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Neighborhood Latino ethnic density and mortality among HIV-positive Latinos by birth country/region, Florida, 2005–2008

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Abstract

Objective—Lower mortality for Latinos has been reported in high Latino density areas. The objective was to examine the contribution of neighborhood Latino density to mortality among HIV-positive Latinos.

Methods—Florida HIV surveillance data for 2005–2008 were merged with 2007–2011 American Community Survey data using zip code tabulation areas. Hazard ratios (HR) were

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calculated using multi-level weighted Cox regression and adjusted for individual-level factors and neighborhood poverty.

Results—Of 4649 HIV-positive Latinos, 11.8% died. There was no difference in mortality risk across categories of Latino ethnic density for Latinos as a whole. There were subgroup effects wherein mortality risk differed by ethnic density category for Latinos born in some countries/ regions. Residing in an area with ≥50% Latinos compared with <25% was associated with increased mortality risk for Latinos born in Puerto Rico (HR 1.67; 95% CI [1.01–2.70]). Residing in an area where Mexicans were the majority Latino group was associated with increased mortality risk for Latinos born in Mexico (HR 3.57; 95% CI [1.43–10.00]).

Conclusions—The survival advantage seen among the Latino population in high Latino density areas was not seen among HIV-positive Latinos. Research is needed to determine if this may be related to stigma or another mechanism.

Keywords

Latino; human immunodeficiency virus; ethnic density; mortality; neighborhood

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Introduction

In 2010, the age-adjusted all-cause mortality rate for the general Latino population in the United States (US) was lower than for non-Latino whites (559 vs. 755 per 100 000 population, respectively) (National Center for Health Statistics 2014). Yet, the mortality rate for Latinos with human immunodeficiency virus (HIV) was more than 2.5 times the rate of their non-Latino white counterparts (female: 1.1 vs. 0.4 per 100 000; male: 4.6 vs. 1.8 per 100 000, respectively) (National Center for Health Statistics 2014). Further disparities have been reported among Latino immigrants of varying birth countries/regions. The 3-year survival rate in the US for foreign-born Latinos diagnosed with acquired immune deficiency syndrome (AIDS) between 2001 and 2005 was 88% (95% confidence interval (CI) [88–89]) compared with 91% (95% CI [90–91]) for US-born Latinos (Espinoza, Hall and Hu 2012). HIV-positive Latinos born in Puerto Rico were at the highest risk of mortality when compared with HIV-positive Latinos born in mainland US (Espinoza *et al.* 2012, Hanna *et al.* 2008).

Research suggests that racial/ethnic minorities who live among people of their own ethnic group experience health benefits. In the US, the protective effect of ethnic density (the proportion of an ethnic group in a defined area) has most consistently been reported for Latinos (Becares *et al.* 2012). A study in New York City found a 3 per 100 000 population decrease in all-cause mortality per 1% increase in Latino ethnic density among Latino men, even after controlling for neighborhood socioeconomic status (Inagami *et al.* 2006). A study in Texas reported lower risk of all-cause mortality for Mexican-Americans living in census tracts with a higher percentage of Mexican-Americans compared with Mexican-Americans living in census tracts with a lower percentage of Mexican-Americans (hazard ratio (HR) 0.64; 95% CI [0.42–0.96]) (Eschbach *et al.* 2004). This effect persisted after controlling for age, gender, health status, and disability and despite the lower socioeconomic status of the high density neighborhoods. Additional benefits of ethnic density for Latinos have been reported for heart disease (Alvarez and Levy 2012) and mortality (Franzini and Spears 2003); stroke; lung, breast and colorectal cancer (Franzini and Spears 2003, Eschbach, Mahnken and Goodwin 2005); smoking during pregnancy (Shaw, Pickett and Wilkinson 2010), infant mortality (Shaw *et al.* 2010, Jenny, Schoendorf and Parker 2001), preterm birth (Mason *et al.* 2010, Masi *et al.* 2007), and low birth weight (Masi *et al.* 2007, Peak and Weeks 2002); depression (Gerst *et al.* 2011, Sheffield and Peek 2009, Ostir *et al.* 2003); poor self-rated health (Patel *et al.* 2003, Shaw and Pickett 2011); cholesterol screening (Benjamins, Kirby and Bond Huie 2004); and access to care (Haas *et al.* 2004). Empirical data suggest that ethnic density might work through decreased exposure to racism (Whitley *et al.* 2006, Becares, Nazroo and Stafford 2009) and discrimination (Whitley *et al.* 2006, Becares *et al.* 2009, Das-Munshi *et al.* 2010); improved social support (Das-Munshi *et al.* 2010, Halperin and Nazroo 2000), social cohesion (Hong, Zhang and Walton 2014) and social networks (Whitley *et al.* 2006, Becares *et al.* 2009, Das-Munshi *et al.* 2010); and increased access to care (Benjamins *et al.* 2004, Haas *et al.* 2004) and culturally appropriate resources (Whitley *et al.* 2006). Other proposed mechanisms include decreased levels of socially induced stress (Eschbach *et al.* 2004) and social stigma (Pickett and Wilkinson 2008), improved access to and dissemination of health information through informal interactions (Lee 2009), and higher numbers of language/cultural-concordant physicians (White, Haas and Williams 2012).

