



Disparities in HbA1c testing between aging US Latino and non-Latino white primary care patients

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ABSTRACT

US Latinos disproportionately face diabetes-related disparities compared to non-Latino Whites. A number of barriers, including linguistic and cultural discordance, have been consistently linked to these disparities. Glycated hemoglobin (HbA1c) testing is used to assess glycemic control among individuals living with diabetes. This study aimed to compare HbA1c levels and corresponding testing rates among non-Latino Whites and Latinos with both English and Spanish preference from a national cohort of primary care patients within community health centers.

We analyzed electronic health records from patients who turned 50 years of age ($n = 66,921$) and were diagnosed with diabetes during or prior to the study period. They also must have been under observation for at least one year from January 1, 2013 to December 31, 2017. We calculated the rates of HbA1c tests each person received over the number of years observed and used covariate-adjusted negative binomial regression to estimate incidence rate ratios for Spanish preferring Latinos and English preferring Latinos compared to non-Latino Whites. Spanish preferring Latinos (rate ratio = 1.23, 95% CI = 1.16–1.30), regardless of HbA1c level, had higher testing rates than non-Latino Whites and English preferring Latinos. English preferring Latinos with controlled HbA1c levels had higher rates of HbA1c testing compared to non-Latino whites.

Overall, the Latinos with Spanish preference maintained higher HbA1c testing rates and had disproportionately higher rates of uncontrolled HbA1c levels compared to non-Latino whites. Future efforts should focus on understanding effective approaches to increasing engagement among Spanish preferring Latinos and addressing organizational-level barriers, given HbA1c disparities.

1. Introduction

In 2020, the Centers for Disease Control and Prevention estimated the prevalence of diabetes among US adults age 45–64 to be 17.5%, and 26.8% among those 65 and older. (Centers for Disease Control and Prevention, 2020) US Latinos are disproportionately affected by this chronic disease; with a prevalence of 19.8%. (Centers for Disease Control and Prevention, 2020) This prevalence is exacerbated by disparities in glycemic control; 18.7% Latino adults with diabetes suffer from poor glycemic control compared to only 10.1% of non-Latino Whites. (Ali et al., 2012) There is still limited evidence within the literature on these disparities among the Latino population as they age.

There is concern for this large aging population, considering the

microvascular and neurological complications that arise from poor glycemic control. (Sacks, 2013) Studies have attributed these health disparities to a myriad of social, biological and environmental factors. (Marquez et al., 2019; Piccolo et al., 2016) For example, Spanish-language preference or limited English proficiency among Latinos limits access to language concordant health services, which in turn has contributed to the higher prevalence of poor glycemic control. (Fernandez et al., 2011) While these types of barriers to diabetes self-management and care have been well documented (Fernandez et al., 2011; Testerman and Chase, 2018; Ricci-Cabello et al., 2014), specific rates of clinical services, such as glycated hemoglobin (HbA1c) measurement, have been less extensively documented among aging Latino populations. This evidence is crucial to understanding the current state

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of access Latino groups have to clinical services for self-management.

The HbA1c test, a biological marker for assessing long-term average glucose control, primarily over the course of 3-month periods, has been validated as an effective tool for assessing glycemic control among those living with the chronic disease. (Kovatchev, 2017; Bennett and Dharmaage, 2007) The American Diabetes Association (ADA) recommends that people living with diabetes receive HbA1c testing at minimum twice a year for those who are meeting treatment goals, or more frequently for those not meeting goals. (American Diabetes Association, 2021) Similarly, several national health organizations recommend HbA1c rates be monitored regularly to prevent diabetes-related complications, particularly for aging populations with higher risk of developing diabetes. (Center for Disease Control and Prevention, 2019; US Department of Health and Human Services, 2004) Evidence from a large study among 42,837 participants found those adhering to both regular HbA1c testing and treatment plans were five times more likely to meet glycemic control (HbA1c <7%), when compared to those that did not. (Lian and Liang, 2014) Given the overwhelming evidence and guidelines for diabetes management, there exists a need to assess HbA1c testing rates among Latino populations, particularly among the aging generations.

