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Article

Racial disparities in mortality in the adult hispanic population

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ABSTRACT

Objective: We addressed three research questions: (1) Are there racial mortality disparities in the adult Hispanic population that resemble those observed in the non-Hispanic population in the US? (2) Does nativity mediate the race-mortality relationship in the Hispanic population? and (3) What does the Hispanic mortality advantage relative to the non-Hispanic white population look like when Hispanic race is considered?
Methods: We estimated a series of parametric hazard models on eight years of mortality follow-up data and calculated life expectancy estimates using the Mortality Disparities in American Communities database.
Results: Hispanic white adults experience lower mortality than their Hispanic black, American Indian and Alaska Native, Some Other Race, and multiple race counterparts. This Hispanic white advantage is found mostly among the US born. The Hispanic advantage relative to the non-Hispanic white population operates for most Hispanic race groups among the foreign born but either disappears or converts to a disadvantage for most of the non-white Hispanic groups among the US born.
Contribution: Our study extends the literature on the Hispanic Mortality Paradox by revealing that the adult Hispanic population experiences racial mortality disparities that closely resemble those observed in the non-Hispanic population. The Hispanic mortality advantage is mediated not only by nativity but by race. These results indicate that race is a critical factor that should be considered in any study with the goal of understanding the health and mortality profiles of the Hispanic population in the US.

1. Introduction

Hypotheses posited to explain the "Hispanic Mortality Paradox" have been tested and explored for over thirty years since the first study described the paradoxical finding that the Hispanic population in the southwestern US had similar health outcomes to the non-Hispanic white population despite the former's lower socioeconomic status (Markides & Coreil, 1986). Subsequent research expanded on this finding revealing that the "Hispanic Mortality Paradox" is defined not by similar but better mortality outcomes in the Hispanic relative to the non-Hispanic white population (Markides & Eschbach, 2011). While no one hypothesis that completely explains the Hispanic mortality advantage has been identified, we have learned a great deal along the way. Research has revealed that the Hispanic mortality advantage is greater among the foreign born than the US born and that only a small portion can be explained by return migration among the foreign born (Palloni & Arias, 2004; Turra & Elo, 2008; Riosmena, Wong, & Palloni, 2013). Further, the mortality advantage, identified through vital statistics, survey-mortality linked data, and administrative data, cannot be explained by poor data quality (Arias, 2010; Arias, Heron, & Hakes, 2016). Part of the advantage can be explained by the lower smoking prevalence among Hispanic adults, mostly among the foreign born (Blue & Fenelon, 2011). Finally, research has revealed that the Hispanic mortality advantage appears to dissipate with time and acculturation into US culture (Markides & Eschbach, 2011; Riosmena, Everett, Rogers, & Dennis, 2015; Riosmena, Kuhn, Jochem, & Jochem, 2017).

The terms "Hispanic" or "Latino," created in the United States to classify members of a population who share a common language, mask the great diversity of the people these terms classify (Ennis, Rios-Vargas, & Albert, 2011). Persons classified as Hispanic or Latino in the US have origins in many different countries representing diverse cultural, economic, social and political characteristics, and diverse histories of immigration and patterns of assimilation and acculturation into US culture (Arias, 2001; Portes & Zhou, 1993). Hispanic persons descend mainly from the three distinct founding populations of the modern Americas; Native American, European and African, with differing

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proportions from each and varying degrees of admixture across the different Latin American countries (Gonzalez Burchard, Borrell, Choudhry, et al., 2005; Henry-Sanchez & Geronimus, 2013; Perreira & Telles, 2014). These societies have histories of colonization very much in common with the US experience particularly with respect to the emergence of racial hierarchies where white Europeans are at the top of the hierarchy and indigenous and African origin populations are at the bottom (Henry-Sanchez & Geronimus, 2013). Studies that have attempted to decipher the causes of the Hispanic adult mortality advantage have recognized and explored the role of country of origin, nativity status, cultural characteristics, and assimilation and/or acculturation processes (Markides & Eschbach, 2005).

However, an important characteristic that has been mostly ignored in the literature about the adult Hispanic mortality advantage is race (Henry-Sanchez & Geronimus, 2013). Given the well-established racial disparities in mortality outcomes observed in the non-Hispanic US population, the omission is a serious one, especially in light of the findings of a growing number of studies showing Hispanic persons who identify as black or have dark skin have poorer health outcomes than white or light skinned Hispanic persons (Chinn & Hummer, 2016; Borrell & Crawford, 2006; Borrell, 2005; Borrell, 2006; Borrell & Dallo, 2008; Gonzalez Burchard, Borrell, & Choudhry, 2005; Borrell, Crawford, & Dallo, 2007; Landale & Oropesa, 2005). To the best of our knowledge, only one study has explored the role of race in adult Hispanic mortality outcomes in the US (Borrell & Crawford, 2009). Focusing on black/-white disparities, the authors found the Hispanic mortality advantage relative to the non-Hispanic white population at ages 65 and older was present only among Hispanic adults who identified racially as white (Borrell & Crawford, 2009).

