



Short communication

Association of Hispanic ethnicity and linguistic acculturation with cardiovascular medication adherence in patients with suspected acute coronary syndrome

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ABSTRACT

Despite a higher prevalence of cardiovascular disease (CVD) risk factors, Hispanic-Americans have lower rates of CVD-related and all-cause mortality, as well as higher life expectancy than non-Hispanic whites – a phenomenon known as the *Hispanic health paradox*. However, this survival benefit attenuates with increased acculturation to Western lifestyles, potentially due to adoption of unhealthy behaviors. Accordingly, we assessed whether Hispanic ethnicity and linguistic acculturation, as measured by English proficiency, were associated with non-adherence to cardiovascular medications. We enrolled patients presenting to an academic medical center emergency department with suspected acute coronary syndrome between May 2014 and November 2017. Ethnicity, native language, and English proficiency were self-reported. Cardiovascular medication adherence was assessed using an electronic pill bottle that recorded the date and time of each bottle opening. Generalized linear models with a logit link were used to examine the association of Hispanic ethnicity and English proficiency with daily cardiovascular medication adherence, adjusting for demographics, comorbidities, and dosing frequency of the electronically-monitored medication. Among 332 included patients, mean age was 61.68 ± 12.05 years, 43.07% were women, and 62.95% were Hispanic, of whom 80.38% were native Spanish-speakers. Overall, Hispanics had higher odds of medication adherence than non-Hispanics (adjusted OR 1.31, 95% CI 1.16–1.49, $p < 0.001$). However, among native Spanish-speaking Hispanics, greater English proficiency was associated with lower odds of medication adherence (adjusted OR 0.80 per 1-point increase in English proficiency, 95% CI 0.75–0.86, $p < 0.001$). Although Hispanics had better medication adherence than non-Hispanics overall, increased linguistic acculturation among native Spanish-speakers was associated with worse adherence behaviors.

1. Introduction

Compared to non-Hispanic whites in the U.S., Hispanic-Americans have a higher prevalence of several cardiovascular risk factors, including obesity, diabetes, and dyslipidemia (Daviglius et al., 2012; Balfour et al., 2016; Cortes-Bergoderi et al., 2013). They also tend to have lower socioeconomic status, decreased access to medical care, poorer health literacy, and greater psychosocial stress, all of which are associated with higher incidence of cardiovascular disease (CVD) (Balfour et al., 2016; Cortes-Bergoderi et al., 2013; Ruiz et al., 2013, 2016).

Despite their seemingly elevated risk, Hispanic-Americans have consistently better CVD outcomes than their non-Hispanic counterparts, with 20% lower all-cause mortality (Arias et al., 2010), 33% lower cardiovascular-specific mortality (Cortes-Bergoderi et al., 2013), and a 25% survival advantage over other ethnic groups with CVD (Ruiz et al., 2013).

This discrepancy between cardiovascular risk and outcomes is known as the *Hispanic health paradox* (Ruiz et al., 2016). Multiple hypotheses have been proposed to explain these contradictory findings, though the evidence remains highly inconsistent (Balfour et al., 2016;

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Cortes-Bergoderi et al., 2013; Ruiz et al., 2016; Fitzgerald, 2010; Abraído-Lanza et al., 2005; Lara et al., 2005). One explanatory theory is the sociocultural hypothesis, which states that Hispanic cultural factors serve to strengthen social connections that in turn protect against adverse cardiovascular outcomes (Ruiz et al., 2016). This is supported by the observation that ethnically-dense Hispanic neighborhoods have lower rates of CVD, potentially due to traditional dietary practices, moral imperatives against tobacco and alcohol use, and communal coping mechanisms for dealing with discrimination and socioeconomic disadvantage (Balfour et al., 2016; Ruiz et al., 2016). However, the sociocultural hypothesis has not been formally tested, making these associations anecdotal only (Ruiz et al., 2016).