Language preference is also crucial to study, given the documented barriers that exist for those with limited English proficiency. (Fernandez et al., 2011) Community Health Centers (CHCs) serve millions of Latino patients nationwide, so understanding these patterns in this setting is crucial to understanding the testing patterns of low-income Latinos. (National Association of Community Health Centers, 2021) The objective of this study was to compare HbA1c and testing rates in a multistate cohort of non-Latino White and Latino (with English or Spanish preference) populations over 50 living with diabetes and accessing clinical services within CHCs—commonly used clinics among aging low-income Latinos given the greater accessibility they provide. To further assess disparities relative to glycemic control among Latinos, we investigated the moderating effect of maximum HbA1c levels on testing rates and ethnic/language groups. We hypothesized Latino patients compared to non-Latino white patients would be less likely to receive HbA1c testing and have a higher prevalence of uncontrolled HbA1c levels.

2. Methods

2.1. Sample population

We conducted a retrospective cohort study utilizing data from the ADVANCE Clinical Research Network. (Collaborative et al., 2021) This network aims to build and maintain a data laboratory among safety net populations, including those who are under-insured and undocumented. (Collaborative et al., 2021) We drew a sample population of over 66,921 older patients with diabetes who accessed care at one of 694 clinics across 21 US states. Data were extracted from the electronic health record (EHR) of patients who turned 50 years of age and were diagnosed with diabetes (listed under the International Classification of Diseases [ICD] 9 and ICD 10 codes) during or prior to the study period of January 1, 2013 to December 31, 2017. All patients with prevalent Type 1 and/or Type 2 diabetes were included in the study. The majority of the sample are patients with Type 2 diabetes (96%). All adults with diabetes included in the retrospective cohort also had minimally one year of person time under observation after the diagnosis.

Dependent variables. We evaluated the rate of HbA1c testing per person per year under observation. Individuals in the study were under observation for three years after their last clinical encounter and had to be re-entered if absent for more than three years.

Independent Variable. These rates were compared between three ethnicity/language groups: Spanish preferring Latinos, English preferring Latinos, and non-Latino Whites as the reference group.

Covariates. A primary covariate and stratification variable for secondary analyses was HbA1c levels; people with diabetes have HbA1c

levels of 6.5% or higher and the target level for them is to maintain these levels below 7%. We categorized patients into three categories: patients with all HbA1c measurements under 7% were considered the group with the best HbA1c control, patients with at least one measurement above 7% but never above 9% were the moderately uncontrolled HbA1c group, and patients with at least one HbA1c measure above 9% were considered uncontrolled. In addition, we controlled for age at diagnosis, sex, insurance status during observation, number of encounters per year during observation, current state of residence, average BMI during observation, and a documented diagnosis of atherosclerotic cardiovascular disease (ASCVD).

Statistical analysis. We described patient characteristics in total and by our three ethnicity/language groups. Covariate-adjusted negative binomial regression was used to estimate HbA1c testing rates and rate ratios (RR) between ethnicity/language groups. Robust standard errors were calculated to account for clustering of patients at the clinic level. Secondary analyses were conducted to investigate the moderating effect of HbA1c levels on testing rates and ethnic/language groups by including interaction terms between ethnic/language group and testing results. Analyses were conducted in R version 4.0.3 and statistical significance was set at p-value < 0.05. This study was approved by the Institutional Review Board of Oregon Health & Science University and have met the university's guidelines for protection of human subjects concerning their safety and privacy.

