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Diabetes Complications and Pain Among Mexican Americans Aged 80 and Older

Chinedu Onwudebe, MS,[1] Soham Al Snih, MD, PhD,[2,3,] Mukaila A. Raji, PhD, MS,[3,4,] and Sadaf Arefi Milani, PhD, MPH[3,5,*,]

[1]John Sealy School of Medicine, University of Texas Medical Branch, Galveston, Texas, USA.
[2]Department of Population Health & Health Disparities, University of Texas Medical Branch, Galveston, Texas, USA.
[3]Sealy Center on Aging, University of Texas Medical Branch, Galveston, Texas, USA.
[4]Division of Geriatrics and Palliative Medicine, Department of Internal Medicine, University of Texas Medical Branch, Galveston, Texas, USA.
[5]Department of Epidemiology, University of Texas Medical Branch, Galveston, Texas, USA.

*Address correspondence to: Sadaf Arefi Milani, PhD, MPH. E-mail: samilani@utmb.edu

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Abstract

Background and Objectives: Diabetes is common among Hispanic older adults; however, the association between diabetic complications and pain has not been widely studied in this population. Our objective was to examine the association between diabetes complications and pain over 6 years among Mexican Americans aged 80 years and older.

Research Design and Methods: We used data from Waves 7 to 9 (2010–2016) of the Hispanic Established Population for the Epidemiologic Study of the Elderly ($n = 853$). Participants were categorized as having no diabetes, diabetes without complications, and diabetes with complications. Pain was defined as reporting pain when standing or walking (pain on weight-bearing) and having pain that limited daily activities (pain interference). We used generalized estimating equations to estimate the odds of pain over 6 years as a function of diabetes status controlling for socioeconomic and health characteristics.

Results: At baseline, the mean age was 85.7 (standard deviation = 3.9) years, 65.2% female, 68.5% had no diabetes, 14.7% had diabetes without complications, and 16.9% had diabetes with complications. Those with diabetes without complications had lower odds of reporting pain on weight-bearing and pain interference, compared to those with no diabetes. Among those reporting diabetes ($n = 269$), those with complications had higher odds of pain on weight-bearing and pain interference, compared to those without complications. Those with both micro and macro complications had over 2 times the odds of pain, compared to those having no complications.

Discussion and Implications: The lower burden of pain in those with diabetes but no complications may reflect optimal management of diabetes. Routine screening and treatment of pain in patients with diabetes complications can mitigate excess disability and increase the quality of life for patients with diabetes.

Translational Significance: Mexican American older adults have substantial burdens of both diabetes and pain; however, the association between diabetes complications and pain is understudied. Among very old Mexican Americans, aged 80 and over, those with diabetes but no complications had a lower burden of pain. This may reflect better management of the disease among those without complications. This study underscores the necessity of screening for pain and pain management as part of the treatment plan in patients with longstanding diabetes. This is especially critical in Mexican American older adults, who have a high prevalence of diabetes and many barriers to accessing care.

Keywords: Aging, Chronic disease, Ethnicity

The incidence and prevalence of type 2 diabetes mellitus are significantly higher among Mexican American adults compared to non-Hispanic White adults (1). In 2017–2018, the Centers for Disease Control and Prevention reported that the prevalence of diagnosed diabetes in Mexican American adults aged 18 years or older was 14.4%, the highest among subgroups of Hispanic origin (1). A study that included both diagnosed and undiagnosed diabetes documented a prevalence of 21.7% among Mexican Americans aged 20 and older (2). Late diagnosis of diabetes is linked to social determinants of health such as decreased access to health care, lower education, and low income (3). Overall, higher rates of diabetes in Mexican Americans than non-Hispanic Whites likely reflect several factors including the high rate of obesity, metabolic syndrome, and physical inactivity, as well as genetic susceptibility to insulin resistance (3–6). Mexican American men and women have a higher prevalence of diabetes compared to their non-Hispanic White counterparts (men: 28.8% vs

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14.8%; women: 26.5% vs 9.8%) (7). Hispanic older adults are one of the fastest-growing populations in the United States and Mexican Americans account for 59.5% of all U.S. Hispanics (8,9). The number of Americans aged 85 and older is expected to triple from 6.6 million to 19 million from 2019 to 2060, with the number of Hispanic Americans aged 85 and older projected to increase from 509,096 to 3.4 million in that same time frame, making Hispanic American older adults an important, yet understudied, population (9).

