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ORIGINAL PAPER

Regional Variation in Diabetic Outcomes by Country-of-Origin and Language in an Urban Safety Net Hospital

April K. Wilhelm[1] · Debra J. Jacobson[2] · Laura Guzman-Corrales[3] · Chun Fan[2] · Karen Baker[4] · Jane W. Njeru[5] · Mark L. Wieland[5] · Deborah H. Boehm[3]

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Abstract Adherence to diabetic care guidelines among US immigrants remains low. This study assesses adherence to diabetic care guidelines by country-of-origin and language among a limited English-proficient (LEP) population. Timely completion of diabetic measures and acceptable levels of hemoglobin A1c (A1c), low density lipoprotein (LDL) cholesterol, and blood pressure (BP) were compared between LEP and English-proficient (EP) patients in this 2013 retrospective cohort study of adult diabetics. More LEP patients met BP targets (83 vs. 68 %, $p < 0.0001$) and obtained LDL targets (89 vs. 85 %, $p = 0.0007$); however, they had worse LDL control (57 vs. 62 %, $p = 0.0011$). Ethiopians and Somalians [adjusted OR (95 % CI) = 0.44 (0.30, 0.63)] were less likely than Latin Americans to meet BP goals. LEP patients outperformed EP peers on several diabetic outcomes measures with important variation between groups. These data highlight the success of a safety net hospital in improving diabetes management among diverse populations.

Keywords Diabetes · Limited English language proficiency · Immigrant · Interpreter use

Introduction

An estimated 347 million people worldwide carried the diagnosis of diabetes in 2008, a sizeable increase from previous estimates of 153 million in 1980 [1]. Rates of diabetes are increasing rapidly within many developing countries [1], leading to a rising prevalence of diabetes among certain immigrant populations in the United States and Canada [2]. In addition to experiencing a higher incidence of diabetes, racial and ethnic minorities in the United States also have increased mortality rates and higher risk of diabetic complications [3]. Disparities in health care access and utilization, screening rates, and glycemic control are likely contributing factors [4–6].

Adherence to diabetic care guidelines among immigrant populations remains low compared with US-born individuals [7]. Limited English proficiency (LEP) is a major contributor to these documented disparities. Approximately 60 million US residents 5 years of age or older speak a language other than English at home [8]. Language barriers have been associated with decreased access to health care services [9, 10], lower rates of patient self-reported medical comprehension [11, 12], and increased risk of adverse medication reactions [11]. Use of medical interpreters or language concordant providers improves communication, health care utilization, delivery of health care services, clinical outcomes, and patient satisfaction [13–16], but

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✉ Laura Guzman-Corrales
Laura.Guzman-Corrales@hcmed.org

[1] United Family Medicine Residency Program, Saint Paul, MN, USA

[2] Division of Biomedical Statistics and Informatics, Mayo Clinic, Rochester, MN, USA

[3] Minneapolis Medical Research Foundation, 701 Park Avenue South (P7), Minneapolis, MN 55415, USA

[4] Analytic Center of Excellence, Hennepin County Medical Center, Minneapolis, MN, USA

[5] Division of Primary Care Internal Medicine, Mayo Clinic, Rochester, MN, USA

these services do not eradicate disparities associated with LEP.

Among US Latinos with diabetes, LEP is an independent predictor of poor glycemic control [17]. Similar suboptimal disease specific outcomes among LEP patients have been documented in the literature [18, 19]. However, other studies show no significant association between LEP and diabetes outcomes [12, 20], suggesting heterogeneity of experiences based on ethnic group, setting, or other factors. No previous studies have evaluated the variation of diabetes outcomes by region and language group in a primary care setting. Therefore, the purpose of this study was to determine whether adherence to established measures of diabetic care varies by country-of-origin and language group among a diverse patient population at a large urban safety net hospital system.

Methods

Study Setting

Hennepin County Medical Center (HCMC) is an urban safety net hospital serving a diverse patient population of approximately 169,159 individuals from within Minneapolis, MN, and the surrounding area. Approximately 20 % of patients within the HCMC system were born outside the United States. In 2014, HCMC's interpreter services provided interpretation in an estimated 78 languages during patient encounters. An on-site professional medical interpreter, video interpreter, phone call with an interpreter, or language concordant provider is available for all LEP patients. Diabetes care at the HCMC primary care clinics is offered in a team-based approach involving clinicians, social workers, and care coordinators who collaborate to provide further support to patients.