3. Results

In total, 66,921 adults with type 2 diabetes were identified as meeting the criteria for our retrospective cohort. As seen in Table 1, the majority of the sample population across groups was non-Latino Whites. The Spanish preferring Latino group had comparatively more women than the other two groups. Both English preferring and Spanish preferring Latinos presented a higher prevalence of individuals never insured compared to non-Latino Whites. Spanish preferring Latinos also presented a larger proportion in the higher-frequency clinic visit groups. The mean age of participants across groups was 61.0 years with all groups having similar age at first encounter in the study period. Maximum HbA1c levels above 7% were observed more among Spanish preferring and English preferring Latinos, compared to non-Latino Whites. Approximately 40% of Spanish preferring Latinos had a maximum HbA1c level above 9%, the highest proportion of any group.

In terms of HbA1c testing, Spanish preferring Latinos had the highest adjusted overall rate of 1.70 HbA1c tests/year, followed by English preferring Latinos with 1.54 tests/year and non-Latino Whites with 1.51 tests/year. Among all groups, higher HbA1c levels coincided with an increase in HbA1c testing rate (Wald p-value < 0.005). Among those with a maximum HbA1c level <7%, non-Latino Whites had the lowest testing rate of 1.16 tests/year, followed by English preferring Latinos and Spanish preferring Latinos with yearly testing rates of 1.27 and 1.43, respectively. Spanish preferring Latinos with a maximum HbA1c level > 9% had the highest annual testing rate of 1.85 tests/year, followed by non-Latino Whites with 1.70 and English preferring Latinos with 1.68. Among individuals with a maximum HbA1c level between 7% and 9%, Spanish preferring Latinos had a yearly testing rate of 1.71, while English preferring Latinos and non-Latino Whites had similar annual rates of 1.58 and 1.56 tests/year, respectively.

As seen in Fig. 1, English preferring Latinos did not have significantly different HbA1c testing rates compared to non-Latino whites across all maximum HbA1c level groups (rate ratio [RR] = 1.03 95% CI = 0.98–1.08). However, Spanish preferring Latinos were significantly different to non-Hispanic whites, with an overall rate ratio of 1.23 (95% CI = 1.16–1.30). English preferring Latinos had similar RRs to non-Latino Whites across all HbA1c levels strata. However, Spanish preferring Latinos had higher testing rates than non-Latino Whites at all HbA1c levels, with rate ratios of 1.21 (95% CI = 1.15–1.28), 1.15 (95% CI = 1.08–1.22), and 1.16 (95% CI = 1.10–1.22) when max HbA1c

Table 1
Patient Demographics and Diabetes-Related Outcomes.

	Overall	Race/Ethnicity and Language			P-Value
		Non-Hispanic White	Latino Preferring Spanish	Latino Preferring English	
	66,921	9332	25,731	31,858	
Age					<0.001
50–55	3640 (5.4)	579 (6.2)	1189 (4.6)	1872 (5.9)	
55–60	24,340 (36.4)	3666 (39.3)	9044 (35.1)	11,630 (36.5)	
60–65	26,683 (39.9)	3708 (39.7)	10,491 (40.8)	12,484 (39.2)	
65–70	11,488 (17.2)	1285 (13.8)	4650 (18.1)	5553 (17.4)	
70–73	770 (1.2)	94 (1.0)	357 (1.4)	319 (1.0)	
Age (Initial Visit)	61 (3.98)	61 (3.91)	61 (3.97)	61 (4.00)	<0.001
Female	37,077 (55.4)	5157 (55.3)	15,384 (59.8)	16,536 (51.9)	<0.001
Insurance					<0.001
Never Insured	10,292 (15.4)	1418 (15.2)	4428 (17.2)	4446 (14.0)	
Some Private	7809 (11.7)	1099 (11.8)	2349 (9.1)	4361 (13.7)	
Some Public	41,725 (62.3)	5726 (61.4)	16,596 (64.5)	19,403 (60.9)	
Some Public & Private	7095 (10.6)	1089 (11.7)	2358 (9.2)	3648 (11.5)	
Tests Per Year					<0.001
0–1	30,731 (45.9)	4731 (50.7)	9946 (38.7)	16,054 (50.4)	
1–2	29,956 (44.8)	3812 (40.8)	12,594 (48.9)	13,550 (42.5)	
3–5	5646 (8.4)	719 (7.7)	2846 (11.1)	2081 (6.5)	
5–10	551 (0.8)	67 (0.7)	325 (1.3)	159 (0.5)	
10+	37 (0.1)	3 (0.0)	20 (0.1)	14 (0.0)	
Visits Per Year					<0.001
0–1	11,610 (17.3)	1797 (19.3)	3970 (15.4)	5843 (18.3)	
1–2	20,865 (31.2)	3064 (32.8)	7494 (29.1)	10,307 (32.4)	
3–5	16,431 (24.6)	2181 (23.4)	6701 (26.0)	7549 (23.7)	
5–10	15,296 (22.9)	1947 (20.9)	6721 (26.1)	6628 (20.8)	
10+	2719 (4.1)	343 (3.7)	845 (3.3)	1531 (4.8)	
Age at diagnosis					<0.001
<50	649 (1.0)	94 (1.0)	266 (1.0)	289 (0.9)	
50–55	6784 (10.1)	981 (10.5)	2283 (8.9)	3520 (11.0)	
55–60	24,801 (37.1)	3646 (39.1)	9311 (36.2)	11,844 (37.2)	
60–65	24,971 (37.3)	3483 (37.3)	9854 (38.3)	11,634 (36.5)	
65–70			3750 (14.6)	4333 (13.6)	