Diabetes complications range from macrovascular conditions (heart attack/atherosclerotic cardiovascular diseases [ASCVD], amputations, and stroke) to microvascular diseases (renal impairment and end-stage renal disease [ESRD], retinopathy and blindness, and neuropathy) (10,11). Mexican Americans have higher rates of diabetes-related complications and worse glycemic control than non-Hispanic Whites (prevalence of diabetic retinopathy: 34.0% in Mexican American adults vs 26.4% in White adults; incidence rate of ESRD: 4.5 patients per 1 000 person-years for Hispanic adults vs 3.2 patients per 1 000 person-years for White adults (12–15). Hispanic adults are reported to have the highest incidence of proliferative diabetic retinopathy, followed by Black, Asian, and White adults (16). Diabetes is a major contributor to ASCVD, the leading cause of death among Hispanics in the United States (3). Additionally, Hispanics were found to have a higher incidence of lower-extremity amputations as a result of diabetes, diabetic eye disease, and nephropathy in comparison to their non-Hispanic White counterparts (3). These complications are major contributors to excess disability and poor quality of life in Hispanics. The pathways by which the accelerated onset of disability and worsened quality of life likely involve several factors including mobility impairment, increased susceptibility to frailty, development of geriatric syndromes, and increased odds of developing pain that interferes with daily functions.

Pain, especially pain that interferes with function, and diabetes share risk factors such as older age, obesity, and physical inactivity, with both exacerbated by smoking and excessive alcohol use (17,18). One study found that 75% of Mexican Americans aged 25–75 years with type 2 diabetes reported pain, as measured by the Illness Perceptions Questionnaire (19). One source of pain in patients with diabetes is diabetic neuropathy, which is associated with excess pain; a review of recent discoveries on genetics of diabetes and diabetes complications found that over 50% of individuals over 50 years of age with diabetes develop diabetic neuropathy (11). Another potential source of pain is intermittent claudication (from peripheral artery disease), which along with diabetic neuropathy increases the odds of lower-extremity amputations and foot ulcerations (11). Unclear is the extent and the magnitude of the association of micro- and macrovascular complications of diabetes with the onset of pain when standing or walking (pain on weight-bearing) and having pain that limited daily activities (pain interference)—disabling pain.

We draw from the Verbrugge and Jette disablement model (20), where diabetes (Stage 1) may co-occur with impairments (Stage 2), placing individuals at risk for later functional limitations and disability. This relationship may be explained by multiple pathways through which diabetes is associated with pain. First, at least half of people with diabetes develop diabetic neuropathy; of these, 30%–50% experience neuropathic pain (21). Second, diabetes is associated with musculoskeletal pain, as persistent hyperglycemia leads to the accumulation of end glycation products, which cause stiffening of connective tissue and musculoskeletal pain. Pain in diabetic patients has been found to be related to the aforementioned neuropathy in addition to a myriad of factors, such as pathological processes like vascular insufficiency and osteoporosis, as well as decreased levels of insulin-like growth factor, obesity, and sedentary lifestyle (22). Throughout this disablement process, risk factors—biological, such as sex and age; psychological, such as depression (23); social (24–26), such as education or nativity; and environmental, such as neighborhood (27,28)—may increase the risk of disablement in individuals. These factors include demographics (eg, ethnicity) and access to health care. We examine Hispanic ethnicity as one factor that may affect how individuals experience this disablement.

Although pain has not been examined among older Hispanics with diabetes, findings on pain in the Hispanic populations are mixed. Previous studies have found that Mexican Americans and Hispanic adults, in general, more often report severe pain, experience undertreated pain, and are less likely than non-Hispanic Whites to receive prescriptions for analgesic medication (29–31). Conversely, it has been found that Mexican Americans have lower odds of chronic back pain, upper- and lower-extremity pain, chronic localized pain, and widespread pain when compared to non-Hispanic Whites (32). In a previous study using the Hispanic Established Population for the Epidemiologic Study of the Elderly (HEPESE), the prevalence of self-reported pain on weight-bearing in Mexican Americans aged 65 and older was 31.9% (33). However, other studies on community-dwelling or noninstitutionalized adults over age 50 have demonstrated that once socioeconomic factors are controlled for, there is no significant difference in pain between Hispanics and non-Hispanic Whites (34,35).