Despite evidence of a protective effect of Latino ethnic density for Latinos, no studies to date have examined the relationship between ethnic density and HIV/AIDS or other infectious diseases. Since the development of highly active antiretroviral therapy (HAART), HIV has become a chronic condition requiring life-long medical care. Social support (informational, tangible or emotional) from friends and family has been found to encourage HIV seropositive status disclosure (Smith, Rossetto and Peterson 2008), improve quality of life and mental health (Friedland, Renwick and McColl 1996, Swindells *et al.* 1999), and increase retention in HIV care (Catz *et al.* 1999) and medication adherence (Edwards 2006) among persons with HIV. It is possible, based on findings for the general Latino population and for Latinos with non-communicable diseases, that the social support provided by a predominantly Latino neighborhood could offer long-term assistance to Latinos with HIV. Furthermore, a relationship between neighborhood Latino ethnic density and survival for Latinos with HIV could also provide some insight on availability of culturally appropriate care and resources in high and low Latino ethnic density areas. Finally, Latinos in the US differ in socioeconomic status, health care access (Motel and Patten 2012), and outcomes along the HIV/AIDS care continuum (Espinoza *et al.* 2008). Despite the heterogeneity among Latinos in the US, most studies examine Latinos as one group. Although some studies have examined ethnic density among certain Latino ethnic groups (i.e. Mexicans), we were unable to identify studies that examined and compared the effect of ethnic density for Latinos from other birth countries/regions. Therefore, the objective of this study was to examine the role of neighborhood Latino ethnic density in all-cause mortality among Latinos diagnosed with HIV in Florida. Further, we sought to (1) compare the role of Latino ethnic density in mortality within Latinos of varying birth countries/regions and (2) determine if Latino ethnic density ameliorates disparities within Latinos.

Methods

Study sample

De-identified HIV surveillance data were obtained from the Florida Department of Health (FDOH) Enhanced HIV/AIDS Reporting System (eHARS). Latinos ages 13 and over who met the Centers for Disease Control and Prevention (CDC) case definition for HIV (Centers for Disease Control and Prevention 1999, 2008) between 2005 and 2008 were included (N=5061). Cases were followed through December 31, 2011 for mortality from any cause. Individuals alive at the end of the follow-up period were censored (mean follow-up for censored cases = 59 months). Vital status was ascertained from the FDOH's Office of Vital Statistics, the Social Security Administration's Death Master File, and the National Death Index. Cases with missing or invalid data for zip code at time of HIV diagnosis (n=282), diagnosed under the age of 13 (n=14), missing month of HIV diagnosis (n=10), and cases diagnosed in a correctional facility (n=106) were excluded. Cases diagnosed in a correctional facility were excluded because neighborhood characteristics obtained from the American Community Survey are representative of individuals residing in each ZCTA, and not of individuals residing in correctional facilities. Furthermore, individuals residing in correctional facilities may have limited interaction with the adjacent neighborhood and different access to resources and health care than the surrounding community. A total of 4649 Latinos diagnosed with HIV between 2005–2008 met the inclusion criteria and were included in the analyses. Of these, 548 (11.8%) died within the follow-up period, and the remaining 4101 (88.2%) were censored.

Individual- and neighborhood-level variables

The following variables were extracted from eHARS: sex at birth; age at HIV diagnosis; birth country; HIV diagnosis month and year; HIV transmission mode; HIV-to-AIDS interval in months (if case progressed to AIDS); month and year of death; residential zip code at time of HIV diagnosis; and whether the case was diagnosed at a correctional facility. Zip code at time of HIV diagnosis (e.g. at the start of the follow-up period) was used instead of zip code at time of death for two reasons: (1) zip code at time of death is not complete from all sources of death reports, and (2) zip code at the end of the follow-up period is not available for cases who did not die. Neighborhood characteristics were obtained from the 2007–2011 American Community Survey (ACS) (US Census Bureau 2014). Zip codes were matched to a corresponding zip code tabulation area (ZCTA). ZCTAs are generalized areal representations of zip code service areas used by the ACS to tabulate summary statistics (US Census Bureau 2013). Cases in our cohort resided in 530 unique ZCTAs at time of HIV diagnosis. The following neighborhood characteristics were extracted at the ZCTA-level: percent of population below poverty line; percent of population 16 and older unemployed; percent of population 18 and older that was a high school graduate; percent of population who identified themselves as Hispanic/Latino; and percent of Hispanic/Latino population who identified themselves as either Puerto Rican, Mexican, Cuban, Central American, or South American (separately).

Analysis

Latinos were categorized into one of the following birth countries/regions: US-born (excludes Puerto Rico), Puerto Rico, Mexico, Cuba, Central America, South America, and other. First, we conducted a descriptive analysis of individual and neighborhood-level factors by birth country/region (table 1). For this part of the analysis, neighborhood-level poverty, education and unemployment were divided into quartiles based on the Florida population. Among Latinos, a strong ethnic density effect has been reported in areas with 50% Latinos or more (Alvarez and Levy 2012, Shaw *et al.* 2010). For this reason, and to address small cell sizes in the analysis by birth country/region, we categorized Latino ethnic density into 3 categories: <25%, 25–49%, and ≥50%. Given the heterogeneity of Latinos, we also sought to determine the importance of being surrounded by people of their specific ethnic origin (e.g. Cuban, Puerto Rican, Mexican, etc.). To examine this, we categorized cases as either ethnically congruent or not. We defined ethnic congruency as birth in the same country/region as the majority Latino group in the ZCTA. For example, a case born in Mexico was considered to be ethnically congruent if they lived in a ZCTA where the largest ethnic group among Latinos was Mexican.