In this article we explore the relationship between race and mortality within the adult Hispanic population in greater detail than previously done by disaggregating the population into all US standard racial categories permitted by sample size limitations. We examine how nativity mediates the race-mortality relationship and how race mediates the "Hispanic Mortality Paradox." We used the Mortality Disparities in American Communities (MDAC), a database comprised of the full U.S. Census Bureau's 2008 American Community Survey (ACS), which is a representative sample of the entire US population, including the institutionalized, linked to US National Vital Statistics System (NVSS) mortality data for years 2008 through 2015. With over 4.2 million person records and 308,000 deaths, the MDAC allowed us to include all US standard race categories, with minor modifications, in our analysis. We estimated parametric hazard models for the eight-years of mortality follow-up of the Hispanic population aged 25 and older. In the models we controlled for Hispanic country/region of origin, demographic characteristics, socioeconomic status, and nativity. We also estimated life expectancy at age 25 by Hispanic origin and race.

1.1. Background

The latest US mortality statistics continue to show large racial disparities within the non-Hispanic population. For example, in 2017, the infant mortality rate (IMR) for the non-Hispanic black and the non-Hispanic American Indian and Alaska Native (AIAN) populations was 2.3 and 2.0 times higher, respectively, than that of the non-Hispanic white population (10.97 and 9.21 vs. 4.67) (Ely & Driscoll, 2019). A more comprehensive measure of mortality, life expectancy at birth, also reveals pronounced racial disparities, with the non-Hispanic AIAN and non-Hispanic black populations having a life expectancy at birth 7.3 and 3.6 years lower, respectively, than that of the non-Hispanic white population (Arias and Xu, 2019; Arias, Xu, & Jim, 2014).

Research into the causes of these racial mortality disparities has revealed that differences in socioeconomic status explain a large part but not all the observed differences (Priest & Williams, 2017; Williams, 1999; Williams & Collins, 1995; Williams & Mohammed, 2009). There is evidence that racial discrimination may be a key explanatory factor in observed, persistent, racial disparities in health and mortality outcomes in the US (Cuevas, Araujo Dawson, & Williams, 2016; Priest & Williams, 2017). Some researchers have proposed that "in color conscious American society, skin color may be an important determinant of the degree of exposure to racial discrimination, access to valued resources and the intensity of the effort necessary to obtain them" (Williams & Collins, 1995), all with deleterious effects on health (Dressler, 1993; Frank, Redstone Akresh and Lu, 2010). There is no reason to believe that black or dark-skinned Hispanic persons do not experience the same degree of racial discrimination as their non-Hispanic counterparts. In fact, some research has shown that Hispanic immigrants experience "skin-color-based" labor force discrimination (Frank, Redstone Akresh, & Lu, 2010; Frank, Redstone Akresh, and Lu, 2010).

An important question therefore is whether there is something about Hispanic/Latino ethnicity that conveys protection against the negative effects of racially-based discrimination on health and mortality outcomes. A growing number of studies about the role of race in health outcomes in the Hispanic population concur that there appears to be no global Hispanic ethnicity protection. These studies show that there are large racial health disparities, net of socioeconomic status and pertinent demographic characteristics, within the Hispanic population in the US (Chinn & Hummer, 2016; Cuevas et al., 2016).

Most studies exploring the relationship between race and health outcomes in the Hispanic population have focused on black/white disparities. The findings of these studies have consistently shown that black Hispanic persons experience worse physical and mental health outcomes than do their Hispanic white counterparts and that the disparities mirror those observed between non-Hispanic black and white persons (Cuevas et al., 2016). Two studies, one using the National Health Interview Survey and one the Behavioral Risk Factor Surveillance System, both found that Hispanic black adults were more likely to report their health status as fair/poor than both Hispanic and non-Hispanic white adults (Borrell et al., 2007; Borrell & Dallo, 2008). Exploring the prevalence of hypertension, Borrell, 2006 similarly found that Hispanic black adults reported higher levels of hypertension than their Hispanic white counterparts even when the comparison was between high income/education Hispanic black and low income/education Hispanic white adults (Borrell, 2006). A study of mental health outcomes among Hispanic adolescents found that Hispanic black adolescent females experienced higher levels of depressive symptoms than females of any other race/-ethnicity, while Hispanic black adolescent males had higher levels of negative affect than their Hispanic white counterparts (Ramos, Jaccard, & Guilamo-Ramos, 2003). One study found that Hispanic white women experienced better functional health outcomes than Hispanic black or other race women (Chinn & Hummer, 2016).

