Published in final edited form as:

Diabet Med. 2012 September ; 29(9): e321–e325. doi:10.1111/j.1464-5491.2012.03584.x.

Is the Physical Functioning of Older Adults with Diabetes Associated with the Processes and Outcomes of Care? Evidence from Translating Research Into Action for Diabetes (TRIAD)

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Abstract

Aims—To examine the relationship between physical function limitations and diabetes self-management, processes of care, and intermediate outcomes in adults ≥ 65 years of age with type 2 diabetes.

Methods—We studied 1,796 participants 65 years of age and older in managed care health plans enrolled in Translating Research into Action for Diabetes (TRIAD). Physical functioning was assessed at baseline with the Physical Component Summary of the Short Form-12 (SF-12) Health Survey. Diabetes self-management was assessed with follow-up surveys, and processes of care (eye exams, urine microalbumin testing, foot exams, etc.) and intermediate health outcomes (HbA1c, blood pressure, LDL-c) were assessed with medical chart reviews. Multivariate regression models were constructed to examine the associations between physical function limitations and outcomes.

Results—Frequency of eye exams (OR 0.69, 95% CI 0.49 - 0.99) was the only process of care that was worse for participants with physical function limitations (n=573) compared to those without limitations (n=618). Neither self-management nor intermediate outcomes differed by whether patients had or did not have physical function limitations.

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Declaration of Competing Interests: Nothing to declare.

Conclusion—Limitations in physical functioning as assessed by the SF-12 were not associated with substantial difference in diabetes care in adults ≥ 65 years of age enrolled in managed care health plans.

Keywords

physical function; quality of care; geriatrics

Introduction

Diabetes mellitus is a chronic disease prevalent among older adults. It is associated with complications and co-morbidities that may result in physical function limitations defined as inability to walk one-fourth of a mile, climb stairs, or do housework (1, 2). Indeed, 23% of U.S. adults ≥ 60 years of age have diabetes (3), and 63% to 85% of adults ≥ 45 years of age with diabetes have physical function limitations (4). The effect of co-existing diabetes and physical function limitations on the quality of diabetes care has not been studied. The quality of diabetes care is usually measured by patient self-management, processes of care, and intermediate health outcomes.

Diabetes self-management activities including self-monitoring of blood glucose and foot care, and successful diabetes self-management likely requires good physical functioning. Physical function limitations have been reported by patients as a major barrier to self-management (5).

Diabetes processes of care are recommended measures performed by providers, which include assessing a patient's glycemic (HbA1c), blood pressure, and LDL-cholesterol (LDL-c) levels. Older adults with more co-morbidities usually have more physical function limitations and receive more processes of care from medical providers (6). More processes of care have not always led to improvements in diabetes intermediate health outcomes including glycemic, blood pressure, and LDL-c control (7-9). Poor health-related behaviours may contribute to this discordance between processes of care and intermediate outcomes (10).

Outcomes are dependent on both patient self-management and provision of care (11). As many older diabetes patients have physical function limitations, it is important to investigate if physical function limitations affect their diabetes care. We hypothesized that older adults with type 2 diabetes and more physical function limitations, compared to those with fewer limitations, might perform less self-management, receive more diabetes processes of care, and be less likely to achieve desired intermediate health outcomes.

Patients and methods

Study population

Translating Research Into Action for Diabetes (TRIAD) is a multicentre prospective observational study of diabetes care in managed care health plans. The study's design has been reported previously (12). Briefly, the study involves six centres and 10 managed care health plans across the United States that serve over 180,000 non-institutionalized patients with diabetes. The patient inclusion criteria were a diagnosis of diabetes, age 18 years or older, continuous enrolment in the participating health plan for a minimum of 18 months, at least 1 health care claim in the previous 18 months, receipt of the majority of diabetes care through the plan, and the ability to speak English or Spanish. TRIAD recruited a stratified random sample of ~9,500 adults with diabetes (1,500 – 2,000 per centre). Patients were sampled from provider groups with at least 50 patients with diabetes enrolled in the study's

health plans. The cohort was surveyed in 2000-2001, 2002-2003, and 2005 by computerized telephone or mailed survey. The response rates adjusted for inability to contact and mortality were 69%, 83%, and 75%, respectively (13). The protocol was reviewed and approved by Institutional Review Boards at all participating sites. All participants provided informed consent.

For this report, we analysed data from participants with type 2 diabetes 65 years of age and older who completed TRIAD surveys in 2000-2001 and 2002-2003 and had their medical records reviewed (N=1,796).