Interestingly, the protective effect of Hispanic ethnicity appears to attenuate as Hispanics adopt features of U.S. society through the process of *acculturation* (Ruiz et al., 2016; Fitzgerald, 2010; Abraído-Lanza et al., 2005; Lara et al., 2005). The multidimensional nature of acculturation makes it difficult to quantify, thus most measurement tools rely on proxies such as generational status, length of U.S. residence, or primary language (Fitzgerald, 2010; Abraído-Lanza et al., 2005; Lara et al., 2005). However, virtually all acculturation scales include language as a subconstruct, as it is relatively easy to measure and has been shown to explain most of the variance among the different scales in use (Lara et al., 2005). Many studies examining the influence of acculturation on Hispanic populations have found inverse associations between acculturation and health-related behaviors. For example, more acculturated Hispanics have higher rates of tobacco, alcohol, and drug use than their less acculturated counterparts (Ruiz et al., 2016; Fitzgerald, 2010; Abraído-Lanza et al., 2005; Lara et al., 2005). Hispanics tend to adopt unhealthy eating patterns as acculturation increases, with a shift from traditional diets emphasizing fruits, vegetables, and whole grains to greater intake of processed foods and sugar-sweetened beverages (Fitzgerald, 2010; Abraído-Lanza et al., 2005; Lara et al., 2005). Given this decline in nutritional quality, it is not surprising that Hispanics with higher acculturation are also more likely to be overweight or obese (Fitzgerald, 2010; Abraído-Lanza et al., 2005). Such behavioral changes can have grave consequences: in one large prospective cohort study, acculturation was associated with a greater burden of CVD risk factors and adverse outcomes, including stroke and coronary artery disease (Davignus et al., 2012).

Less is known about the association between acculturation and medication adherence, one of the most important preventive health behaviors. Some studies have shown that Hispanics are less likely to fill their cardiovascular medications than non-Hispanic whites (Holmes et al., 2012; Fernández et al., 2017; Traylor et al., 2010). However, the role that acculturation plays in this association remains ambiguous. While greater acculturation has been linked to increased medication adherence among Arab-Americans (Tailakh et al., 2016) and Chinese-Americans (Jin and Acharya, 2016), studies exploring this association in Hispanic populations have yielded mixed results (Padilla et al., 2011; Hall et al., 2016; Rivera Mindt et al., 2020). Furthermore, to our knowledge, prior studies have relied on pharmacy fill data, which are poorly suited to assessing the influence of Hispanic ethnicity and linguistic acculturation on daily implementation of a medication regimen. To help fill this gap in the literature, we examined whether Hispanic ethnicity and linguistic acculturation were associated with electronically-monitored adherence to cardiovascular medications among patients with suspected acute coronary syndrome (ACS). We hypothesized that greater linguistic acculturation would be associated with poorer implementation of a medication regimen, in keeping with the observed impact of acculturation on other preventive health behaviors.

2. Methods

2.1. Design, setting, and population

The Reactions to Acute Care and Hospitalization (ReACH) study is a prospective observational cohort study assessing posttraumatic stress disorder symptoms among patients presenting to the emergency department (ED) of a quaternary academic medical center in New York City for evaluation of suspected ACS (Birk et al., 2019). The medical center serves a large Hispanic community, primarily of Dominican and Puerto Rican descent, with high rates of poverty, unemployment, and limited English proficiency. Eligibility criteria included age ≥ 18 years, English and/or Spanish fluency, and suspected ACS (unstable angina or non-ST elevation myocardial infarction) as determined by the treating ED physician. Patients with ST-elevation myocardial infarction (i.e., acute coronary artery occlusion leading to transmural myocardial ischemia or necrosis) were excluded given that they typically required immediate coronary intervention and spent minimal time in the ED, making it infeasible to enroll them in the parent ReACH study. Patients with terminal illness, severe cognitive impairment, severe mental illness, or other inability to complete the study protocol were also excluded. The current investigation was part of an ancillary medication adherence study within the ReACH cohort. Patients discharged on at least one cardiovascular medication (e.g., aspirin, statin, anticoagulant, antihypertensive) were eligible. Patients were excluded from the ancillary study if they were not prescribed a cardiovascular medication, were unable to self-administer medications, or were unwilling to take medication from an electronic pill bottle (described below). The Columbia University Irving Medical Center Institutional Review Board approved the study, and all patients provided signed informed consent. Study data are available from the authors upon request.