Second, we explored the role of Latino ethnic density in all-cause mortality for Latinos as a whole and for each birth country/region separately (table 2). Highly correlated covariates can cause variables to appear non-significant in survival analyses (Cantor 2003). Thus, prior to model building, we examined the correlation between neighborhood SES variables (poverty, high school graduation, and unemployment) and between SES variables and ethnic density. Correlation between neighborhood poverty and high school graduation was high (Pearson coefficient = −0.81). Correlation was lowest for ethnic density and poverty (poverty = 0.15; unemployment = −0.25; high school graduation = −0.49). Exploratory principal component analysis showed that poverty accounted for most of the variability in SES variables. Therefore, we used only poverty as a continuous variable to control for neighborhood SES in regression analyses. Kaplan-Meier survival curves were generated by birth country/region, poverty level, and ethnic density category. The Cox regression model's proportional hazards assumption was violated. Therefore, SAS macro PHSREG by Kohl and Heinze (Kohl and Heinze 2014) was used to run weighted Cox models. Weighted Cox regression models address non-proportionality by calculating an average hazard ratio when the hazard varies in time while taking into account the decreasing number of cases throughout the follow-up period (Schemper, Wakouning and Heinze 2009). There are at least 2 limitations to this method. First, it requires a larger sample size than the proportional Cox model. Still, the method has provided appropriate results with samples of n=80 (our smallest group contains 324 cases) (Schemper *et al.* 2009). Second, the weighted Cox model is a nonparametric test. If non-proportionality is negligible, the proportional Cox model, as a parametric test, might be more robust to detect an effect. Multi-level (level 1: individual; level 2: ZCTA) modeling was used to account for correlation among cases living in the same ZCTA. Hazard ratios were calculated by ethnic density category and adjusted for all individual-level variables and neighborhood poverty.

Third, we tested whether Latino ethnic density reduced disparities within Latinos of varying birth countries/regions (table 3) using US-born Latinos as a referent group (Espinoza *et al.*

2012, Hanna *et al.* 2008). We compared 4 models: (1) unadjusted, (2) adjusted for individual-level variables, (3) adjusted for individual-level variables and neighborhood poverty, and (4) adjusted for individual-level variables, poverty (continuous) and ethnic density. During this analysis only, Latino ethnic density was entered as a continuous variable consistent with the ethnic density literature (Inagami *et al.* 2006, Eschbach *et al.* 2004, Franzini and Spears 2003, Peak and Weeks 2002, Patel *et al.* 2003, Shaw and Pickett 2011) in an effort to fully adjust for this variable and avoid any loss of data during categorization.

Finally, we examined the role of ethnic congruency in mortality. Given our hypothesis that ethnic congruency is protective, we used Latinos diagnosed in a ZCTA where the majority Latino group was of their same ethnic origin as the referent group. Only foreign-born Latinos were included in this analysis because surveillance data does not provide country of origin for US-born Latinos. Hence, it was not possible to determine if a case born in the US was ethnically congruent to the majority Latino group in their neighborhood. Latinos born in "other" countries were also excluded because they partially represent Latinos with unknown birth country/region. For foreign-born Latinos, hazard ratios were adjusted for individual-level variables and neighborhood poverty. All models included year of HIV diagnosis in an effort to control for secular changes in clinical treatment and policy related to healthcare access and HIV/AIDS. This study was approved by the Florida Department of Health and the Florida International University Institutional Review Boards.

Results

In Florida, there were 4649 Latinos diagnosed with HIV between 2005 and 2008 who met the inclusion criteria. Of these, 11.8% died within the follow-up period. While 32% were born in mainland US, the second largest ethnic group was Latinos born in Cuba (16.2%) (table 1). HIV-positive Latinos of varying birth countries/regions differed significantly in gender, age, HIV transmission mode, HIV-to-AIDS interval, and survival length. A larger proportion of Latinos born in Central America (55%) resided in ZCTAs in the highest poverty quartile when compared with all other Latino groups. A smaller proportion of South Americans (21%) resided in ZCTAs in the highest poverty quartile when compared with all other groups including Latinos born in mainland US (36.6%). Of all HIV-positive Latinos, 36.7% resided in a ZCTA where ≥50% of the population identified themselves as "Hispanic/Latino." A larger proportion of Latinos born in Cuba (66.6%) resided in the highest ethnic density category (≥50%) when compared with all other groups. Of foreign-born Latinos, 21.7% lived in a ZCTA congruent with their specific ethnicity. The majority of Latinos born in Cuba (70.2%) lived in a ZCTA where Cubans were the largest Latino group. No cases born in Central America experienced ethnic congruency.