Measurements

In 2000-2001, we assessed patients' socio-demographic characteristics, body mass index, type and duration of diabetes, and insulin use. Co-morbidities were assessed with the Charlson index (14). The Charlson index is an extensively studied and valid measure that weights various comorbid conditions that predict mortality; a higher score indicates more co-morbidities and a greater risk of death. Physical functioning was measured with the Physical Component Summary (PCS) from the Short Form - 12 Health Survey (SF-12) (15). The PCS asked if a patient's health limited his/her ability to perform moderate activities, to climb several flights of stairs, to accomplish daily activities, or to be involved in work or daily activities, and if pain interfered with normal activities. The PCS has a range of 0 to 100 with a mean score of 50 and a standard deviation (SD) of 10 in the general U.S. population. A higher score indicates better functioning. PCS scores were categorized into tertiles to represent participants with minimal, moderate, and extensive physical function limitations.

Outcomes assessed in 2002-2003 included diabetes self-management (frequency of glucose monitoring and extra minutes per day spent caring for feet; assessed via survey), processes of care (eye exams, urine microalbumin testing, foot exams, HbA1c and LDL-c testing; assessed from medical chart review); and intermediate outcomes (values of HbA1c, LDL-c, and blood pressure; assessed from medical chart review). Participants using insulin were analysed separately for daily self-monitoring of blood glucose. Desirable intermediate outcomes were defined based on the American Diabetes Association (16) recommendations: HbA1c < 7% (53 mmol/mol); LDL-c < 100 mg/dL (2.59 mmol/L); and blood pressure < 130/80 mmHg.

Statistical analysis

Baseline characteristics are presented as numbers and percentages or mean $\pm$ standard deviation. Multivariate regression analyses were performed to examine the associations between PCS scores and self-management, processes of care, and outcomes. All models were adjusted for age, sex, race, education, income, duration of diabetes, use of insulin, body-mass index, and health plan (as fixed effects). All analyses were performed using SAS (version 9.2; Cary, NC).

Results

There were 1,796 patients 65 years of age or older. Mean age was 72.7 ± 5.2 years. Approximately half were women and 54% were white, 13% Hispanic, 13% Asian, and 12% Black. Twenty-five percent had less than 12th grade education and 34% had annual income less than \$15,000. Average Charlson index score was 2.56 ± 1.68 .

All patients had type 2 diabetes; 53% had diabetes for more than 10 years and 25% were using insulin. Over 82% of the patients had annual eye exams, urine microalbumin tests, foot exams, or HbA1c determinations, and 79% had annual lipid tests. All patients had annual blood pressure measurements.

On average, patients reported spending 7 ± 16 minutes per day in caring for their feet. Seventy-four percent of insulin users and 45% of non-insulin users reported daily self-monitoring of blood glucose. Mean HbA1c was $7.4 \pm 1.4\%$ (57 ± 8 mmol/mol), LDL-c was 107 ± 32 mg/dL (2.77 ± 0.83 mmol/L), and blood pressure was $137 \pm 18.2 / 73 \pm 11.2$ mmHg.

The mean PCS score was 43.6 ± 2.9 . We categorized PCS scores into tertiles to represent patients with minimal (PCS score 50.5 ± 2.4 , $n=618$), moderate (44.2 ± 1.9 , $n=605$), and extensive (35.3 ± 4.0 , $n=573$) physical function limitations. Compared to patients with minimal or moderate physical function limitations, those with extensive physical function limitations were more likely to be older, female, Black, obese, have less education, have less income, use insulin, and have higher Charlson scores (Table 1, all $p < 0.01$). After adjustment for age, sex, race, education, income, duration of diabetes, use of insulin, BMI, and health plan, patients with extensive physical function limitations were less likely to receive eye exams (OR 0.69, 95% CI 0.49 - 0.99) (Table 2) than those with minimal physical function limitations. Otherwise, patients with extensive, moderate, and minimal physical function limitations were equally likely to perform self-management, to receive the other 4 processes of care, and to achieve desirable intermediate health outcomes.

The intermediate outcomes recommended by the American Diabetes Association may not be appropriate for older adults with complex health conditions and limited life expectancies (17). Therefore, we also performed analyses with less stringent targets, i.e., HbA1c $< 8.0\%$ (64 mmol/mol), LDL-c < 130 mg/dL (3.37 mmol/L), and blood pressure $< 140/90$ mmHg. Our results remained the same.

Discussion

The care of older adults with type 2 diabetes requires ongoing self-management and coordinated provider care. Physical function limitations have been reported to impact patients' self-management. Given the prevalence of physical function limitations among older adults with diabetes, we investigated whether these limitations affected processes of care and outcomes.

We found that limitations in general physical functioning among adults ≥ 65 years of age were not associated with substantial difference in self-management of diabetes or intermediate outcomes. Among the 5 diabetes processes of care, physical function limitations were associated only with less frequent eye exams. This finding confirmed and complemented results from a previous study of Medicare beneficiaries participating in the National Long-Term Care Survey (18). Eye exams were less likely to be performed in diabetes patients with more functional limitations. The National Long-Term Care Survey did not include patients enrolled in health maintenance organizations, and patients without limitations in activities of daily living and instrumental activities of daily living were under-represented.