Table 1 (continued)

	Overall	Race/Ethnicity and Language			P-Value
		Non-Hispanic White	Latino Preferring Spanish	Latino Preferring English	
70–73	9133 (13.6)	1050 (11.3)	267 (1.0)	238 (0.7)	
Max HbA1c					<0.001
Always < 7	16,782 (25.1)	2247 (24.1)	5827 (22.6)	8708 (27.3)	
Any >=7 & <9	18,395 (27.5)	2473 (26.5)	7032 (27.3)	8890 (27.9)	
Any >=9	25,062 (37.5)	3575 (38.3)	10,927 (42.5)	10,560 (33.1)	
NA	6682 (10.0)	1037 (11.1)	1945 (7.6)	3700 (11.6)	

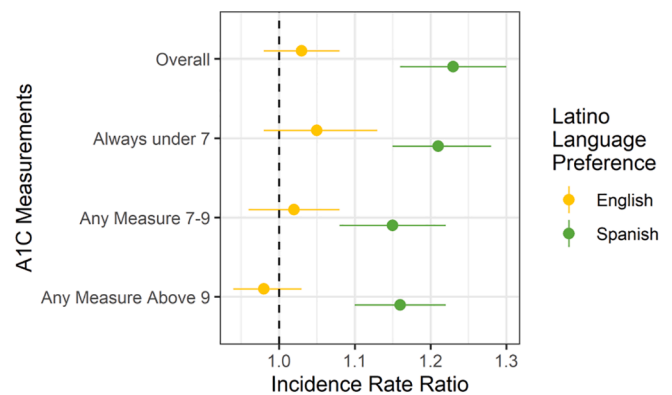


Fig. 1. HbA1c Testing Rate Ratios, overall and by HbA1c levels.

levels were always <7%, between 7 and 9%, and ever >9% respectively.

4. Discussion

Overall, this retrospective study revealed Spanish preferring Latinos had higher HbA1c testing rates in comparison to non-Latino Whites and English preferring Latinos. However, the disparity in glycemic control may provide context for the higher testing rates among Spanish preferring Latinos. Spanish preferring Latinos disproportionately faced a higher prevalence of HbA1c above 9%, which, as recommended by the ADA, should lead to the patient receiving HbA1c testing approximately 3 times per year in order to continuously assess progress. (Center for Disease Control and Prevention, 2019) Their testing rate, and the rate for all groups with maximum HbA1c level above 9%, are receiving less than the recommended ADA testing rate. The differences in HbA1c levels are reflective of other national studies that have compared Latino populations with non-Latino Whites. (Avilés-Santa et al., 2016; Small et al., 2020)