There was no difference in mortality risk by Latino ethnic density category for Latinos as a whole after controlling for individual-level factors and neighborhood poverty. Latinos born in Puerto Rico who resided in a ZCTA with <25% Latinos experienced a decreased mortality risk when compared with Latinos born in Puerto Rico who resided in a ZCTA with ≥50% Latinos (HR 0.60; 95% CI [0.37–0.99]) (Table 2). Differences in mortality by ethnic density category were not identified for other Latino groups. Compared to Latinos born in mainland US, those born in Puerto Rico had an increased mortality risk (HR 2.00; 95% CI [1.53–2.59]), and those born in South America had a decreased mortality risk (HR 0.60; 95% CI [0.40–0.89]) after controlling for individual-level factors and neighborhood poverty. Disparities were not reduced after controlling for ethnic density (table 3).

Ethnic congruency did not affect mortality risk for foreign-born Latinos as a whole after controlling for individual-level variables and neighborhood poverty (HR 0.97; 95% CI [0.76–1.24]) (data not in table). Latinos born in Mexico who lived in a ZCTA where Mexicans were not the majority Latino group were at decreased mortality risk compared with Latinos born in Mexico who lived in a ZCTA where the majority Latino group was Mexican (HR 0.28; 95% CI [0.10–0.70]). Ethnic congruency did not affect mortality for other Latinos born outside mainland US (Puerto Rico HR 1.03, 95% CI [0.65–1.67]; Cuba HR 1.10, 95% CI [0.68–1.74]; South American HR 1.81, 95% CI [0.70–5.68]).

Discussion

The results of this study indicate that neighborhood Latino ethnic density is not associated with mortality among HIV-positive Latinos. Sensitivity analysis showed consistent results when comparing very high ethnic density (>90%) with low ethnic density (<10%) (HR 0.90, 95% CI [0.60–1.35]) as well as using ethnic density as a continuous variable (HR 1.00 per 5 unit increase, 95% CI [0.98–1.02]). Previous studies found evidence of lower all-cause, heart disease (Franzini and Spears 2003), and infant (Shaw *et al.* 2010) mortality for Latinos in the US who live in higher Latino density areas. Our findings suggest that the relationship between ethnic density and mortality may be more complex, particularly for mortality from stigmatizing conditions. While the mechanisms of ethnic density –lower discrimination (Whitley *et al.* 2006, Das-Munshi *et al.* 2010), socially induced stress (Eschbach *et al.* 2004) and stigma (Pickett and Wilkinson 2008), and improved social support (Das-Munshi *et al.* 2010, Halpern and Nazroo 2000), cohesion (Hong *et al.* 2014) and networks (Whitley *et al.* 2006, Das-Munshi *et al.* 2010)– might enhance the protective Latino values of *familismo* (a value emphasizing close, supportive family relationships) (Campos *et al.* 2014) and *personalismo* (a value emphasizing warm, empathetic personal interactions) (Lopez-Class *et al.* 2011) to improve health, they challenge many social aspect of HIV/AIDS. High levels of perceived stigma (Varas-Diaz, Serrano-Garcia and Toro-Alfonso 2005) and low levels of HIV serostatus disclosure (Zee *et al.* 2004) increase isolation among Latinos (Varas-Diaz *et al.* 2005) and might prevent them from taking advantage of the surrounding Latino community. Stigma (Darrow, Montanea and Gladwin 2009) and low levels of HIV/AIDS knowledge (Ritieni, Moskowitz and Tholandi 2008) among the general Latino population might also prevent a Latino community from supporting individuals with HIV/AIDS. It is important to note that higher Latino density has been found to be protective in non-stigmatizing conditions and that effect may not extend to conditions like HIV/AIDS.

The findings of this study also suggest that the relationship between Latino ethnic density and mortality differs for Latinos by birth country/region. Results showed a significant association between Latino ethnic density and mortality only for Latinos born in Puerto Rico. It should be noted, however, that the effect was marginally significant (HR 0.60, 95% CI [0.37–0.99]). A study among Puerto Ricans with HIV/AIDS reported that stigma negatively influenced social interactions leading to loss of social support and isolation (Varas-Diaz *et al.* 2005). It is possible that HIV-positive Latinos born in Puerto Rico who live in Latino dense areas experience more stigma compared with their counterparts surrounded by a majority non-Latino neighborhood.

Latino ethnic density did not partially account for disparities in mortality seen between HIV-positive Latinos of varying birth countries/regions. Hazard ratios changed negligibly in Model 4 after controlling for ethnic density. The finding that Latinos born in Puerto Rico have an increased mortality risk compared with Latinos born in mainland US is consistent with the literature (Espinoza *et al.* 2012, Hanna *et al.* 2008, Espinoza *et al.* 2008). Our analysis controlled for HIV transmission mode and therefore presumably accounted for the higher rates of injection drug use reported by this Latino group (Espinoza *et al.* 2008, 2012). By controlling for delayed HIV diagnosis (HIV-to-AIDS interval <1 month), we attempted to adjust for the disparities in late diagnosis seen among Latinos of varying birth countries/regions that range from 35% among Latinos born in Cuba to 58% among those born in Central America (Espinoza *et al.* 2008). Our findings still may reflect some differences in late diagnosis, as well as differences in rate of disease progression, delayed linkage to and/or retention in care, and access to and/or adherence to antiretroviral treatment. The unique opportunity to travel back and forth between mainland US and Puerto Rico might cause detrimental disruption in HIV care leading to poor health outcomes (Taylor *et al.* 2014). In addition, Puerto Ricans report lower median household income and have the second highest poverty rate among the 10 largest Latino ethnic subgroups (Motel *et al.* 2012). Although they also report higher educational attainment and rates of health insurance coverage, individual-level income and poverty may be indirectly contributing to the disparities we see between Latinos born in Puerto Rico and those born in mainland US.