Among all of the process of care measures that we studied, eye exams were the only measure that couldn't be performed by primary care physicians or endocrinologists during routine office visits. Our findings suggest that patients with physical function limitations might benefit from a multi-disciplinary clinic offering both primary care and eye services.

Our study has several limitations. We studied a managed care population with relatively few physical function limitations. The mean PCS score in our population was 43.6 ± 2.89 , whereas the PCS scores for patients with diabetes in the 2001 Medical Expenditure Panel Survey were 35.8 (without depression, mean age 60.6 ± 0.5 y) and 40.4 (with depression, mean age 57.0 ± 1.6 y) (19). The lack of physical function limitations in our population may

have reduced our ability to detect a relationship between physical functioning and diabetes care. Questions in PCS assessed general physical functioning instead of assessing a patient's ability to perform specific tasks related to diabetes care, such as ability to inspect feet, dexterity to draw up insulin, etc. Our measure of physical functioning, which was obtained through self-report, may be influenced by social desirability. In addition, we examined only three outcomes. We did not evaluate whether adults with physical function limitations received family support for their care.

Nevertheless, our study is the first to explore the associations between physical function limitations and diabetes self-management, processes of care, and intermediate outcomes in older adults. We found that patients enrolled in managed care health plans are less likely to receive eye exams if they had more general functional limitations, but that general functional limitations do not appear to have a major impact on self-management, processes of care, or intermediate outcomes in older adults. Although our results are reassuring, additional studies of older adults are needed that employ more sensitive measures of physical functioning and focus on the functions that are necessary to carry out diabetes care.

Acknowledgments

This study was jointly funded by Program Announcement number 04005 from the Centers for Disease Control and Prevention (Division of Diabetes Translation) and the National Institute of Diabetes and Digestive and Kidney Diseases. Its contents are the responsibility of the authors and do not represent the official views of The Centers for Disease Control and Prevention and the National Institute of Diabetes and Digestive and Kidney Diseases. Contributions to this study were made by members of the Translating Research into Action for Diabetes Study Group. The authors acknowledge the participation of our health plan partners.

Abbreviations

ADA	American Diabetes Association
HbA1c	Haemoglobin A1c
LDL-c	low-density lipoprotein cholesterol

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Table 1Baseline characteristics of patients participated in the study.[#]

Study Participants	Number (Total N=1,796)	Minimal limitations (n=618)	Moderate limitations (n=605)	Extensive limitations (n=573)	p- values
Age at interview (Years, SD)	72.7 (5.2)	72.2 (4.9)	73.0 (5.2)	73.1 (5.4)	0.003
Sex					<0.001
Female	921 (51%)	260 (42%)	321 (53%)	340 (59%)	
Male	873 (49%)	358 (58%)	284 (47%)	233 (41%)	
Race/ethnicity					0.003
White	930 (54%)	324 (55%)	300 (53%)	306 (56%)	
Hispanic	229 (13%)	80 (13%)	84 (15%)	65 (12%)	
Asian/Pacific-Island	214 (13%)	92 (15%)	72 (13%)	50 (9%)	
Black	209 (12%)	49 (8%)	68 (12%)	92 (17%)	
Other	127 (7%)	48 (8%)	43 (7%)	36 (6%)	
Education					<0.001
< 12th grade	446 (25%)	127 (21%)	143 (24%)	176 (31%)	
High school graduate	552(31%)	174 (28%)	202 (34%)	176 (31%)	
Some college	455 (26%)	154 (25%)	157 (27%)	144 (25%)	
4 yr college	319 (18%)	158 (26%)	90 (15%)	71 (13%)	
Income					<0.001
< \$15,000	543 (34%)	142(25%)	194 (36%)	207 (41%)	
\$15,000 to <\$40,000	628(39%)	206 (37%)	224 (42%)	198 (39%)	
\$40,000 to <\$75,000	314 (20%)	148 (26%)	92 (17%)	74 (15%)	
\$75,000	120 (7%)	65 (12%)	27 (5%)	28 (6%)	
Body Mass Index (kg/m ²)					<0.001
Normal (<26)	351 (20%)	137 (23%)	116 (20%)	98 (18%)	
Overweight (26 to <30)	678 (39%)	277 (46%)	228 (39%)	173 (31%)	
Obese (30 to <35)	638 (36%)	177 (30%)	226 (38%)	232 (42%)	
Grossly obese (35)	79 (5%)	9 (1%)	18 (3%)	52 (9%)	
Charlson Index (Mean, SD)	2.56 (1.68)	2.23 (1.48)	2.41 (1.61)	3.07 (1.94)	<0.001
Duration of diabetes					0.127
< 5 years	419 (24%)	158 (26%)	144 (24%)	117 (21%)	
5-10 years	408 (23%)	145 (24%)	140 (23%)	123 (22%)	
>10 years	933 (53%)	303 (50%)	308 (52%)	322 (57%)	
Any insulin use	450 (25%)	119 (19%)	145 (24%)	186 (32%)	<0.001
Diabetes Processes of Care					
Eye exam	1481(82%)	531 (86%)	497 (82%)	453 (79%)	0.008