The relationship between diabetes, diabetes complications, and disabling pain has not been previously studied among very old Mexican Americans, aged 80 and older. Previous studies have examined musculoskeletal pain and diabetes, but not the association between diabetes complications and pain. In particular, this is important among very old adults (aged 80 and older), because the prevalence of both pain and diabetes increases with age for all racial/ethnic groups (36,37). We were interested in understanding the relationship between various levels of diabetes severity as measured by diabetes versus diabetes with complications (micro- and macrovascular complications) and how these relate to the onset of activity-limiting pain that interferes with daily functions. Given this gap and the burden of both disabling pain and diabetes among Mexican Americans, the objective of this study is to examine the relationship between diabetes complications and pain in community-dwelling Mexican Americans aged 80 and older. We hypothesize that diabetes complications will be associated with pain among Mexican Americans aged 80 and older compared to those without diabetes and those with diabetes without complications. Our findings have the potential to guide clinicians to recognize the presence of diabetes complications as a marker for possible underlying and possibly unrecognized pain, such that the presence of any diabetes complication should alert clinicians to conduct a more comprehensive pain screening. These findings can guide the design of culturally appropriate screening, treatment of pain, and the mitigation of disablement in the growing population of older Mexican Americans.

Methods and Materials

Sample

We used data from Waves 7 to 9 (2010–2016) of the HEPESE. The HEPESE is a longitudinal study of older Mexican Americans residing in the Southwestern United States, including Arizona, California, Colorado, New Mexico, and Texas. The HEPESE began in 1993/1994 among those aged 65 and older and participants are surveyed every 2–3 years. Interviews elicit information on sociodemographic, psychosocial, health, and functioning (38,39). At Wave 5 (2004/2005), a probability sample of Mexican Americans aged 75 and older was added to the sample (n = 902). Informed oral consent was obtained from all participants and the study was approved by the University of Texas Medical Branch institutional review board (IRB # 92-85). These data are publicly available at the National Archive of Computerized Data on Aging (40).

For our analysis, we used Wave 7 (hereafter baseline) because the pain interference question was first incorporated into the survey at this wave. We excluded participants who had missing information on pain (n = 76) and those with missing information on relevant covariates at baseline (Figure 1). This yielded our first analytical sample (n = 853). We then excluded participants without diabetes to yield our second analytical sample (n = 269).

Measures

Independent variable

At each wave, participants were asked if they had ever been told by a doctor that they had diabetes, sugar in their urine, or high blood sugar. Then, they were asked if, because of their diabetes, they have ever had problems with their eyes, kidneys, or circulation, or if they ever had a part of their body amputated. We categorized participants as having no diabetes, diabetes without complications, and diabetes with complications (those who report at least 1 complication). We also categorized the type of complication into micro- (eye or kidney) or macro- (circulation or amputations) vascular complications. Those with diabetes were categorized as either having no complications, micro complications, macro complications, or both. Participants were asked if they currently take insulin shots or oral hypoglycemic medication and how long they have had diabetes (<10 years, ≥10 years).

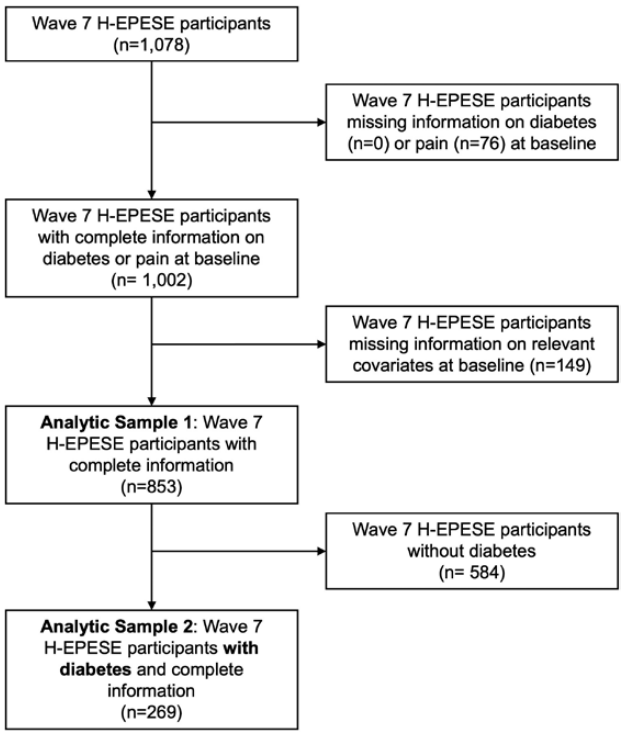

Figure 1. Flow chart of the analytic sample selection. HEPESE = Hispanic Established Population for the Epidemiologic Study of the Elderly.