To our knowledge, only two studies have explored the role of race in mortality outcomes within the Hispanic population in the U.S. One focusing on infant mortality found that patterns of infant mortality within the Hispanic population mirrored those observed within the non-Hispanic population. For example, the authors found the infant mortality rate among Hispanic black infants was 1.8 times that of Hispanic white infants in the 1995–1999 period (Henry-Sanchez & Geronimus, 2013). The other study compared Hispanic white and Hispanic black mortality outcomes to those of non-Hispanic white adults ages 25 and older (Borrell & Crawford, 2009). The results of this study are mixed. Both Hispanic black and white persons ages 25–44 had higher risks of death than their non-Hispanic white counterparts while mortality was lower for Hispanic white men and women ages 65 and older compared to their non-Hispanic white counterparts. The authors found no difference in mortality between Hispanic black and non-Hispanic white adults ages 65 and older (Borrell & Crawford, 2009).

The findings described above demonstrate that the role of race in Hispanic health and mortality outcomes is important. These studies, however, are limited in important ways. First, a majority of the studies exploring racial disparities in health outcomes are based on self-reported health status and/or conditions. There is evidence that self-report varies

by race/ethnicity and may be biased (Shetterly, Baxter, Mason, & Hamman, 1996). Second, most of the health outcome studies have focused mostly on the Hispanic white and black sub-populations. While the results of these studies are of paramount value, they ignore large segments of the Hispanic population. A considerable proportion of the Hispanic population does not identify as either white or black. For example, according to the 2010 decennial census 36.7% of the Hispanic population did not identify with any of the five standard US racial categories and 6% identified with two or more of the five categories. In comparison, 2.5% identified as black and 53% as white (Ennis et al., 2011). The former two groups likely fall somewhere between the white and black dichotomy and face some degree of discrimination based on phenotype and skin color (Frank, Redstone Akresh, & Lu, 2010). A non-negligible percentage (1.4%) of the Hispanic population identified as AIAN, a population with some of the worse health and mortality profiles of any population in the US (Arias et al., 2014; Espey et al., 2014).

Premised on this background information, we addressed three questions: (1) Are there racial mortality disparities in the adult Hispanic population that resemble those observed in the non-Hispanic population in the US? (2) Does nativity mediate the race-mortality relationship in the Hispanic population? and (3) What does the Hispanic mortality advantage relative to the non-Hispanic white population look like when Hispanic race is considered?

2. Materials and methods

2.1. Data source

The MDAC is a database consisting of the full 2008 American Community Survey (ACS) linked to National Vital Statistics System (NVSS) mortality data for years 2008 through 2015. It contains over 4,171,000 person records with more than 308,000 deaths (U.S. Census Bureau, 2017). The ACS is a nationally representative sample that replaced the 17% decennial Census long form beginning with the 2000 census and includes persons living in both housing units and group quarters. Detailed information about demographic, economic, social, and housing characteristics of the population is collected via internet/mail, telephone, or personal interviews (U.S. Census Bureau, 2014). The 2008 ACS includes approximately 4.5 million person records and had a response rate of 97.8% for housing units and 98.0% for group quarters (U.S. Census Bureau, 2014).

Mortality status was ascertained through linkage of the 2008 ACS records that met the minimum requirement (record contained at least one of three combinations of Social Security Number (SSN), first name, last name, and date of birth) to match to the National Death Index (NDI) database housed at the National Center for Health Statistics (NCHS) (NCHS, 2018). The NDI is a centralized database of death record information, including date and cause of death, available to researchers for scientific studies (NCHS, 2018). The NDI contains all death records in the US NVSS dating back to 1979 and is updated yearly. ACS records successfully matched to the NDI were linked to their corresponding death certificates, which include decedent demographic characteristics and detailed cause of death information. The success of a match to the NDI is highly dependent on the matching identifiers available in the matching dataset. The SSN has been found to be the most important identifier (Cowper, Kubal, Maynard, & Hynes, 2002). Ninety-five percent of ACS records in MDAC have an SSN, making the matching rate excellent overall. However, there is non-negligible variation in the availability of SSN by ethnicity, nativity and age, which we account for in our statistical analyses described below.

2.2. Methods

The sample of Hispanic adults ages 25 and older in the MDAC total 274,000 with 12,500 deaths and the sample of non-Hispanic white adults total 2,294,000 with 250,000 deaths. We used the original unimputed race variable in the ACS to generate race categories consistent with the Office of Management and Budget (OMB) 1997 "Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity" (Office of Management and Budget, 1997). The categories include white, black, AIAN, Asian and Pacific Islander (API), Multiple Race, and Some Other Race (SOR). Because of their small sample sizes, the Asian and Native Hawaiian and Other Pacific Islander (NHOPI) groups were combined to form a single API category. The 1997 revision allowed for the selection of more than one race category so ACS respondents who selected more than one race were grouped into the Multiple Race category. According to the OMB standards, race and ethnicity (Hispanic origin) are distinct and separate concepts where persons with origins in Latin America or any other Spanish culture, regardless of race, are classified as Hispanic or Latino (Office of Management and Budget, 1997). We used the following country/region of origin categories to classify Hispanic sub-groups: Cuban, Dominican, Puerto Rican, Mexican, Central American, South American and Other Hispanic. The number of deaths in the MDAC sample by Hispanic origin, race and sex are presented in Panel 1 of Table 1.