The dataset used for this study did not include individual-level SES. In an effort to control for individual-level SES and other potential unmeasured confounders, we conducted post hoc sensitivity analysis of unobserved confounding using Propensity Score Calibration (Lanehart *et al.* 2012, Sturmer *et al.* 2005). Only one association changed after controlling for unobserved confounding. During our original analysis, we found no difference in risk of mortality between Latinos born in Cuba compared with Latinos born in the US after adjusting for individual- and neighborhood-level covariates available in our dataset (table 3, model 4) (HR 1.14, CI 0.85–1.52). When we adjusted for unobserved confounders using the propensity scores, we found Latinos born in Cuba to be at increased mortality risk (HR 1.14, CI 1.02–1.27). This is consistent with findings from Espinoza *et al.* (2008) reporting lower 12- and 36-month survival after AIDS diagnosis for Latinos born in Cuba compared with those born in the US. Covariates that were not measured in this study appear to be confounding the association between birth country and mortality for Latinos born in Cuba.

Finally, this study identified a decreased mortality risk for Latinos born in Mexico who resided in ZCTAs where Mexican-Americans were not the majority Latino group. Areas where Mexicans are the majority Latino group might correlate with migrant workers and rural status. In our study, 54% of rural cases lived in an area where Mexicans were the majority Latino group. Nevertheless, the effect of ethnic congruency on Latinos born in Mexico persisted after excluding rural cases (HR 0.34, 95% CI [0.12–0.89]). Post hoc analysis revealed that Latinos born in Mexico were the only group who did poorly in areas where Mexicans were the majority Latino group. This is surprising given the protective effects of ethnic density on all-cause and heart disease mortality found in two Texas studies (Eschbach *et al.* 2004, Franzini and Spears 2003). One study specifically examined Mexicans in high Mexican-American density areas (Eschbach *et al.* 2004). However, these studies did not involve the interplay between stigma, community and health. Our results do support findings reported by Jenny *et al* (2001). In this study, infants born to US-born Mexican mothers had a decreased mortality risk but those born to Mexican-born mothers had an increased mortality risk with increasing Mexican ethnic density.

Our study has several limitations. First, sample size for some Latino groups was not ideal. In an evaluation of ethnic density studies, Shaw *et al*. suggested that ethnic density studies with a sample size of <500 tended to have neutral findings (Shaw *et al.* 2012). This potential limitation only affects our results for Latinos born in Puerto Rico, Mexico, and Central America. However, Shaw and colleagues also showed that sample sizes >4000 tended to show protective effects. Therefore, it is important to note that we failed to find an association with a sample of 4649 for Latinos as a whole. The small number of deaths in some Latino groups may have also limited our power to find an association. Second, we were unable to examine ethnic density for smaller geographic units (e.g. census blocks) as only zip code data were available. In 2002, Krieger and colleagues reported that zip codes might fail to properly account for socioeconomic status compared to census tracts and block groups in Rhode Island and Massachusetts (Krieger *et al.* 2002). However, this was found for cancer incidence rates only; zip codes worked well for all-cause mortality rates. Nonetheless, Latino ethnic density has been shown to provide benefits among Latinos in larger geographic areas (Shaw *et al.* 2010, Jenny *et al.* 2001). Third, our dataset did not allow us to determine ethnic origin for US-born Latinos. Therefore, we could not study ethnic congruency in this group. Fourth, as mentioned previously, we did not have data on individual-level SES and were unable to adjust for this in the analysis. However, Latino ethnic density has been found to be an independent predictor of mortality among Latinos after controlling for individual-level SES (Eschbach *et al.* 2004). Fifth, we did not have information on how long cases lived at the reported zip code. Thus, we were unable to determine the length of time that cases were exposed to the ethnic density level used in the analysis. Sixth, there is a possibility that Latinos who become ill return to their home country. This would cause incomplete death data for foreign-born Latinos and underestimate mortality rates for this group. There is no reason to believe that back-migration differs by ethnic density level and therefore this only limits our study of disparities by birth country/region. Even so, research suggests that the apparent mortality advantage of foreign- versus US-born Latinos does not hold for Latinos with HIV/AIDS (Ruiz, Steffen and Smith 2013). Finally, our findings may not be generalizable to the foreign-born US Latino population as our sample of foreign-born Latinos was predominantly Cuban. However, the diversity of Florida's Latino population allowed us to examine Latinos of varying birth countries/regions. Additionally, using a Florida sample allowed us to study high levels of ethnic density because 20% of ZCTAs were comprised of 25% Latinos or more (US Census Bureau 2014).

It is important that future ethnic density research is able to incorporate information on the length of time a case is exposed to a particular neighborhood, as well as mobility patterns of the population under study. Additionally, the level of interaction with neighbors, involvement with community events, and availability and access to structural resources are important considerations. Future HIV/AIDS and ethnic density research would benefit from information regarding levels of community HIV/AIDS knowledge and stigma, and neighborhood HIV/AIDS resources.