Dependent variable

At each wave, participants were asked if they experienced pain when standing or walking in the past month (pain on weight-bearing). This measure is mostly related to musculoskeletal pain. If the participants responded yes, they were asked how much the pain restricted daily activities (a lot, some, not at all, don't know). Those who reported that their pain restricted their daily activities a lot or some were considered to report pain interference. Those who reported that their pain did not restrict their daily activities were considered to have noninterfering pain. Those who did not report pain or noninterfering pain were included in the reference group. Participants were also asked if they ever took medication for their pain.

Covariates

Covariates included age, sex, marital status (single, married, widowed), years of education, nativity (U.S. born, Mexican born), language of interview (English, Spanish), Mini-Mental Status Examination (MMSE) score (41), Center for Epidemiologic Studies—Depression Scale (CES-D) (42) score, and medical conditions (stroke, cancer, hypertension, arthritis, or heart attack). These medical conditions were summed into a comorbidities variable. We report both continuous CES-D scores and high depressive symptoms, categorized as a CES-D score of 16 or higher, but we control for continuous CES-D scores in our models.

Statistical Analysis

Chi-square tests of independence, Fisher's exact tests, and t-tests were used to test the baseline characteristics of the sample by diabetes status. We used generalized estimating equations (GEE) models with a link logit binomial distribution and an unstructured correlation structure to estimate the odds ratio (OR) and 95% confidence interval (CI) of pain on weight-bearing and pain interference as a function of diabetes status over 6 years of follow-up. All variables were used as time varying with the potential to change at each wave, except for sex, years of education, and nativity. First, we examined diabetes status, categorized as no diabetes, diabetes without complications, and diabetes with complications. Second, we examined the type of complication (none, micro, macro, or both), only among those with diabetes. Stata 17.0 was used for all analyses.

Results

Sample 1 Baseline Characteristics

Our first sample (n = 853) included participants that were 85.7 years old on average (standard deviation [*SD*]: 3.9)

Table 1. Baseline Characteristics of Mexican Americans Aged 80 Years and Older by Diabetes Status at Baseline (n = 853)

Baseline Characteristics	Total (n = 853; 100%)	No Diabetes (n = 584; 68.5%)	Diabetes, No Complications (n = 125; 14.7%)	Diabetes With Complications (n = 144; 16.9%)	p Value
Age, mean (*SD*)	85.7 (3.9)	86.1 (3.9)	84.9 (4.0)	85.1 (3.4)	.127
Sex					.169
Men	297 (34.8%)	214 (36.6%)	35 (28.0%)	48 (33.3%)	
Women	556 (65.2%)	370 (63.4%)	90 (72.0%)	96 (66.7%)	
Marital status, *n* (%)					.659
Single	66 (7.7%)	42 (7.2%)	10 (8.0%%)	14 (9.7%)	
Married	274 (32.1%)	188 (32.2%)	36 (28.8%)	50 (34.7%)	
Widowed	513 (60.1%)	354 (60.6%)	79 (63.2%)	80 (55.6%)	
Years of education, mean (*SD*)	5.2 (4.0)	5.1 (4.0)	5.5 (4.3)	4.9 (4.1)	.524
Nativity					.591
U.S. born	469 (55.0%)	317 (54.3%)	74 (59.2%)	78 (54.2%)	
Mexican born	384 (45.0%)	267 (45.7%)	51 (40.8%)	66 (45.8%)	
Language of interview, *n* (%)					.103
English	147 (17.2%)	108 (18.5%)	23 (18.4%)	16 (11.1%)	
Spanish	706 (82.8%)	102 (81.5%)	102 (81.6%)	128 (88.9%)	
Pain on weight-bearing, *n* (%)					.045
No	412 (48.3%)	292 (50.0%)	64 (51.2%)	56 (38.9%)	
Yes	441 (51.7%)	292 (50.0%)	61 (48.8%)	88 (61.1%)	
Pain interference, *n* (%)					0.022
No pain	412 (48.3%)	292 (50.0%)	64 (51.2%)	56 (38.9%)	
Noninterfering pain	73 (8.6%)	46 (7.9%)	16 (12.8%)	11 (7.6%)	
Pain interference	368 (43.1%)	246 (42.1%)	45 (36.0%)	77 (53.5%)	
Pain treatment, *n* (%) (n = 842)*					.016
No	503 (59.7%)	358 (61.8%)	76 (62.3%)	69 (48.9%)	
Yes	339 (40.3%)	221 (38.2%)	46 (37.7%)	72 (51.1%)	
MMSE score, mean (*SD*)	21.4 (6.6)	21.3 (6.9)	21.9 (5.9)	21.7 (6.0)	.027
CES-D score, mean (*SD*)	10.2 (8.8)	10.1 (8.8)	9.6 (7.8)	11.4 (9.6)	.052
High depressive symptoms (CES-D ≥16)	210 (24.6%)	137 (23.5%)	32 (25.6%)	41 (28.5%)	.440
Comorbidities, mean (*SD*)	1.6 (0.9)	1.5 (0.9)	1.8 (0.8)	2.0 (0.8)	.388
Stroke, *n* (%)	66 (7.7%)	39 (6.7%)	11 (8.8%)	16 (11.1%)	.182
Cancer, *n* (%)	77 (9.0%)	46 (7.9%)	16 (12.8%)	15 (10.4%)	.178
Hypertension, *n* (%)	612 (71.8%)	381 (65.2%)	106 (84.8%)	125 (86.8%)	<.001
Arthritis, *n* (%)	558 (65.4%)	370 (63.4%)	78 (62.4%)	110 (76.4%)	.010
Heart attack, *n* (%)	74 (8.7%)	43 (7.4%)	14 (11.2%)	17 (11.8%)	.132