Study Participants	Number (Total N=1,796)	Minimal limitations (n=618)	Moderate limitations (n=605)	Extensive limitations (n=573)	p- values
Urine microalbumin assessment	1508 (84%)	515 (83%)	505 (83%)	488 (85%)	0.636
Foot exam	1534 (85%)	530 (86%)	520 (86%)	484 (84%)	0.737
Glycemic assessment	1576 (88%)	555 (90%)	529 (87%)	492(86%)	0.112
LDL-c assessment	1416 (79%)	499 (81%)	483 (80%)	434(76%)	0.082
Diabetes Self-Management					
Extra minutes spent caring for feet (Mean, SD)	7.1 (16.4)	6.27 (14.5)	7.54 (18.5)	7.48 (15.9)	0.376
Self-monitoring of blood 1 time daily, non-insulin users	591 (45%)	211 (43%)	200 (45%)	180 (48%)	0.382
Self-monitoring of blood 1 time daily, insulin users	328 (74%)	89 (77%)	101 (70%)	138 (75%)	0.457
Diabetes Intermediate Outcomes					
HbA1c (Mean, SD)	7.39 (1.35) ; 57 mmol/mol (8)	7.41 (1.3)	7.44 (1.4)	7.33 (1.35)	0.414
LDL-c (mg/dL) (Mean, SD)	107 (32); 2.8 mmol/L (0.8)	106 (30)	107 (34)	106 (31)	0.820
Blood pressure					
Systolic blood pressure (Mean, SD)	137 (18.2)	136 (18)	138 (18)	138 (18)	0.362
Diastolic blood pressure (Mean, SD)	73 (11.2)	73 (11)	73 (11)	73 (12)	0.797
Physical Component Summary (PCS) (Mean, SD)	43.6 (2.9)	50.5 (2.4)	44.2 (1.9)	35.4 (4.0)	<0.001

Results are number of patients (percentage of patients) based on each characteristics unless otherwise specified.

SD = standard deviation; HbA1c = Haemoglobin A1c; LDL-c = low-density lipoprotein cholesterol; PCS = Physical Component Summary of the Short Form-12 Health Survey

Table 2

Adjusted odds ratios of diabetes processes of care, self-management, and intermediate outcomes, according to physical function limitations.[#]

	Physical Function Status	
	Moderate limitations (n=605) vs. minimal limitations (n=618)	Extensive limitations (n=573) vs. minimal limitations (n=618)
Processes of Care	(OR, 95% CI)	(OR, 95% CI)
Eye exam	0.94 (0.66 - 1.34)	0.69 (0.49 - 0.99)
Urine microalbumin assessment	1.17 (0.82 - 1.67)	1.17 (0.80 - 1.69)
Foot exam	1.24 (0.85 - 1.83)	0.85 (0.58 - 1.25)
Glycemic assessment	0.89 (0.59 - 1.34)	0.82 (0.54 - 1.25)
LDL-c assessment	1.03 (0.74 - 1.44)	0.87 (0.62 - 1.22)
Self-Management		
Daily SMBG, non-insulin user	1.13 (0.84 - 1.52)	1.13 (0.82 - 1.55)
Daily SMBG, insulin user	0.89 (0.47 - 1.66)	1.08 (0.57 - 2.05)
Foot self-care	1.21 (0.91 - 1.60)	1.18 (0.88 - 1.59)
Intermediate Outcomes		
HbA1c<7% (53 mmol/mol)	1.01 (0.77 - 1.33)	1.16 (0.87 - 1.54)
LDL-c<100 mg/dL (2.58 mmol/L)	1.02 (0.77 - 1.34)	1.04 (0.78 - 1.50)
Blood pressure<130/80 mmHg	0.86 (0.63 - 1.17)	1.05 (0.77 - 1.44)

[#] Adjusted for age, sex, race, education, income, duration of diabetes, insulin use, body mass index, and health plan.

Reference group has minimal physical function limitations based on tertiles of the Physical Component Summary (PCS) score of the Short Form-12 Health Survey. SMBG = self-monitoring of blood glucose; HbA1c = Haemoglobin A1c; LDL-c = low-density lipoprotein cholesterol