This patient sample assessed HbA1c testing services in CHCs, which may differ from other public and private clinic organizations. CHCs are community-based clinics designed to provide health services for underserved populations, and a primary aim is high engagement with patient populations, as well as providing culturally and linguistically competent services. (Sadowski et al., 2011) This creates a specific environment that encourages patient openness to HbA1c testing through building social relationships between staff, patients, and providers, in addition to providing information in a linguistically concordant manner. (Sadowski et al., 2011) Older Spanish preferring Latinos or Latinos with limited English fluency in the US have been found to have lower health

literacy, which is actually associated with greater physician trust and higher adherence to treatment when there exist more physician-patient language concordance. (Mutchler et al., 2007) These factors greatly increase the ability to engage these Latino populations with clinical services like HbA1c testing. It also highlights the contributions of CHCs' organizational-level efforts to address linguistical barriers, ensuring appropriate clinical protocols, and maintain effective care team communication and training. (Sadowski et al., 2011; Mutchler et al., 2007)

While CHCs may be able to deliver equitable care in specific discrete services (e.g. ordering HbA1cs), the differences observed in the proportion of Spanish preferring Latinos and English preferring Latinos with a HbA1c maximum level above 9% compared to non-Latino Whites demonstrates that equity in these services may not be enough to achieve equity in common diabetes outcomes (hemoglobin a1c control). Spanish preferring Latinos had the highest proportion of uncontrolled diabetes among all groups. This highlights the powerful role linguistical, cultural, racial and ethnic factors have in diabetes-related health outcomes—in particular among low-income populations accessing safety-net clinics. Further efforts should focus on individual- and organizational-level programs and interventions within clinical settings that from their inception consider linguistical, cultural, racial, and ethnic factors.

4.1. Limitations

There were limitations to this study. First, the cohort was limited to include an older population seeking services within CHCs, which historically and traditionally serve populations disproportionately facing social risks related to income, transportation, and food. (Collaborative et al., 2021) This may have captured individuals suffering from higher rates of uncontrolled glycemia, given the exposure to potential social risk contributors. (Testerman and Chase, 2018; Ricci-Cabello et al., 2014) Secondly, while all patients within the health center were tested for diabetes, for some patients who established care during the study period, they may have had diagnoses prior to establishing care resulting in some uncertainty in their age at diagnosis. This may limit the findings given length of diagnosis influences patients' adherence to self-management. We could not account for diabetes and nutritional counseling given in the clinic or other health behaviors that may affect HbA1c levels and testing. Analyses based on clinical encounters are limited by what is recorded in the EHR which could be subject to a patient's geographic migration and change of healthcare provider in addition to the expected intervals between encounters, however, research has shown that CHC patients often stay within CHC networks.

5. Conclusion

Latinos with diabetes, specifically those over 50, tend to get at least as much HbA1c monitoring tests as similar non-Latino Whites at CHCs. Spanish preferring Latinos did show the highest testing rates, specifically those with a maximum HbA1c above 9%, but still below the recommended rate by several diabetes treatment guidelines. In our sample, HbA1c level was not associated with testing frequency. Latinos may benefit from the specific aims of CHCs, such as high patient engagement and culturally competent care. However, across groups with a maximum HbA1c level above 9%, additional measures may be necessary (aside from HbA1c testing) to achieve better glucose control.

CRedit authorship contribution statement

Benjamin Aceves: Conceptualization, Writing – original draft, Writing – review & editing. **David Ezekiel-Herrera:** Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Miguel Marino:** Writing – review & editing, Project administration, Supervision. **Roopradha Datta:** Writing – review & editing. **Jennifer Lucas:** Writing – review & editing. **Sophia Giebultowicz:** Writing –

review & editing. **John Heintzman:** Funding acquisition, Supervision, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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