 663)	29.7	$\pm$ 5.87
Diabetes medication		
No medication	86	12.5
Oral agent only	416	60.5
Insulin with or without oral agents	186	27.0
Number of prescription medications (n = 684)	6.5	$\pm$ 4.23
Diabetes-related chronic health conditions		
Heart disease	311	45.2
Stroke	173	25.2
Thrombosis/blood clots in legs	58	8.4
Kidney disease	77	11.2
Eye disease	274	39.8
Extremity amputation	13	1.9
Neuropathy	156	22.7

Table 2

Frequency and Percentage of Respondents Reporting Indicated Number of Days Performing Foot Self-Care Behaviors (N = 688)

Characteristic	Percentage Reporting Indicated Number of Days			
	0 Days	1-2 Days	3-5 Days	6-7 Days
Washed feet	3 (0.4)	25 (3.6)	140 (20.4)	520 (75.6)
Dried between toes (n = 684)	99 (14.5)	28 (4.1)	119 (17.4)	438 (64.0)
Checked feet (n = 686)	158 (23.0)	32 (4.7)	52 (7.6)	444 (64.7)
Inspected shoes	372 (54.1)	43 (6.3)	28 (4.1)	245 (35.6)
Did not soak feet	53 (7.7)	6 (0.9)	84 (12.2)	545 (79.2)

Table 3
Foot Care Index Score Overall and by Selected Demographic and Health Characteristics

	Foot Care Index Score					
	N	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
Overall	688	3.0	4.2	5.2	5.8	7.0
Demographic						
Gender						
Male	348	3.0	4.2	4.8	5.6	7.0
Female	340	3.0	4.2	5.4	6.2	7.0
Ethnicity						
African American	216	3.0	4.2	5.4	6.4	7.0
Native American	178	3.0	4.2	5.0	5.6	7.0
White	294	3.0	4.2	4.9	5.8	7.0
Education level (n = 687)						
<High school graduate	447	3.0	4.2	5.2	5.8	7.0
≥High school graduate	240	3.1	4.2	5.0	5.8	7.0
Poverty status (n = 660)						
On Medicaid	234	2.8	4.2	5.2	5.8	7.0
No Medicaid and income <\$25,000	299	3.2	4.2	5.4	5.8	7.0
No Medicaid and income ≥\$25,000	127	2.8	4.2	4.6	5.8	7.0
Age group						
<75 years	393	3.2	4.2	5.4	6.0	7.0
≥75 years	295	2.8	4.0	5.0	5.6	7.0
Health						
Diabetes duration						
<10 years	342	3.0	4.2	5.0	5.8	7.0
≥10 years	346	3.0	4.2	5.2	5.8	7.0
Diabetes medication						
No medication	86	2.8	4.2	5.0	5.8	7.0
Oral agent only	416	3.0	4.2	5.2	5.7	7.0
Insulin with or without oral agents	186	2.8	4.2	5.2	6.2	7.0
History of neuropathy or amputation						
Yes	165	2.8	4.2	5.2	5.8	7.0
No	523	3.0	4.2	5.2	5.8	7.0
SF-12 physical component summary score (n = 656)						
<50	552	3.0	4.2	5.2	5.8	7.0
≥50	104	3.2	4.2	5.2	5.8	7.0
SF-12 mental component summary score (n = 656)						
<50	278	2.8	4.2	5.4	5.8	7.0
≥50	378	3.0	4.2	5.0	5.6	7.0
Medical care						
Seen a doctor for a diabetes-related visit in the past year (n = 683)						
Yes	288	3.2	4.2	5.6	6.1	7.0
No	395	3.0	4.2	5.0	5.6	7.0
Doctor checked nerves in feet in the past year						
Yes	302	3.2	4.2	5.6	6.4	7.0
No	386	2.8	4.2	4.8	5.6	7.0
Seen a podiatrist in the past year						
Yes	174	2.8	4.2	5.4	5.6	7.0
No	514	3.0	4.2	5.0	5.8	7.0
Education						
Attended a diabetes education class in the past year (n = 687)						
Yes	114	3.2	4.2	5.6	6.4	7.0
No	573	3.0	4.2	5.0	5.6	7.0
Received information on how to care for feet						
Yes	162	3.6	4.6	5.6	6.8	7.0
No	526	2.8	4.2	4.8	5.6	7.0
Shown how to care for feet						
Yes	183	4.2	4.6	5.6	6.8	7.0

	Foot Care Index Score					
	N	10th Percentile	25th Percentile	Median	75th Percentile	90th Percentile
No Support Received support caring for feet	505	2.8	4.0	4.8	5.6	7.0
Yes	355	3.0	4.2	5.0	5.8	7.0
No	333	2.8	4.2	5.4	5.8	7.0

Table 4
Univariate Associations With Foot Self-Care Index Scores (N = 688 unless otherwise noted)

Variable	F Value	P Value
Demographic		
Gender	4.91	.0270
Ethnicity	1.50	.2239
Education level (n = 687)	0.11	.7377
Poverty status(n = 660)	0.93	.3945
Age group	2.77	.0631
Health		
Diabetes duration (ln)	2.13	.1446
Diabetes medication	0.18	.8362
History of neuropathy or amputation	0.42	.5175
SF-12 physical component summary score (n = 656)	0.00	.9947
SF-12 mental component summary score (n = 656)	1.81	.1793
Medical care		
Seen a doctor for a diabetes-related visit in the past year (n = 683)	4.22	.0402
Doctor checked nerves in feet in the past year	12.77	.0004
Seen a podiatrist in the past year	0.36	.5493
Education		
Attended a diabetes education class in the past year (n = 687)	3.37	.0668
Received information on how to care for feet	27.99	<.0001
Shown how to care for feet	46.22	<.0001
Support		
Received support caring for feet	0.12	.7271

Table 5
Multivariate Predictors of Foot Self-Care Index Scores (N = 688)

Variable	Coefficient	SE	95% CI	t Value	P Value
Shown how to care for feet Yes vs no	0.7506	0.1191	0.5168, 0.9843	6.30	<.0001
Gender Female vs male	0.2121	0.1003	0.0151, 0.4091	2.11	.0349
Doctor checked nerves in feet in the past year Yes vs no	0.2430	0.1050	0.0368, 0.4491	2.31	.0210
Received support caring for feet Yes vs no	−0.2098	0.1032	−0.4124, −0.0071	−2.03	.0425