To our knowledge, this study is the first to examine the role of ethnic density in mortality among HIV-positive Latinos. Results suggest that HIV-positive Latinos do not benefit from the protective effect of Latino ethnic density. Many ethnic density studies have been conducted among Mexican-Americans (Eschbach *et al.* 2004, Jenny *et al.* 2001, Peak and Weeks 2002, Patel *et al.* 2003, Do *et al.* 2007, Kulis *et al.* 2007, Reyes-Ortiz *et al.* 2009). Our findings suggest that research should be conducted in all Latino ethnic groups to improve external validity of findings. Furthermore, research should focus on measuring the association between ethnic density and other HIV/AIDS outcomes (e.g., HIV testing, access to treatment), and evaluating if stigma or other mechanisms, such as acculturation and length of time in the US, may play a role. Results from such studies may lead to community-level interventions to utilize Latino ethnic density as a tool to understand and improve health among HIV-positive Latinos. Community involvement in HIV/AIDS related organizations and events has proven to decrease stigma, depression and loneliness in HIV-positive Latinos (Ramirez-Valles *et al.* 2005) and may be a starting point for future interventions.

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TABLE 1

Latinos age 13 and older diagnosed with HIV infection by birth country/region and selected characteristics, Florida, 2005–2008

	All Latinos	U.S.-born Latino	Puerto Rico	Mexico	Cuba	Central America	South America [b]	Other [c]
Total (n) [a]	**4649**	**1506 (32.4%)**	**396 (8.5%)**	**324 (7.0%)**	**754 (16.2%)**	**480 (10.3%)**	**595 (12.8%)**	**594 (12.8%)**
Individual-level variables, n (%)								
Year of HIV diagnosis								
2005	1162 (25.0)	382 (25.4)	90 (22.7)	80 (24.7)	200 (26.5)	124 (25.8)	174 (29.2)	112 (18.9)
2006	1122 (24.1)	366 (24.3)	105 (26.5)	88 (27.2)	162 (21.5)	121 (25.2)	144 (24.2)	136 (22.9)
2007	1225 (26.4)	385 (25.6)	111 (28.0)	88 (27.2)	183 (24.3)	119 (24.8)	159 (26.7)	180 (30.3)
2008	1140 (24.5)	373 (24.8)	90 (22.7)	68 (21.0)	209 (27.7)	116 (24.2)	118 (19.8)	166 (28.0)
Sex at birth								
Male	3714 (79.9)	1,140 (75.7)	280 (70.7)	284 (87.7)	692 (91.8)	345 (71.9)	502 (84.4)	471 (79.3)
Female	935 (20.1)	366 (24.3)	116 (29.3)	40 (12.4)	62 (8.2)	135 (28.1)	93 (15.6)	123 (20.7)
Age group at diagnosis								
13–19 years	114 (2.5)	67 (4.5)	8 (2.0)	8 (2.5)	7 (0.9)	11 (2.3)	8 (1.3)	5 (0.8)
20–39 years	2381 (51.2)	787 (52.3)	167 (42.2)	217 (67.0)	301 (39.9)	328 (68.3)	327 (55.0)	254 (42.8)
40–59 years	1925 (41.4)	599 (39.8)	196 (49.5)	88 (27.2)	373 (49.5)	131 (27.3)	241 (40.5)	297 (50.0)
60 years or older	229 (4.9)	53 (3.5)	25 (6.3)	11 (3.4)	73 (9.7)	10 (2.1)	19 (3.2)	38 (6.4)
Mode of transmission								
IDU	267 (5.7)	125 (8.3)	77 (19.4)	8 (2.5)	19 (2.5)	6 (1.3)	10 (1.7)	22 (3.7)
MSM	2483 (53.4)	772 (52.3)	146 (36.9)	151 (46.6)	523 (69.4)	209 (43.5)	401 (67.4)	281 (47.3)
MSM/IDU	129 (2.8)	48 (3.2)	20 (5.1)	7 (2.2)	25 (3.3)	11 (2.3)	10 (1.7)	8 (1.4)
Heterosexual	1164 (25.0)	386 (25.6)	117 (29.6)	90 (27.8)	133 (17.6)	180 (37.5)	111 (18.7)	147 (24.8)
Other/unknown	606 (13.0)	175 (11.6)	36 (9.1)	68 (21.0)	54 (7.2)	74 (15.4)	63 (10.6)	136 (22.9)
HIV-to-AIDS interval								
< 1 month	1072 (23.1)	310 (20.6)	115 (29.0)	113 (34.9)	140 (18.6)	139 (29.0)	107 (18.0)	148 (24.9)
Three-year survival								
Alive	4238 (91.2)	1,394 (92.6)	330 (83.3)	290 (89.5)	668 (88.6)	435 (90.6)	565 (95.0)	556 (93.6)
Length of survival in months								
Median (range)	57 (0–83)	57 (0–83)	55 (0–83)	58 (0–83)	55 (0–83)	57 (0–83)	59 (0–83)	55 (0–83)
Interquartile range	26	25	26	26	29	28	24	24