Study Population

We conducted a retrospective cohort study to examine differences in diabetic outcomes among LEP patients at HCMC compared with their English proficient (EP) counterparts. HCMC clinical data were drawn from the Clarity database within the EPIC electronic health record provided as a component of Minnesota Community Measures reporting requirements that were current for the 2014 submission [21]. This system defines patient eligibility and disease-specific patient level reporting from which the study data were extracted. This rule-based registry [22] identified all patients age 18–75 years with a diagnosis of diabetes mellitus who were not pregnant at any time during 2013 and completed two diabetic visits in the 2-year period from 2013 to 2014, with at least one visit occurring in 2013 for diabetes ($n = 5461$). One individual opted out of research in the study and was excluded from the analysis leaving a total of 5460 patients in the final cohort. The institutional review board at HCMC reviewed and approved this study protocol.

Study Measures

A preferred language listed as non-English in the patient's demographic file was used as a proxy for LEP. This was considered the primary exposure variable in the study. Patient language preference is readily available in administrative datasets through electronic medical records, and has been used as an indirect measure of LEP in previous studies [23]. Demographics such as age at the beginning of the study period, gender, ethnicity and race, preferred language, and country of origin were obtained from the patients' registration information. The number of outpatient visits and differentiation between type I and type II diabetes mellitus diagnoses (ICD-9 codes 250.00–250.93) were obtained from patients' problem list and visit record in the electronic health record. We did not measure time since onset of diabetes diagnosis, severity of disease, or comorbidities. We were not able to assess the length of an individual patient's time since arrival to the United States, and we had no proxies by which to directly determine socioeconomic status.

Patients were grouped into five age categories, based upon their age as of 1/1/2013 (18–30, 31–44, 45–54, 55–64, and 65 and older). Race/ethnicity was categorized as white, black, Native American/Alaskan Native, Asian, Hispanic/Latino, and other/unknown. The number of outpatient visits to internal medicine, family medicine, or endocrinology offices during the study period was categorized (0–1, 2–3, 4–6, and 7 or greater). The top five country-of-origin groups were used in analysis. The majority of LEP patients hailed from Mexico. The remaining Latin American countries were grouped with those patients from Mexico for the primary analysis due to assumed cultural and linguistic similarities. Given the smaller numbers, LEP patients from Somalia and Ethiopia were also grouped for the analysis. An 'other' group consisted of all remaining countries that ranged from Southeast Asia and the Indian subcontinent to the Middle East.

Study Outcomes

Diabetic process and outcome measures were compared between these groups during the 12-month study period. Outcome and process measures were largely adapted from the American Diabetes Association Standards of Medical Care in Diabetes [24]. Process measures included HgbA1c within the final 6 months of the study period and LDL

Table 1 Baseline characteristics of diabetics and diabetic outcomes by English proficiency (2013)

	EP N = 3905	LEP N = 1555	P^a
Age N (%)			<0.0001
18–30	159 (4.1)	52 (3.3)	
31–44	661 (16.9)	447 (28.7)	
45–54	1211 (31.0)	428 (27.5)	
55–64	1272 (32.6)	405 (26.0)	
65+	602 (15.4)	223 (14.3)	
Gender N (%)			<0.0001
Male	2131 (54.6)	698 (44.9)	
Female	1774 (45.4)	857 (55.1)	
Race/ethnicity[b]			<0.0001
White	1349 (34.5)	26 (1.7)	
Black	1954 (50.0)	184 (11.8)	
Native American/Native Alaskan	147 (3.8)	3 (0.2)	
Asian	86 (2.2)	110 (7.1)	
Hispanic/Latino	160 (4.1)	1125 (72.3)	
Other[c]	209 (5.4)	107 (6.9)	
Outpatient visits			
Total number of visits group N (%)			0.0002
0–1	563 (14.4)	156 (10.0)	
2–3	1150 (29.5)	474 (30.5)	
4–6	1148 (29.4)	505 (32.5)	
7+	1044 (26.7)	420 (27.0)	
DM outcome measures[d]			
HgbA1C < 8 %	2476 (65.6)	1013 (66.7)	0.4454
LDL < 100	2043 (61.6)	777 (56.5)	0.0011
BP < 140/90	2646 (67.8)	1286 (82.8)	<0.0001
DM process measures[d]			
A1C within 6 months	2998 (76.8)	1228 (79.0)	0.0797
LDL within 12 months	3317 (84.9)	1376 (88.5)	0.0007