We fit a series of Gompertz hazard models for Hispanic adults ages 25 and older at baseline under the assumption that the Gompertz distribution represents well adult mortality for ages 25 and above. The Gompertz hazard models are defined as:

$$h(t|X_i;Z_i) = \alpha exp^{(\gamma t)} exp^{\delta(X_i-25)}\ exp^{(\beta Z_i)}$$

where, $h(t|X_i;Z_i)$ is the hazard rate t years after the start of the study for an individual aged X_i with characteristics Z_i at the start of the study. Age is rescaled to $X_i - 25$ so that the Gompertz constant, α, reflects the mortality rate at age 25; γ is an ancillary parameter representing the slope of mortality increase over time; δ is the parameter representing the effect of age; and β_i are the effect parameters of all other characteristics included as controls in the models, Z_i. The covariates include Hispanic country/region of origin, marital status, education, household income, nativity and duration of residence in the US for the foreign-born. We included a control for country/region of origin in addition to the standard demographic and socioeconomic characteristics known to be associated with mortality because the racial composition of the various Latin American countries/regions varies and to ensure the effects of race in the models are not exclusively reflecting the Mexican case.

We estimated the models separately by sex to account for gender differences in immigration and assimilation patterns and social and economic experiences in the US and for the sake of consistency with previous studies on adult Hispanic mortality (Palloni & Arias, 2004). We first estimated a model with controls for nativity status and based on the results we estimated the models separately by nativity status. We define nativity as US born if born in any of the 50 states and the District of Columbia and foreign born if born in another country, including Puerto Rico. We define nativity in this way to be consistent with previous research on Hispanic mortality (Palloni & Arias, 2004). While the Puerto Rican population is technically US born, research has shown differences in mortality between those who live on the island and those who have immigrated to or were born in the US mainland (Rosenwaike, Hempstead, & Rogers, 1991).

To control for the possible biasing effect of data artifact in the form of ethnic differences in match rates in the ACS-NDI linkage algorithm, we control for whether the ACS record had an SSN. We found that ACS-NDI match rates differ by the availability of SSN such that the match rate is 1.9% for records missing SSN and 11.7% for records with SSN. This match rate differential is of particular interest in the evaluation of Hispanic mortality using survey-mortality linked data because the Hispanic population has a lower prevalence of SSN reporting in national surveys and very common first and last names (Lariscy, 2011). Panel 2 of Table 1 shows that ACS records for Hispanic persons, regardless of race, are less likely to have SSN than those of non-Hispanic white persons and that

Table 1
Select study sample characteristics.

	Non-Hispanic White	Hispanic White	Hispanic Black	Hispanic AIAN[a]	Hispanic API[b]	Hispanic Multiple Race	Hispanic Some Other Race[c]
Panel 1: Death Counts by Hispanic Origin, Race, Sex, and Nativity for Population 25 and Older							
Sex							
Male	122,000	4,600	150	100	30	150	1,200
Female	128,000	4,400	100	50	30	150	1,100
Nativity							
US Born	241,000	4,500	100	100	30	150	1,600
Foreign Born	9,700	4,500	150	30	30	80	1,800
Panel 2: Percentage of MDAC records without Social Security Number by Hispanic Origin, Race, Age and Nativity for the Population 25 and Older							
Age							
25 and Older	4.6	20.1	15.3	17.8	9.1	11.8	22.5
25-44	4.8	28.1	18.8	23.5	11.4	14.1	29.0
45-64	4.4	12.8	12.3	12.2	5.6	8.8	13.6
65 and Older	4.6	8.2	8.4	6.2	9.9	7.7	10.4
Nativity							
US Born	4.4	7.7	9.2	6.5	6.3	6.4	8.6
Foreign Born	8.3	29.1	19.8	36.7	11.9	20.8	30.6

Notes: Sample Ns have been rounded as per the Census Bureau's Disclosure Review Board (DRB) to ensure that no confidential information is disclosed. The DRB release number is CBDRB-FY19-091.
[a] American Indian and Alaska Native.
[b] Asian and Pacific Islander.
[c] Some Other Race includes a responses other than one of the five OMB categories and no response (Unknown).
Source: Mortality Disparitites in American Communities (MDAC). Percentages are for unweighted records.

there is great variation by nativity and age. ACS records for foreign born and younger Hispanic persons are less likely to have an SSN.

Finally, to put the results of the Gompertz models in a more understandable metric and assess their validity we estimated life expectancy at age 25 based on the sample marginal death rates over the eight-year mortality follow-up period by Hispanic origin, race, nativity status and sex.

3. Results

3.1. Demographic and socioeconomic characteristics of the adult hispanic population

Table 2 presents the distribution of un-imputed race by country/region of origin and nativity for the Hispanic population ages 25 and older in the MDAC. The last column in the table shows the distribution of the

Table 2
Percentage distribution of race by country of origin and nativity for the hispanic population ages 25 and older.