Notes: CES-D = Center for Epidemiological Studies—Depression Scale; MMSE = Mini-Mental State Examination; *SD* = standard deviation. Comorbidities calculated as a count of stroke, cancer, hypertension, arthritis, and heart attack. Percentages may not add up to 100 because of rounding.
*We did not exclude those missing pain treatment information as this variable was not included in the final models.

and 65.2% female (Table 1). Approximately 69% of the participants had no diabetes, 14.7% had diabetes without complications, and 16.9% had diabetes with complications. Participants had an average of 5.2 years of education (SD: 4.0). A majority of participants were widowed (60.1%), born in the United States (55%), completed their interview in Spanish (82.8%), reported hypertension (71.8%), and reported arthritis (65.4%). Participants reporting diabetes with complications more often reported pain on weight-bearing, pain interference, and pain treatment compared to those with diabetes without complications and those without diabetes ($p < .05$). Those with diabetes, regardless of complications, more often reported hypertension compared to those without diabetes. Those with diabetes and no complications reported less pain and pain interference, less depressive symptoms, less arthritis, and had higher MMSE scores compared to those without diabetes or those with diabetes with complications.

Fully Adjusted GEE Models for Sample 1

Participants with diabetes and no complications had decreased odds of reporting pain on weight-bearing and pain interference (OR = 0.71, 95% CI: 0.52, 0.97 and OR = 0.71, 95% CI: 0.51, 0.99, respectively) over time compared to those without diabetes, after controlling for all covariates (Table 2). Having diabetes with complications was not associated with pain on weight-bearing (OR: 1.25; 95% CI: 0.92, 1.69) or pain interference (OR: 1.09; 95% CI: 0.81, 1.47). Other factors associated with pain on weight-bearing and pain interference were higher depressive symptoms and

comorbidities. Those with higher MMSE scores had lower odds of reporting pain interference over time.

Sample 2 Baseline Characteristics—Participants With Diabetes

Table 3 shows the baseline diabetes characteristics of our sample reporting diabetes by pain interference (n = 269). A majority (65.1%) were participants with diabetes for 10 or more years. Most participants were taking oral hypoglycemic medication (81.8%) but not insulin shots (23.4%). Diabetes duration or treatment did not differ on pain interference status. On average, participants reported 0.54 complications (*SD* = .50). Participants with pain interference reported more complications on average (0.63 [*SD*: 0.48] vs 0.46 [*SD*: 0.50], p = .004). Compared to those without pain interference, those with pain interference more often reported kidney (17.2% vs 8.8%) and circulation (52.5% vs 30.6%) complications (p < .05). The frequency of eye and amputation complications reported were similar regardless of pain status. When complications were categorized based on vessel size, those without pain interference more often reported having no complications or micro complications whereas those with pain interference more often reported having macro or both types of complications.