[a] *P* value from Pearson Chi square test

[b] Race is mutually exclusive

[c] Other category includes 'unknown' or 'refused' race/ethnicity

[d] Outcomes data obtained from Minnesota Community Measures sources

within the 12-month study period. Outcome measures included HgbA1c < 8.0 %, LDL < 100 mg/dL, and BP < 140/90. These outcome measures were identified by the last available laboratory results or blood pressure (BP) measurements during the study period.

Statistical Analysis

The demographic and clinical outcomes of the overall study population (age, gender, race/ethnicity, diabetes I or II, language, country of origin, and number of outpatient visits) were described by English proficiency and compared using Pearson Chi square tests for categorical variables. Chi square tests were used to determine if the outcome and process measures differed between the EP and LEP groups. Logistic regression models were used to determine if outcome measures differed by English-proficiency. Results are presented as odds ratios (OR) and 95 % confidence intervals (CI). Multivariable models were used to adjust for potential confounders, including age, gender, and number of outpatient visits. Additional analyses, limited to LEP patients only, compared demographics by country-of-origin and language group. Logistic regression models were used to determine if diabetic process and outcome measures differed by preferred language or country-of-origin. Multivariable models were used to adjust for potential confounders including age, gender, and number of outpatient clinic visits.

Table 2 Associations in outcome and process measures for those with LEP compared to those with English as a primary language

	Unadjusted		Adjusted[a]	
	OR	95 % CI	OR	95 % CI
A1C				
≥8 %	1.0			
<8 %	1.05	0.93, 1.19	1.06	0.93, 1.20
LDL				
≥100	1.0			
<100	0.81	0.71, 0.92	0.90	0.79, 1.02
BP				
≥140/90	1.0			
<140/90	2.27	1.96, 2.64	2.18	1.87, 2.53
A1C in 6 months				
N	1.0			
Y	1.14	0.99, 1.31	1.21	1.04, 1.41
LDL in 12 months				
N	1.0			
Y	1.36	1.14, 1.63	1.33	1.11, 1.60

Logistic regression models estimating the odds of each diabetes outcome and process measure by English proficiency

[a] Adjusted for age, sex, and number of outpatient visits (general medical and endocrinology visits separately)

Results

There were a total of 5460 patients included in this study, including 1555 LEP patients. Demographic characteristics of the study population are shown in Table 1. The LEP patient population was younger, female-predominant, and had higher numbers of people of Latino or Asian descent than the EP cohort. A total of 25 preferred languages, including English, were represented in the patient population. Primary languages in the LEP group were Spanish (73.1 %), Somali (8.3 %), and Amharic (2.9 %). Study participants represented 91 countries. LEP patients had a higher number of total outpatient visits during the study period.

LEP patients were more likely than the EP group to meet guideline recommendations for BP (82.8 vs. 67.8 %, $p < 0.0001$) and to have obtained a LDL measurement within 12 months (88.5 vs. 84.9 %, $p = 0.0007$) as shown in Table 1. The EP cohort, by contrast, was more likely to have LDL cholesterol at the goal of less than 100 mg/dL (61.6 vs. 56.5 %, $p = 0.0011$). There were no significant differences between the groups for hemoglobin A1c at goal or obtaining an A1c measurement within 6 months.

When adjusted for age, sex, and number and site of outpatient visits, LEP patients remained more likely to meet BP guidelines of less than 140/90 [OR (95 %CI) = 2.18 (1.87, 2.53)] and to have obtained the two process measures—LDL in 12 months [OR (95 % CI) = 1.33 (1.11, 1.60)] and hemoglobin A1c in 6 months [OR (95 % CI) = 1.21 (1.04, 1.41)]—than their EP counterparts (Table 2). However, after adjusting for these covariates there was no significant association between groups with regard to achieving a goal LDL cholesterol of <100 mg/dL or A1c < 8 %.