Race	White	Black	AIAN	API	MR	SOR	UK	Total
Country/Region of Origin								
Cuban	87.8	3.3	0.1	0.2	1.2	5.2	2.2	**4.4**
Dominican	31.5	11.1	0.5	0.5	3.3	46.4	6.6	**3.0**
Puerto Rican	54.7	4.7	0.5	0.8	3.2	27.8	8.3	**9.3**
Mexican	61.6	0.5	0.9	0.3	1.4	29.3	6.2	**61.8**
Central American	51.8	2.8	0.7	0.4	1.9	36.9	5.6	**9.1**
South American	67.7	1.2	0.3	0.5	2.1	23.5	3.0	**7.1**
Other Hispanic	61.3	1.5	1.7	2.2	4.7	20.7	8.0	**5.3**
Total Hispanic	**60.7**	**1.6**	**0.8**	**0.5**	**1.9**	**28.4**	**6.2**	**100.0**
US Born								
Cuban	82.0	5.0	0.4	0.4	2.9	6.1	3.2	**2.5**
Dominican	35.2	14.7	0.4	0.7	4.8	36.9	7.4	**1.0**
Puerto Rican	52.3	6.0	0.7	1.2	4.3	27.6	7.9	**12.4**
Mexican	65.1	0.7	1.2	0.4	2.4	22.8	7.5	**69.1**
Central American	53.6	7.6	0.8	0.4	1.9	36.9	5.6	**1.9**
South American	68.0	1.9	0.4	0.9	4.1	19.3	5.3	**2.2**
Other Hispanic	63.4	1.2	1.9	1.4	5.1	19.8	7.4	**10.9**
Total Hispanic	**63.1**	**1.8**	**1.2**	**0.6**	**3.0**	**23.0**	**7.3**	**100.0**
Foreign Born								
Cuban	89.3	2.8	0.0	0.2	0.7	5.0	2.0	**5.6**
Dominican	30.9	10.7	0.6	0.5	3.1	47.8	6.4	**4.1**
Puerto Rican	57.1	3.4	0.3	0.4	2.2	28.1	8.6	**7.5**
Mexican	59.0	0.3	0.7	0.2	0.7	33.9	5.3	**57.5**
Central American	51.6	2.4	0.6	0.3	1.8	37.6	5.6	**13.4**
South American	67.6	1.1	0.3	0.4	1.9	24.0	4.7	**10.0**
Other Hispanic	54.4	2.3	0.8	5.2	3.0	23.7	10.6	**2.0**
Total Hispanic	**59.2**	**1.5**	**0.5**	**0.4**	**1.2**	**31.7**	**5.5**	**100.0**

SOR: Some Other Race; MR: Multiple Race, UK: Unknown.
All estimates are weighted using MDAC sample weights.
Source: Mortality Disparities in American Communities (MDAC).

Hispanic population by country/region of origin. The Mexican origin population is the largest adult Hispanic population (61.8%), followed by the Puerto Rican (9.3%), Central American (9.1%), South American (7.1%), Other Hispanic (5.3%), Cuban (4.4%), and Dominican (3.0%) populations. White is the most common race category (60.7%) selected by Hispanic adults, followed by SOR (28.4%), Multiple Race (1.9%), black (1.6%), AIAN (0.8%), and API (0.5%). Another 6.2% of the adult Hispanic population did not respond to the question about race (Unknown).

The distribution of race varied markedly across the indicated countries/regions of origin. The percentage white ranged from 31.5% for the population of Dominican origin to 87.8% for the population of Cuban origin. The percentage SOR ranged from 5.2% among the Cuban population to 46.4% among the Dominican population. The percentage black ranged from 0.5% among the Mexican population to 11.1% among the Dominican population. Multiple Race ranged from 1.2% among the Cuban population to 4.7% among Other Hispanic; AIAN ranged from 0.1% among Cuban to 1.7% among Other Hispanic; and, similarly, API ranged from 0.2% among Cuban to 2.2% among Other Hispanic. Unknown race ranged from 2.2% among the Cuban origin population to 8.3% among the population of Puerto Rican origin.

There was some notable variation in the distribution of race by nativity for the total Hispanic population and across all country/region origin groups. For the total, a higher percentage of the US born selected one or more of the OMB standard choices (69.7%) than the foreign born (62.8%). The greatest difference was found among the Dominican origin population, with 55.7% among the US born and 45.8% among the foreign born selecting one or more of the standard five categories. The smallest difference was observed among the Central American population, with 57.5% among the US born vs 56.8% among the foreign born selecting one of the standard categories. The higher percentages in choice of one of the standard race categories among the US born may reflect a process of racialization whereby Hispanic persons assume the racial identities prescribed to them by the larger American society based on their physical appearance, a process more readily internalized by the US born than the foreign born (Henry-Sanchez & Geronimus, 2013).