Table 2. Fully Adjusted Generalized Estimating Equations for Pain and Pain Interference as a Function of Diabetes Complications Over 6 Years Among Mexican Americans Aged 80 and Older (n = 853)

Predictor Variables	Pain on Weight-Bearing		Pain Interference	
	OR	95% CI	OR	95% CI
Diabetes status				
No diabetes	ref.	ref.	ref.	ref.
Diabetes without complications	0.71	(0.52, 0.97)	0.71	(0.51, 0.99)
Diabetes with complications	1.25	(0.92, 1.69)	1.09	(0.81, 1.47)
Time (years)	1.01	(0.96, 1.08)	1.01	(0.95, 1.07)
Age (years)	0.98	(0.94, 1.01)	0.99	(0.96, 1.02)
Sex				
Men	ref.	ref.	ref.	ref.
Women	0.92	(0.70, 1.21)	1.00	(0.76, 1.32)
Marital status				
Married	ref.	ref.	ref.	ref.
Single	1.03	(0.76, 1.39)	0.92	(0.68, 1.25)
Widowed	0.86	(0.64, 1.15)	0.85	(0.63, 1.15)
Years of education	1.00	(0.96, 1.03)	0.99	(0.96, 1.02)
Language of interview				
English	ref.	ref.	ref.	ref.
Spanish	1.10	(0.80, 1.51)	1.41	(1.00, 1.99)
Nativity				
U.S. born	ref.	ref.	ref.	ref.
Mexico born	1.17	(0.91, 1.51)	1.02	(0.79, 1.32)
MMSE score	0.99	(0.97, 1.01)	0.98	(0.96, 0.995)
CES-D score	1.04	(1.02, 1.05)	1.05	(1.04, 1.06)
Comorbidities	1.42	(1.24, 1.62)	1.40	(1.23, 1.60)

Notes: CES-D = Center for Epidemiological Studies—Depression Scale; CI = confidence interval; MMSE = Mini-Mental State Examination; OR = odds ratio. Pain treatment was not included in the fully adjusted models because of collinearity.

Fully Adjusted GEE Models for Sample 2

Participants with any diabetes complications had greater odds of reporting pain on weight-bearing (Model 1; OR = 1.57, 95% CI: 1.03, 2.40) and pain interference (Model 3; OR = 1.53, 95% CI: 1.01, 2.32), compared to those who did not report any complications, after controlling for all covariates (Table 4). Those with both macrovascular and microvascular complications had greater odds of reporting pain on weight-bearing (Model 2; OR = 2.31, 95% CI: 1.35, 3.97) and reporting pain interference (Model 4; OR = 2.19, 95% CI: 1.30, 3.69), after controlling for all covariates. Having micro or macro complications individually was not associated with pain on weight-bearing or pain interference. Other factors associated with pain on weight-bearing and pain interference included higher depressive symptoms and comorbidities. Higher MMSE scores were associated with lower odds of reporting pain interference over time.

Discussion

In this study of Mexican Americans aged 80 and over, we examined the association of diabetes complications and pain on weight-bearing and pain interference over 6 years of follow-up. We found that, compared to those with no diabetes, those with diabetes and no complications had lower odds of reporting pain on weight-bearing and pain interference. Among those with diabetes, participants reporting at least 1 diabetic complication had higher odds of reporting both pain on weight-bearing and pain interference, compared to those without complications. Additionally, when vessel size was considered, those with both micro and macro complications had higher odds of both types of pain, compared to those with no complications. These findings fill an important gap in the literature given the burden of pain and diabetes among Mexican American older adults, yet limited studies addressing this burden.