The majority of the LEP patients were Spanish speakers from Latin America, with the highest percentage emigrating from Mexico (Table 3). This subset was significantly younger than those originally from Eastern African countries, where diabetes appeared to impact the middle-aged more heavily. There was female gender predominance among the East African population. There were no significant differences in the number of outpatient visits between country-of-origin groups.

When evaluating outcomes for the LEP group by country of origin, patients originally from Ethiopia or Somalia [adjusted OR (95 % CI) = 0.44 (0.30, 0.63)], and other countries [adjusted OR (95 % CI) = 0.61 (0.43, 0.89)] were less likely than those from Latin America to have met the BP guidelines (Table 4). Patients originally from Ethiopia or Somalia were also less likely than those from Latin America to have had a hemoglobin A1c within 6 months [adjusted OR (95 % CI) = 0.66 (0.44, 0.98)] or a LDL within 12 months [adjusted OR (95 % CI) = 0.60 (0.38, 0.95)]. Although the sample sizes for some country-of-origin groups were small, the magnitude of the associations was similar when comparing patients from Mexico to patients from Latin America, Somalia, Ethiopia, and 'other' countries (Supplemental Table 1). Results were also similar when comparing outcomes by preferred language (Supplemental Table 2).

Discussion

In this study, we found that the LEP diabetics outperformed their English-speaking peers on several diabetic outcome measures. Within the LEP group, Spanish speakers from Latin America had the strongest performance. Specifically, Spanish speakers were more likely than other groups to achieve a target BP and to obtain a LDL and hemoglobin A1c measurements at recommended intervals. Diabetics originally from Ethiopia and Somalia had the least favorable outcomes.

These results are surprising in the context of previously demonstrated disparities in diabetic outcomes amongst racially and ethnically diverse patient populations. Several studies have found increased rates of poor glycemic control [5, 6] and diabetic complications such as end-stage renal disease and retinopathy among blacks and Hispanics [3]. Notably, these groups also performed poorly on quality of care process measures such as ophthalmologic exams, BP

Table 3 Characteristics and diabetic outcomes of LEP patients by country-of-origin (2013)

	Latin America	Ethiopia/Somalia	Other[a]	P[b]
N (%)	1101 (70.8)	206 (13.25)	248 (15.95)	
Age				<0.0001
18–44	442 (40.1)	27 (13.1)	30 (12.1)	
45–54	333 (30.2)	47 (22.8)	48 (19.4)	
55–64	236 (21.4)	82 (39.8)	87 (35.1)	
65+	90 (8.2)	50 (24.3)	83 (33.5)	
Sex				0.0149
Male	520 (47.2)	82 (39.8)	96 (38.7)	
Female	581 (52.8)	124 (60.2)	152 (61.3)	
Number of outpatient visits by group N (%)				0.9016
0–1	106 (9.63)	21 (10.19)		
2–3	333 (30.25)	62 (30.10)		
4–6	364 (33.06)	63 (30.58)		
7+	298 (27.07)	60 (29.13)		
DM outcome measures[c]				
A1C < 8 %	707 (65.6)	129 (65.5)	177 (72.5)	0.1063
LDL < 100	549 (55.5)	93 (54.1)	135 (63.1)	0.0989
BP < 140/90	961 (87.3)	142 (68.9)	183 (74.1)	<0.0001
DM process measures[c]				
A1C within 6 months	877 (79.7)	156 (75.7)	195 (78.6)	0.4422
LDL within 12 months	990 (89.9)	172 (83.5)	214 (86.3)	0.0148

[a] Other includes the remaining countries-of-origin of patients from the LEP group as well as 'unknown' or 'other' responses

[b] P value from Pearson Chi square test

[c] Outcomes data obtained from Minnesota Community Measures sources

Table 4 Associations in outcome and process measures for those with LEP by country-of-origin