2.2. Measures and outcomes

Patient demographics, including ethnicity and native language, were self-reported at enrollment. English proficiency was determined by asking native Spanish-speakers to rate how well they spoke English on a 5-point scale (1 – *not at all*, 2 – *poorly*, 3 – *fairly well*, 4 – *well*, 5 – *very well*). Final diagnosis for the symptoms prompting ED presentation (confirmed ACS vs. other diagnosis) was determined by cardiologist review of the electronic health record (EHR). Medical comorbidities were abstracted from the EHR and used to calculate the Charlson comorbidity index (CCI; range 0–37, higher scores indicate greater 1-year mortality risk).

Patients enrolled in the ancillary medication adherence study were mailed an electronic pill bottle (eCAP, Information Mediary Corp., Ottawa, Canada) that automatically recorded the date and time of each bottle opening. Patients were asked to take a designated cardiovascular medication (preferably aspirin, but another cardioprotective medication could be substituted if aspirin was not prescribed) from the eCAP for up to six months after their initial ACS event. Verbal and written instructions for eCAP use were provided in English and Spanish (Appendix). Patients were not counseled on medication adherence nor provided with the electronically-monitored medication as part of the study protocol. Dosing frequency of the electronically-monitored medication was obtained from the EHR. Medication adherence was defined as the percentage of monitored days with the correct number of eCAP openings. Patients who never filled the medication intended to be electronically-monitored were still included in the analysis and were classified as having 0% adherence (i.e., zero eCAP openings).

2.3. Statistical analyses

Generalized linear models with a logit link were used to examine the association between Hispanic ethnicity and medication adherence (accounting for number of days monitored), adjusting for age, sex,

education, CCI, discharge diagnosis (confirmed ACS vs. other diagnosis), and dosing frequency of the electronically-monitored medication. Similar analyses examined the association between English proficiency and medication adherence among Hispanics whose native language was not English. All analyses were performed using SAS statistical software (v9.4, SAS Institute, Cary, NC) at a two-sided p-value of 0.05.

3. Results

Between May 2014 and November 2017, 739 patients agreed to participate in the ancillary medication adherence study, 474 returned the eCAP, and 332 had complete data for analysis. Mean age was 61.68 ± 12.05 years; 43.07% were women; 12.65% were non-Hispanic white, 18.37% were non-Hispanic Black, 62.95% were Hispanic, and 4.22% were another race/ethnicity (1.81% had missing race/ethnicity data). Among all patients, 56.93% completed high school or less, 16.57% completed trade school or some college, 16.57% completed college, and 9.94% completed graduate school; Hispanics had lower educational attainment than non-Hispanics ($p < 0.001$). Among Hispanics, 80.38% were native Spanish-speakers with a mean English proficiency score of 3.79 ± 1.25 (range 1–5; higher scores indicate better English proficiency). Mean CCI was 1.98 ± 1.93 , 21.39% of patients had prior myocardial infarction, 8.13% had prior stroke, and 38.55% had confirmed ACS during the index admission. Most patients had active health insurance (90.66%), with no significant differences between Hispanics and non-Hispanics (89.37% vs. 94.31%, $p = 0.13$). Aspirin was the most common electronically-monitored medication (66.05%). Patients took their medication as prescribed on $74.55 \pm 29.48\%$ of days monitored during the first month post-discharge. Overall, 60.54% of patients were adherent to their monitored medication $\geq 80\%$ of the time (64.11% of Hispanics vs. 54.57% of non-Hispanics, $p = 0.08$). Sixteen (4.82%) patients had no eCAP openings.