	All Latinos	U.S.-born Latino	Puerto Rico	Mexico	Cuba	Central America	South America [b]	Other [c]
Total (n) [a]	**4649**	**1506 (32.4%)**	**396 (8.5%)**	**324 (7.0%)**	**754 (16.2%)**	**480 (10.3%)**	**595 (12.8%)**	**594 (12.8%)**
ZCTA-level variables, n (%)								
Percent of population below poverty line (average 2007–2011), quartiles								
<8.7	339 (7.3)	127 (8.4)	29 (7.3)	21 (6.5)	31 (4.1)	22 (4.6)	50 (8.4)	59 (9.9)
8.7–12.9	993 (21.4)	325 (21.6)	79 (20.0)	59 (18.2)	150 (19.9)	74 (15.4)	153 (25.7)	153 (25.8)
13.0–19.3	1569 (33.8)	503 (33.4)	140 (35.4)	107 (33.0)	257 (34.1)	120 (25.0)	267 (44.9)	175 (29.5)
≥19.4	1748 (37.6)	551 (36.6)	148 (37.4)	137 (42.3)	316 (41.9)	264 (55.0)	125 (21.0)	207 (34.9)
Percent of population 16 and older who is unemployed (average 2007–2011), quartiles								
<4.2	779 (16.8)	218 (14.5)	47 (11.9)	36 (11.1)	143 (19.0)	65 (13.5)	169 (28.4)	101 (17.0)
4.2–5.5	886 (19.1)	264 (17.5)	55 (13.9)	62 (19.1)	175 (23.2)	111 (23.1)	113 (19.0)	106 (17.9)
5.6–7.2	1206 (25.9)	400 (26.6)	118 (29.8)	91 (28.1)	212 (28.1)	98 (20.4)	145 (24.4)	142 (23.9)
≥7.3	1778 (38.2)	624 (41.4)	176 (44.4)	135 (41.7)	224 (29.7)	206 (42.9)	168 (28.2)	245 (41.3)
Percent of population 18 years and older that is a high school graduate (average 2007–2011), quartiles								
≥92.1	407 (8.8)	155 (10.3)	33 (8.3)	25 (7.7)	21 (2.8)	32 (6.7)	69 (11.6)	72 (12.1)
86.9–92.0	828 (17.8)	313 (20.8)	76 (19.2)	49 (15.1)	76 (10.1)	55 (11.5)	146 (24.5)	113 (19.0)
80.4–86.8	1382 (29.7)	483 (32.1)	126 (31.8)	94 (29.0)	174 (23.1)	103 (21.5)	228 (38.3)	174 (29.3)
<80.4	2023 (43.7)	555 (36.9)	161 (40.7)	156 (48.2)	483 (64.1)	290 (60.4)	152 (25.6)	235 (39.6)
Percent of population who identified themselves as Hispanic/Latino (*ethnic density)*								
≥50	1708 (36.7)	426 (28.3)	95 (24.0)	72 (22.2)	502 (66.6)	222 (46.3)	208 (35.0)	183 (30.8)
25–49	1338 (28.8)	427 (28.4)	129 (32.6)	86 (26.5)	191 (25.3)	121 (25.2)	197 (33.1)	187 (31.5)
<25	1603 (34.5)	653 (43.4)	172 (43.4)	166 (51.2)	61 (8.1)	137 (28.5)	190 (31.9)	224 (37.7)
Congruent Latino origin for foreign born individuals [d]								
No	1541 (33.2)	---	242 (61.1)	182 (56.2)	225 (29.8)	480 (100)	412 (69.2)	---
Yes	1008 (21.7)		154 (38.9)	142 (43.8)	529 (70.2)	0 (0)	183 (30.8)	

ZCTA, zip code tabulation area; IDU, injection drug use; MSM, male to male sexual contact. Percentage may not add up to 100 due to rounding.

[a]Excludes cases diagnosed in a correctional facility (n=106), missing residential zip code at time of HIV diagnosis (n=282), missing month of HIV diagnosis (n=9), or diagnosed under the age of 13 (n=14)

[b]Includes 102 individuals reported as “Hispanic/Latino” and born in Brazil

[c]Individuals born in the Dominican Republic are included in the other Latino category (n=68)

[d]Excludes U.S.-born Latinos and Latinos born in other Latino category

TABLE 2

Weighted multi-level Cox regression hazard ratios and 95% confidence intervals for mortality among Latinos reported with HIV by birth country/region, 2005–2011