	Latin America Reference	Ethiopia/Somalia OR (95 %CI)	Other[a] OR (95 % CI)
Unadjusted			
A1C < 8 %	1.0	1.0 (0.72, 1.37)	1.39 (1.02, 1.89)
LDL < 100	1.0	0.95 (0.68, 1.31)	1.37 (1.01, 1.86)
BP < 140/90	1.0	0.32 (0.23, 0.46)	0.42 (0.30, 0.58)
A1C within 6 months	1.0	0.80 (0.56, 1.13)	0.94 (0.67, 1.32)
LDL within 12 months	1.0	0.57 (0.37, 0.86)	0.71 (0.47, 1.07)
Adjusted[b]			
A1C < 8 %	1.0	1.03 (0.73, 1.44)	1.38 (0.99, 1.93)
LDL < 100	1.0	0.80 (0.57, 1.13)	1.14 (0.82, 1.58)
BP < 140/90	1.0	0.44 (0.30, 0.63)	0.61 (0.43, 0.89)
A1C within 6 months	1.0	0.66 (0.44, 0.98)	0.84 (0.57, 1.24)
LDL within 12 months	1.0	0.60 (0.38, 0.95)	0.78 (0.50, 1.24)

Logistic regression models estimating the odds of each diabetes outcome and process measure compared to those originally from Mexico

[a] Other includes the remaining countries-of-origin of patients from the LEP group as well as 'unknown' or 'other' responses

[b] Adjusted for age, sex, and number of outpatient visits (general medical and endocrinology visits separately)

control, and hemoglobin A1c measurements during their diabetes treatment [3]. However, our findings are consistent with a number of recent studies that demonstrated both higher diabetic screening rates [25] and no significant difference in diabetic complication rates [20] among immigrant patients with language barriers in urban cohorts. Another study of diabetic Hispanic patients found that improved glycemic control rates were not affected by English-proficiency [12].

Our study's urban location may be contributing to these findings of improved diabetic clinical outcomes among LEP patients. LEP often serves as a proxy for lower socioeconomic status. However, in an urban cohort such as this one where a large percentage of the patient population is at—or near—the poverty line, differences between immigrant groups and their American-born peers may be narrowed due to greater socioeconomic homogeneity. In fact, immigrant populations may perform better on quality measures in safety net settings given their lower rates of comorbidities such as mental illness and substance abuse. In one previous study at a Colorado-based study at a large, urban safety net hospital system, racial and ethnic minorities demonstrated superior cervical cancer screening rates and better diabetes management measures (including lipid control and appropriate monitoring of A1c and renal function) compared to their white counterparts [26].

Our study suggests that safety net hospital systems can play a large role in improving chronic disease outcomes among diverse patient populations by providing well-coordinated interdisciplinary health care [27]. However, our data indicate that not all ethnic and language groups benefited equally from receiving their care in this setting, suggesting that other factors are contributing to the differences seen between ethnic groups. Minnesota has also reported this underperformance on diabetic care measures by racial and ethnic minorities [21]. Duration of stay in the United States is one factor that could explain some of these discrepancies. The increased prevalence of diabetes mellitus among recent immigrant groups [2] supports the need for ongoing work within similar safety net systems to further improve health care access, targeted diabetic screening, and culturally appropriate treatment interventions for these groups.

Our study had several limitations. First, there is an assumption that all patients within the HCMC system received an overall similar quality of care in a language in which they are proficient. Given the retrospective nature of this chart review, we are unable to measure the quality of communication for each encounter. Second, we based the patient's LEP classification on a non-English language as their primary language in their demographic file. This proxy for LEP, though used in previous studies to estimate LEP status [23], is incomplete and represents only a subset of true LEP patients. However, due to inconsistencies with interpreted language data in the electronic record, this was felt to be the most accurate way to identify the language in which care was provided. Third, provider language concordance was not assessed and could have impacted the outcomes of the study as well. Those patients with a language-concordant provider or a health care team with increased cultural familiarity might consequently have achieved better outcomes. The retrospective nature of our study also limited our access to certain data such as disease severity, comorbid conditions, and direct markers of socioeconomic status. In particular, the length of a patient's time since arrival to the United States was not available, and may have impacted patient behavior, and thus, our results. Finally, generalizability is limited to similar, diverse and underserved urban cohorts, and may not be widely applicable in other settings.

This is one of the first studies to examine how country-of-origin and language group impact the established process and outcomes measures for optimal diabetic care in diverse patient populations. Our findings demonstrate that LEP patients outperformed their English-speaking peers on several core measures of diabetic care. Spanish-speakers from Latin America performed particularly well. These findings suggest that language coordinated care within a safety net hospital system, with professional medical interpretation, can counteract many of the other barriers to achieving improved clinical outcomes among diverse patient populations. Further research within urban cohorts of immigrant populations is needed to identify and address persistent barriers to achieving goals of diabetic care.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

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