In unadjusted models, Hispanic ethnicity was associated with higher odds of medication adherence (OR 1.26, 95% CI 1.12–1.41, $p < 0.001$), which persisted even after adjusting for covariates (adjusted OR 1.31, 95% CI 1.16–1.49, $p < 0.001$; Table 1). There was no significant difference in medication adherence between Hispanics whose native language was English vs. Spanish ($75.71 \pm 25.46\%$ vs. $76.26 \pm 29.17\%$; unadjusted OR 1.08, 95% CI 0.89–1.30, $p = 0.43$; adjusted OR 1.10, 95% CI 0.89–1.36, $p = 0.37$). However, among Hispanics whose native language was Spanish, greater English proficiency was associated with lower odds of medication adherence in both unadjusted (OR 0.79 per 1-point increase in English proficiency, 95% CI 0.74–0.84, $p < 0.001$) and adjusted models (OR 0.80, 95% CI 0.75–0.86, $p < 0.001$; Table 2).

4. Discussion

In this study, we found that Hispanics were more adherent to cardiovascular medications than non-Hispanics, which could at least partially explain the Hispanic health paradox. However, among native Spanish-speaking Hispanics, greater English proficiency was associated with worse medication adherence. Therefore, medication nonadherence may be one plausible mechanism by which cardiovascular outcomes worsen as Hispanics become increasingly acculturated to Western lifestyles.

Interestingly, our finding of greater medication adherence among Hispanics differs from prior literature showing that, compared to non-Hispanic whites, Hispanics tend to be less adherent to CVD medications (Holmes et al., 2012; Fernández et al., 2017; Traylor et al., 2010). However, the majority of these studies based medication adherence on self-report or pharmacy fill data, which may be more sensitive to out-of-pocket costs and other medication accessibility factors rather than daily pill-taking behavior. Medication adherence is a multidimensional construct encompassing various behaviors (e.g., initiation, implementation, persistence) (Vrijens et al., 2012) that each may be influenced by ethnicity and acculturation in different ways. Electronic monitoring is considered the optimal measure of medication regimen implementation due to its objectivity (i.e., providing a time stamp for each bottle opening), low reactivity, and decreased susceptibility to recall bias or over-reporting (Kronish et al., 2021). Therefore, our use of electronic monitoring primarily captures adherence to daily pill-taking, and only indirectly measures the extent to which patients fill their medications. Additionally, most patients in our sample had active health insurance and were being monitored on adherence to aspirin, a relatively inexpensive and easily accessible medication, which would theoretically minimize the impact of impaired healthcare access on adherence behaviors. Future studies should examine the effects of acculturation on distinct measures of medication adherence.

The lack of difference in medication adherence between Hispanics whose native language was English vs. Spanish was somewhat surprising. If English proficiency is considered a measure of acculturation, one might expect native English-speaking Hispanics to have worse medication adherence than native Spanish-speaking Hispanics. Given the small number of native English-speaking Hispanics in our sample, we may have been underpowered to detect an association between native language and medication adherence. Alternatively, native English-speaking Hispanics and native Spanish-speaking Hispanics may represent two distinct cultural groups, each with unique responses to the forces of acculturation.

Table 1

Association between Hispanic ethnicity and medication adherence (n = 332).

Characteristic	Unadjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Hispanic ethnicity ^a	1.26	1.12 – 1.41	<0.001	1.31	1.16 – 1.49	<0.001
Age ^b	–	–	–	1.01	1.00 – 1.01	0.01
Sex ^c	–	–	–	0.78	0.69 – 0.88	<0.001
Education	–	–	–	–	–	<0.001 ^g
High school or less	–	–	–	–	–	–
Trade school/some college	–	–	–	1.55	1.31 – 1.85	–
College degree	–	–	–	1.12	0.95 – 1.32	–
Graduate degree	–	–	–	1.88	1.50 – 2.34	–
Charlson comorbidity index ^d	–	–	–	0.88	0.85 – 0.91	<0.001
Discharge diagnosis ^e	–	–	–	0.97	0.86 – 1.09	0.58
Medication dosing frequency ^f	–	–	–	0.70	0.60 – 0.82	<0.001

^a Hispanic vs. non-Hispanic.

^b Per 1-year increase.

^c Male vs. female.