We documented a lower prevalence of pain, compared to findings from Kuo et al. (45.4% vs 75.0%), who examined symptoms, including pain, among Mexican and Chinese Americans with type 2 diabetes (19). Although 55% of those with diabetes in our sample reported pain on weight-bearing, the proportion reporting pain was still 20% lower than that reported by Kuo et al. (19) This difference may be attributable to differing definitions and onset of pain. Our main definition is pain interference, which is a more severe measure of pain than simply the presence of pain, as well as different timing of pain. We expand on this study as we consider the role of diabetic complications in the occurrence of pain. Previous work examining pain and diabetes has mostly focused on diabetic neuropathy as a source of pain, and this is understudied among Mexican Americans who have a large burden of diabetes (1). Some studies have found that diabetes is associated with musculoskeletal pain and neuropathic pain; however, these studies did not explore the association between diabetes complications and pain (21,22). Another study found a positive association between type 2 diabetes and the 10-year incidence

Table 3. Baseline Characteristics of Mexican Americas Aged 80 and Older With Diabetes by Pain Status at Baseline (n = 269)

Baseline Characteristics	Total (n = 269; 100%)	No Pain Interference (n = 147; 54.6%)	Pain Interference (n = 122; 45.4%)	p Value
Diabetes duration, n (%)				.148
<10 years	94 (34.9%)	57 (38.8%)	37 (30.3%)	
≥10 years	175 (65.1%)	90 (61.2%)	85 (69.7%)	
Taking insulin shots, n (%)				.117
Yes	63 (23.4%)	29 (19.7%)	34 (27.9%)	
No	206 (76.6%)	118 (80.3%)	88 (72.1%)	
Oral hypoglycemic medication, n (%)				.378
Yes	220 (81.8%)	123 (83.7%)	97 (79.5%)	
No	49 (18.2%)	24 (16.3%)	25 (20.5%)	
Number of complications, mean (*SD*)	0.54 (0.50)	0.46 (0.50)	0.63 (0.48)	.004
Complications, n (%)				
Kidney				.040
Yes	34 (12.6%)	13 (8.8%)	21 (17.2%)	
No	235 (87.4%)	134 (91.2%)	101 (82.8%)	
Eye				.055
Yes	98 (36.4%)	46 (31.3%)	52 (42.6%)	
No	171 (63.6%)	101 (68.7%)	70 (57.4%)	
Circulation				<.001
Yes	109 (40.5%)	45 (30.6%)	64 (52.5%)	
No	160 (59.5%)	102 (69.4%)	58 (47.5%)	
Amputations				.131
Yes	7 (2.6%)	6 (4.1%)	1 (0.8%)	
No	262 (97.4%)	141 (95.9%)	121 (99.2%)	
Micro and/or macro				.044
None	125 (46.5%)	80 (54.4%)	45 (36.9%)	
Micro (kidney or eye)	35 (13.0%)	22 (15.0%)	13 (10.7%)	
Macro (circulation or amputation)	34 (12.6%)	15 (10.2%)	19 (15.6%)	
Both	75 (27.9%)	30 (20.4%)	45 (36.9%)	

Notes: Percentages may not add up to 100 because of rounding. *SD* = standard deviation.

of chronic lower back pain (43). In another study, severity and impact of pain were correlated with the number of diabetes complications (44).

We observed that, among all participants, those with diabetes and no complications had lower odds of pain compared to those without diabetes. However, those with diabetes and complications had higher odds of pain compared to those with diabetes who did not have complications. Those with diabetes but no complications may have their diabetes well controlled. These individuals also reported less pain and pain interference, less depressive symptoms, less arthritis, and better cognition than both those without diabetes and those with diabetes and complications. Our pain measure reflects musculoskeletal pain (pain on weight-bearing), which may be different than the neuropathic pain often experienced by individuals with diabetes.

There are noteworthy clinical implications in the association between diabetes complications and pain. Chronic pain is associated with significant mortality and morbidity, with over two thirds of those with chronic pain suffering from a comorbid psychiatric disorder (45). Pain that interferes with daily function is found to be associated with increasing pain severity (46). Furthermore, in older patients aged 65 and older, pain is associated with disability, anxiety, and isolation (47). Mitigating the effects of pain among patients with those comorbidities will be beneficial to improving health outcomes in patients with diabetes. Our findings reinforce the importance of earlier screening as a method to reduce the complications of diabetes, leading to a decreased overall cost as well as reduced pain for Mexican American older adults with diabetes. Routine screening for pain among older adults with diabetes may be one strategy to improve health outcomes among adults with diabetes. In the context of age-associated increases in the prevalence of cognitive disorders and their potential interference with reporting pain, especially in the very old with diabetes, our findings suggest the need to consider modifying clinical practice guidelines for diabetes care in the very old population; such guidelines should incorporate age- and cognition-appropriate screening at every clinic visit. This population is at especially high risk of underrecognition/diagnosis and undertreatment of pain, a consequence of which is the acceleration of functional decline and faster transition into institutionalization. Pain management also may improve the quality of life in this population with diabetes, particularly those with diabetic complications. Diabetes imposes a significant financial burden on society, with the total medical costs associated with diagnosed diabetes estimated to be $245 billion in 2012. Much of this cost