Table 3 presents descriptive statistics of the Hispanic population ages 25 and older by Hispanic-race categories in comparison to the non-Hispanic white population. Generally, all Hispanic-race groups were younger than the non-Hispanic white population, but the Hispanic-white and Hispanic-black groups were older than other Hispanic-race groups. The percentage married was highest for the Hispanic-white group with percentages very much like those of the non-Hispanic white group. The Hispanic-API group had the highest and the Hispanic-AIAN and Hispanic-SOR groups the lowest educational attainment levels of all the Hispanic-race groups and all had lower educational attainment levels than the non-Hispanic white group. The Hispanic-API and Hispanic-Multiple Race groups had the highest and the Hispanic-black, Hispanic-AIAN and Hispanic-SOR groups had the lowest household income among the Hispanic-race groups, and all, with the exception of Hispanic-API, had lower household income levels than the non-Hispanic white group. With the exception of Hispanic-AIAN and Hispanic-Multiple Race, the proportion foreign born was over 50% among the Hispanic-race groups.

3.2. Mortality risks by race in the adult hispanic population

Table 4 presents the results of the first set of Gompertz hazard models estimated to ascertain whether there are racial disparities in mortality within the Hispanic population ages 25 and older. First, we examine whether the Gompertz distribution adequately reflects the mortality profile of the Hispanic population ages 25 years and older. The results suggest that it does. The Gompertz slope parameters, γ, for both males and females (0.072, 0.079) appropriately reflect increasing mortality over time. Likewise, age effects, δ, show the rates of mortality increase starting at age 25 for males and females (0.082, 0.089) are within the range observed for US male and female populations. Second, the control for whether an MDAC respondent had a social security number (SSN) shows, as expected, substantial differences between those with and without SSN. For example, Hispanic males with SSN had a mortality risk

Table 3
Selected characteristics (%) of the study sample of men and women ages 25 and older:

	Non-Hispanic White		Hispanic White		Hispanic Black		Hispanic AIAN[a]		Hispanic API[b]		Hispanic Multiple Race		Hispanic SOR[c]	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age														
25-64	80.1	75.2	90.0	86.1	90.0	86.8	93.4	91.1	91.1	89.2	93.2	89.9	94.0	90.6
65 and Older	19.9	24.8	10.0	14.0	10.0	13.2	6.6	8.9	9.0	10.8	6.8	10.1	6.0	9.4
Marital Status														
Married	65.6	59.2	61.2	56.3	48.0	36.4	52.7	51.2	56.4	52.8	49.6	46.5	58.3	53.8
Never Married	17.4	11.9	25.2	18.2	34.5	30.6	28.6	19.7	29.3	22.0	33.3	24.4	28.7	22.2
Separated, Divorced or Widowed	16.9	28.9	13.6	25.5	17.5	32.9	18.7	29.1	14.2	25.1	17.1	29.1	13.0	24.0
Educational Attainment														
Less than High School	8.7	8.3	35.9	33.5	25.7	23.9	43.1	34.1	14.8	13.2	22.4	19.7	41.2	38.9
High School Graduate	24.7	27.7	25.8	24.6	27.3	22.6	23.6	22.4	23.7	20.6	24.1	21.4	26.7	24.6
Some College	28.9	31.1	20.6	23.3	26.2	29.4	20.7	28.0	31.7	35.2	29.6	33.7	19.3	22.2
Four Years of College or More	32.1	29.5	13.8	15.2	14.5	19.9	8.5	10.2	24.9	27.4	17.8	20.9	8.7	10.5
Unknown	4.6	3.4	3.8	3.4	6.4	4.3	4.2	5.3	4.9	3.8	6.2	4.4	4.2	3.9
Household Income														
First Quartile	20.4	26.4	30.3	36.8	33.2	43.8	32.3	37.9	19.9	23.5	25.2	30.4	30.2	37.7
Second Quartile	24.1	23.5	28.0	26.4	25.4	25.2	29.6	28.1	21.3	24.3	24.3	23.6	29.1	27.9
Third Quartile	25.8	23.6	22.4	20.2	18.3	17.5	21.0	20.8	24.2	25.9	22.7	24.4	22.5	20.4
Fourth Quartile	27.6	24.4	16.6	15.8	15.0	12.3	12.3	12.4	29.3	25.0	21.4	19.3	14.6	13.2
Unknown	2.1	2.1	2.7	0.8	8.2	1.3	4.9	0.8	5.4	1.2	6.4	2.3	3.6	0.8
Nativity/Length of Residence in US														
US Born	94.9	94.5	37.4	40.6	40.6	41.8	50.3	62.8	49.8	50.2	58.8	61.1	36.0	34.0
Foreign Born, in US 15+ Years	3.7	4.1	37.6	37.1	39.8	41.3	25.8	21.8	37.2	35.4	24.9	26.3	40.3	42.2
Foreign Born, in US 5–14 Years	1.1	1.1	20.2	18.5	15.4	12.6	18.1	13.5	11.7	11.5	13.0	10.4	17.1	19.9
Foreign Born, in US < 5 Years	0.3	0.3	4.8	3.8	4.3	4.3	5.8	1.9	1.3	2.9	3.2	2.2	6.6	3.9

[a] American Indian or Alaska Native.
[b] Asian and Pacific Islander.
[c] SOR: Some Other Race includes a response that is not one of the five OMB categories and no response (Unknown).