	aHR [a]							
	All Latinos	**U.S.-born Latino**	**Puerto Rico**	**Mexico**	**Cuba**	**Central America**	**South America**	**Other**
Individual-level variables								
Year of HIV diagnosis								
2005	1.49 (1.11–2.01)	1.32 (0.75–2.39)	1.07 (0.55–2.12)	3.72 (0.90–26.00)	1.55 (0.81–3.08)	1.45 (0.60–3.65)	4.25 (1.08–29.23)	2.35 (0.86–7.13)
2006	1.29 (0.95–1.76)	1.48 (0.85–2.68)	0.74 (0.36–1.53)	2.94 (0.72–20.36)	0.94 (0.45–1.95)	1.31 (0.53–3.33)	2.22 (0.48–16.01)	1.44 (0.50–4.45)
2007	1.44 (1.06–1.97)	1.45 (0.80–2.67)	0.93 (0.47–1.88)	4.26 (1.06–29.36)	1.57 (0.82–3.10)	1.09 (0.42–2.83)	1.97 (0.42–14.39)	2.21 (0.84–6.51)
2008	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Sex at birth								
Male	1.04 (0.81–1.33)	1.10 (0.70–1.72)	0.58 (0.34–0.99)	8.37 (1.64–156.32)	1.38 (0.64–3.24)	1.19 (0.46–3.19)	2.13 (0.54–9.58)	0.56 (0.26–1.20)
Female	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Age at diagnosis (continuous/ 5 unit increase)	1.26 (1.22–1.31)	1.31 (1.23–1.41)	1.26 (1.13–1.41)	1.06 (0.89–1.24)	1.51 (1.38–1.65)	1.02 (0.87–1.19)	1.03 (0.84–1.25)	1.18 (1.03–1.35)
Mode of transmission								
Heterosexual	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
IDU [b]	1.94 (1.45–2.59)	1.32 (0.81–2.14)	1.78 (1.01–3.16)	N/A[c]	3.06 (1.31–6.82)	N/A[c]	0.99 (0.04–7.44)	1.44 (0.39–4.20)
MSM	0.79 (0.60–1.03)	0.56 (0.34–0.93)	1.54 (0.77–3.13)	0.27 (0.10–0.70)	1.19 (0.66–2.26)	2.29 (0.87–6.75)	0.71 (0.23–2.69)	0.51 (0.20–1.29)
Other/unknown	0.90 (0.67–1.21)	0.65 (0.36–1.12)	0.42 (0.14–1.02)	0.65 (0.25–1.61)	0.83 (0.34–1.87)	5.33 (2.12–14.24)	0.89 (0.21–3.49)	0.59 (0.24–1.36)
HIV-to-AIDS interval								
< 1 month	2.86 (2.38–3.43)	2.41 (1.70–3.38)	2.77 (1.79–4.29)	2.14 (0.99–4.69)	3.54 (2.26–5.51)	4.03 (2.20–7.55)	3.29 (1.46–7.21)	2.71 (1.44–5.08)
> 1 month	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
ZCTA-level variables								
Percent of population below poverty line (average 2007–2011) (continuous / 5 unit increase)	1.14 (1.09–1.20)	1.05 (0.96–1.15)	1.21 (1.08–1.34)	1.08 (0.88–1.32)	1.12 (1.00–1.25)	1.18 (1.01–1.37)	1.39 (1.12–1.70)	1.07 (0.88–1.28)
Percent of population who identified themselves as Hispanic/ Latino (*ethnic density)*								
≥ 50	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent

	aHR [a]							
	All Latinos	**U.S.-born Latino**	**Puerto Rico**	**Mexico**	**Cuba**	**Central America**	**South America**	**Other**
25–49	0.88 (0.70–1.10)	0.88 (0.56–1.39)	0.61 (0.36–1.02)	0.73 (0.19–2.66)	1.19 (0.72–1.90)	0.55 (0.23–1.18)	1.05 (0.42–2.59)	0.65 (0.28–1.45)
<25	0.95 (0.76–1.18)	1.04 (0.70–1.56)	0.60 (0.37–0.99)	1.14 (0.39–3.59)	1.22 (0.50–2.55)	0.44 (0.17–1.05)	0.97 (0.38–2.43)	0.92 (0.44–1.96)

ZCTA, zip code tabulation area; IDU, injection drug use; MSM, male to male sexual contact; HR, hazard ratio; aHR adjusted hazard ratio; CI, confidence interval.

[a] aHR adjusted for all variables in the column

[b] IDU and IDU/MSM categories have been combined to address small cell numbers

[c] Estimate not available due to small numbers of Latinos from that country of birth with IDU as a mode of HIV transmission

TABLE 3

Weighted multi-level Cox regression hazard ratios and 95% confidence intervals for mortality among Latinos reported with HIV by birth country/region, Florida, 2005–2011

	Model 1 HR (95% CI)	Model 2 aHR (95% CI)	Model 3 aHR (95% CI)	Model 4 aHR (95% CI)
United States	Referent	Referent	Referent	Referent
Puerto Rico	2.71 (2.09–3.51)	1.99 (1.53–2.59)	2.00 (1.53–2.59)	2.00 (1.53–2.59)
Mexico	0.97 (0.64–1.41)	1.01 (0.67–1.49)	0.89 (0.59–1.32)	0.90 (0.59–1.32)
Cuba	1.26 (0.96–1.64)	1.21 (0.92–1.59)	1.15 (0.87–1.52)	1.14 (0.85–1.52)
Central America	0.96 (0.68–1.34)	1.08 (0.75–1.51)	0.95 (0.67–1.34)	0.95 (0.66–1.34)
South America	0.50 (0.33–0.73)	0.57 (0.37–0.83)	0.60 (0.40–0.89)	0.60 (0.40–0.89)
Other	0.74 (0.52–1.04)	0.66 (0.46–0.93)	0.67 (0.47–0.94)	0.67 (0.47–0.94)

HR, crude hazard ratio; aHR adjusted hazard ratio; CI, confidence interval.

Model 1: Model includes country/region of birth only

Model 2: Model includes country/region of birth and demographic variables (year of HIV diagnosis, sex at birth, age [continuous], mode of transmission, HIV-to-AIDS interval)

Model 3: Model includes country/region of birth, demographic variables and ZCTA-level poverty (continuous)

Model 4: Model includes country/region of birth, demographic variables, ZCTA-level poverty (continuous), and ZCTA-level ethnic density (continuous)