Table 4. Fully Adjusted Generalized Estimating Equations for Pain and Pain Interference as a Function of Diabetes Complications Over 6 Years Among Mexican Americans Aged 80 and Older With Diabetes (n = 269)

Predictor Variables	Pain on Weight-Bearing		Pain Interference	
	OR	95% CI	OR	95% CI
Diabetes complications				
No	ref.	ref.	ref.	ref.
Yes	1.57	(1.03, 2.40)	1.53	(1.01, 2.32)
Micro and/or macro complications				
None	ref.	ref.	ref.	ref.
Micro (kidney or eye)	1.01	(0.56, 1.84)	1.10	(0.61, 2.01)
Macro (circulation or amputation)	1.53	(0.83, 2.84)	1.43	(0.77, 2.66)
Both	2.31	(1.35, 3.97)	2.19	(1.30, 3.69)

Notes: All models controlled for time (years), age, sex, marital status, years of education, language of interview, nativity, Mini-Mental State Examination score, Center for Epidemiological Studies—Depression Scale score, comorbidities, diabetes disease duration, insulin treatment, and oral hypoglycemics. We analyzed diabetes complications and type of complications (micro and/or macro) separately. CI = confidence interval; OR = odds ratio.

is among older adults, resulting in a growing economic cost to the Medicare program as well. Improving screening and appropriate management for diabetes complications and pain can alleviate this burden.

It has been shown that Mexican Americans have lower odds of experiencing different kinds of localized and widespread pain in comparison to non-Hispanic Whites (32). Previous work on the burden of pain among Mexican Americans is mixed, with findings differing based on pain definitions and consideration of socioeconomic factors. Mexican Americans are a group with unique barriers to care, such as decreased medication adherence due to concerns of unwanted effects and treatment, cost of medication, or language barriers (12,31). Evidence shows that those with lower English proficiency have increased difficulty accessing primary care and have a worse experience as a patient than those who are proficient in English (48). A previous study found that speaking Spanish increased both the likelihood of patients reporting any pain as well as pain severity, compared with English-speaking patients (49). Another study found that, in comparison to English-speaking Hispanic Americans, Spanish-speaking Hispanic Americans are less likely to seek assistance from health care providers regarding pain, with participants with lower English use having the greatest risk of chronic pain undertreatment (31). In Mexican American older adults with diabetes complications, pain management is an intervention that can be utilized to improve the quality of life. Screening for chronic pain is important in this population and, because Hispanics are less likely to want to take pain medication, exploration of nonpharmacologic treatment options may be beneficial (50). As one of the major growing populations in the United States, future work should address cultural and systemic barriers to pain management among Mexican Americans with diabetes.

Limitations of our study include the potential of selection bias occurring through the inclusion of participants aged 80 and older at baseline. This may have resulted in a healthier sample and may have underestimated the relationship between diabetes complications and pain. Our findings may also be susceptible to recall bias due to the self-reported nature of the data. Additionally, our findings are not generalizable to the Hispanic American population in the United States, as the Hispanic population is a heterogeneous group with different health profiles (51). Strengths of our study include its longitudinal 6-year follow-up, the inclusion of socioeconomic factors, duration of disease, treatment used by participants, nature of pain, sample stratification according to diabetes status, and use of the HEPESE sample, which is well characterized.

Conclusion

In this sample of Mexican Americans aged 80 and older, those with any diabetes complications or both microvascular and macrovascular diabetic complications had higher odds of pain, compared to those with diabetes and no complications. This underscores the necessity of pain management as part of the treatment plan in patients with uncontrolled or longstanding diabetes. This is especially pertinent in Mexican American older adults, who have a high prevalence of diabetes and have many barriers to accessing care. Building on our findings—and taking into account the cultural, social, and environmental factors that may affect the management of both diabetes and pain—future work is needed to investigate the interplay between diabetes complications and pain in this population, to better characterize the association between diabetes and pain.

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Conflict of Interest

None.

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