^d Per 1-point increase (range 0–37; higher score indicates greater 1-year mortality risk).

^e Acute coronary syndrome vs. other diagnosis (for index emergency department presentation).

^f More than once per day dosing vs. once per day dosing of electronically-monitored medication.

^g F-test for overall effect of education (degrees of freedom = 3; reference level = high school or less)

Table 2

Association between English proficiency among Spanish-speakers and medication adherence (n = 168).

Characteristic	Unadjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
English proficiency ^a	0.79	0.74 – 0.84	<0.001	0.80	0.75 – 0.86	<0.001
Age ^b	–	–	–	1.01	1.01 – 1.02	0.001
Sex ^c	–	–	–	1.13	0.93 – 1.36	0.21
Education	–	–	–	–	–	0.001 ^g
High school or less	–	–	–	–	–	–
Trade school/some college	–	–	–	1.78	1.27 – 2.49	–
College degree	–	–	–	0.86	0.65 – 1.13	–
Graduate degree	–	–	–	1.55	0.71 – 3.41	–
Charlson comorbidity index ^d	–	–	–	0.85	0.81 – 0.89	<0.001
Discharge diagnosis ^e	–	–	–	0.89	0.74 – 1.07	0.22
Medication dosing frequency ^f	–	–	–	0.55	0.42 – 0.72	<0.001

^a Per 1-point increase (range 1–5; 1 = *not at all*, 2 = *poorly*, 3 = *fairly well*, 4 = *well*, 5 = *very well*).^b Per 1-year increase.^c Male vs. female.^d Per 1-point increase (range 0–37; higher scores indicate greater 1-year mortality risk).^e Acute coronary syndrome vs. other diagnosis (for index emergency department presentation).^f More than once per day dosing vs. once per day dosing of electronically-monitored medication.^g F-test for overall effect of education (degrees of freedom = 3; reference level = high school or less).

4.1. Strengths and limitations

The major strength of this study was its use of electronic medication monitoring. That being said, the electronic pill bottle could not confirm whether the enclosed medication was ingested after bottle opening. Other limitations included the cross-sectional design, modest sample size, and single recruitment site. We did not collect number, class, or cost of outpatient medications, which could have influenced adherence patterns. Most of the Hispanic patients in our sample were of Dominican or Puerto Rican descent, potentially making our results less generalizable to other Hispanic populations. Furthermore, we acknowledge that English proficiency is an imperfect measure of acculturation that does not fully capture this multidimensional construct.

5. Conclusions

Although Hispanics demonstrated better medication adherence than non-Hispanics overall, among native Spanish-speaking Hispanics, greater English proficiency was associated with worse medication adherence. Medication nonadherence may partially explain why cardiovascular outcomes worsen as Hispanics become increasingly acculturated. Linguistic acculturation should be considered when predicting medication nonadherence rather than relying on ethnicity alone.

6. Prior presentations

This work was accepted as an abstract at the 2020 Society of General Internal Medicine Annual Meeting (held virtually in May 2020 due to COVID-19).

7. Financial disclosures

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Author contributions

IMK conceptualized and designed the study; supervised the study protocol, participant recruitment, and data collection; and obtained research funding. CA provided advice on study design and methodology. EKR helped coordinate the study and curate the collected data. TC created the statistical models and formally analyzed the data. NAL prepared the manuscript and visually presented the data. All authors contributed to manuscript review and editing. IMK takes responsibility for the manuscript as a whole.

Declaration of Competing Interest

NAL has no conflicts of interest. TC has no conflicts of interest. EKR has no conflicts of interest. CA has no conflicts of interest. IMK received funding to support this work in the form of grants HL117832, HL123368, and HL128310 from the National Institutes of Health (NIH)/National Heart, Lung, and Blood Institute (NHLBI). The study sponsor had no role in the study design; collection, analysis, or interpretation of data; manuscript preparation; or the decision to submit the manuscript for publication. The research presented in this manuscript is that of the authors and does not reflect the official policy of the NIH/NHLBI.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.pmedr.2021.101455>.

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