Table 4
Gompertz hazard models of all-cause mortality of the Hispanic population ages 25 and older.

	Male		Female	
	Coefficient	SE	Coefficient	SE
Baseline Hazard				
Constant	−8.639***	0.113	−9.560***	0.124
Age-25	0.0815***	0.001	0.0893***	0.001
Gamma	0.0716***	0.007	0.0790***	0.007
Record Has SSN				
No	——		——	
Yes	1.469***	0.086	1.532***	0.094
Race				
White	——		——	
Black	0.1608	0.106	0.0324	0.116
AIAN	0.4961***	0.128	0.0073	0.182
API	−0.2742	0.213	0.0351	0.189
Some Other Race	0.0061	0.041	0.0821*	0.042
Multiple Race	0.0703	0.118	0.1005	0.117
Hispanic Sub-Group				
Mexican	——		——	
Cuban	0.1673**	0.055	0.1795**	0.058
Dominican	−0.4598**	0.137	−0.3821***	0.107
Central American	−0.5579***	0.092	−0.4579***	0.085
Puerto Rican	0.1112*	0.051	0.0950	0.054
South American	−0.2387**	0.077	−0.2303**	0.076
Other Hispanic	0.0738	0.053	0.0533	0.053
Marital Status				
Married	——		——	
Never Married	0.5252***	0.051	0.4581***	0.057
Separated, Divorced or Widowed	0.3586***	0.036	0.251***	0.037
Educational Attainment				
Less than High School	——		——	
High School Graduate	−0.0341	0.042	−0.0893*	0.041
Some College	−0.2436***	0.048	−0.2394***	0.052
Four Years of College or More	−0.3218***	0.057	−0.3898***	0.069
Household Income				
First Quartile	——		——	
Second Quartile	−0.2928***	0.040	−0.1706***	0.044
Third Quartile	−0.3848***	0.049	−0.2651***	0.052
Fourth Quartile	−0.4994***	0.059	−0.2622***	0.059
Nativity/Length of Residence in US				
US Born	——		——	
Foreign Born, in US 15+ Years	−0.3148***	0.037	−0.3039***	0.040
Foreign Born, in US 5–14 Years	−0.4551***	0.080	−0.5813***	0.083
Foreign Born, in US < 5 Years	−0.5565***	0.154	−0.5678***	0.169
Sample Size	129,000		134,000	
Events	6,200		5,800	

*p < .05, **p < .01, ***p < .001.
Notes: Estimates are calculated using MDAC sampling weights.
Sample Ns have been rounded as per the Census Bureau's Disclosure Review Board (DRB) to ensure that no confidential information is disclosed. The DRB release number is: CBDRB-FY19-091.

that was 4.3 times greater than those without and Hispanic females a risk 4.6 times greater. What this clearly illustrates is that deaths are missed by the NDI matching algorithm when SSN is missing. We estimated the same models for records with SSN and the results were not substantively different from those of the full models with controls for SSN (results not shown).

With respect to our main question, the results in Table 4 provide only some support to the conjecture that racial mortality disparities within the Hispanic population are similar to those within the non-Hispanic population. Hispanic AIAN males experience mortality risks that are 64% greater than those of Hispanic white males and Hispanic SOR females have mortality rates that are around 9% greater than those of their white counterparts. There appears to be no other important differences between the Hispanic white population and any of the other Hispanic race groups. On the other hand, mortality disparities within the Hispanic population by country/region of origin are substantial. Cuban and Puerto Rican males have mortality rates that are 18% and 12% higher, respectively, while Dominican, Central American, and South American males have mortality risks that are 37%, 43%, and 21% lower, respectively, than Mexican males. Similarly, Dominican, Central American, and South American females have mortality rates that are 32%, 37%, and 21% lower, while Cuban females have mortality risks that are 20% higher than Mexican females.

The effects of the demographic and socioeconomic covariates included in the models are as expected. Married males and females have lower mortality than their non-married counterparts; both males and females with some college or more have lower mortality than those with less than a high school education. Similarly, males and females in the higher household income quartiles have lower mortality than their counterparts in the lowest income strata. The effects of nativity and length of residence among the foreign born were large. Among males, the foreign born with less than 5, 5–14, and 15 years or more in the US had mortality rates that were 43%, 37%, and 27% lower than those of their US born counterparts. Among females, the values were 43%, 44%, and 26% lower, respectively.

The nativity effects on mortality outcomes concur with the findings of previous studies. The foreign-born segment of the Hispanic population and particularly those with shorter duration of residence have substantially lower mortality than their US born counterparts (Markides & Eschbach, 2011). We explored in greater depth how nativity mediates the correlation between race and mortality within the Hispanic population by estimating models separately for foreign born and US born Hispanic adults.

Table 5 presents the results of the models for the foreign-born segment of the adult Hispanic population. As before, the Gompertz distribution provides a good representation of the mortality profile of this population; and, the effect of SSN on NDI matching success is large. With respect to the role of race on mortality risks, we found, with only one exception, no differences between Hispanic white males and females and the other race groups. Foreign born Hispanic-AIAN males had mortality risks that were 81% higher than those of their white counterparts. Disparities by country/region of origin were large. Cuban and Puerto Rican males and females had mortality rates that ranged from 10% to 18% greater than those of their Mexican-origin counterparts. Dominican, Central American and South American males and females had mortality rates that ranged from 24% to 40% lower than those of Mexican individuals.

The demographic and socioeconomic covariates included in the models had the expected effects with some nuances. The effect of educational attainment did not follow closely the education-mortality gradient observed for the total population. For the foreign born, mortality disparities by education is only evident in comparisons between those with less than a high school and those with 4 or more years of college education. Some studies have questioned whether the education-mortality gradient applies to the Hispanic population and it appears from our results that it may not among the foreign born (Beltran-Sanchez, Palloni, Riosmena, & Wong, 2016). Finally, differences between immigrant cohorts were not identified with one exception. Females in the US for 5–14 years had lower mortality than those in the US 15 or more years, but interestingly there was no difference between the cohort with less than 5 years and those in the US 15 or more years. Among males, there was no statistical difference between those with the longest duration of residence in the US and either of the two cohorts with shorter durations. These results merit further exploration given the conjecture that longer duration of residence in the US among the foreign born is positively correlated with mortality rates (Markides & Eschbach, 2011).

Table 6 presents the results of the same set of models estimated on the US-born adult Hispanic population. As with the previous models, the Gompertz distribution fits the mortality profiles of both males and females well and the SSN covariate has the expected effect. In the case of US born Hispanic adults, we found strong evidence that there are racial disparities in mortality among this population that resemble those

Table 5
Gompertz hazard models of all-cause mortality of the foreign born Hispanic population ages 25 and older.

	Male		Female	
	Coefficient	SE	Coefficient	SE
Baseline Hazard				
Constant	−8.930***	0.136	−9.876***	0.151
Age-25	0.0847***	0.002	0.0939***	0.002
Gamma	0.0643***	0.010	0.0781***	0.010
Record Has SSN				
No	——		——	
Yes	1.284***	0.097	1.308***	0.107
Race				
White	——		——	
Black	0.0600	0.128	−0.0405	0.154
AIAN	0.5958*	0.266	−0.1244	0.443
API	−0.1737	0.242	−0.3471	0.245
Some Other Race	0.0248	0.055	0.0196	0.057
Multiple Race	−0.1356	0.182	−0.2631	0.174
Hispanic Sub-Group				
Mexican	——		——	
Cuban	0.1691**	0.062	0.1433*	0.065
Dominican	−0.4277**	0.145	−0.3686**	0.115
Central American	−0.5149***	0.096	−0.4666***	0.091
Puerto Rican	0.1370*	0.064	0.0996	0.066
South American	−0.2745**	0.084	−0.2914***	0.083
Other Hispanic	0.1117	0.124	0.1850	0.111
Marital Status				
Married	——		——	
Never Married	0.4382***	0.077	0.4351***	0.077
Separated, Divorced or Widowed	0.2996***	0.052	0.2403***	0.052
Educational Attainment				
Less than High School	——		——	
High School Graduate	0.0417	0.058	0.0337	0.057
Some College	−0.1232	0.070	−0.0593	0.075
Four Years of College or More	−0.1681*	0.077	−0.1967*	0.087
Household Income				
First Quartile	——		——	
Second Quartile	−0.2560***	0.056	−0.1924**	0.062
Third Quartile	−0.3307***	0.067	−0.2759***	0.071
Fourth Quartile	−0.3844***	0.081	−0.2505**	0.077
Length of Residence in US				
In US 15+ Years	——		——	
In US 5–14 Years	−0.1379	0.078	−0.2540**	0.080
In US < 5 Years	−0.2553	0.153	−0.2634	0.160
Sample Size	78,000		78,000	
Events	3,100		3,000	

*p < .05, **p < .01, ***p < .001.
Notes: Estimates are calculated using MDAC sampling weights.
Sample Ns have been rounded as per the Census Bureau's Disclosure Review Board (DRB) to ensure that no confidential information is disclosed. The DRB release number is: CBDRB-FY19-091.
Source: Mortality Disparities in American Communities (MDAC) database.

observed in the non-Hispanic population. Hispanic black and AIAN males experienced mortality rates that were 43% and 53% greater, respectively, than those of their white counterparts. These racial disparities closely mirror those that have been observed among non-Hispanic men. Hispanic SOR and Multiple Race females experienced mortality rates that were 18% and 42% greater, respectively, than those of Hispanic white females. Interestingly, the large mortality disparities we found within the foreign-born Hispanic population by country/region of origin almost all but disappeared among the US born. Only Central American males had lower mortality than Mexican origin males. Another difference with the foreign-born segment of the population is that the education–mortality gradient is steeper for both males and females resembling closely the pattern observed among the non-Hispanic population (Beltran-Sanchez et al., 2016).

The results presented thus far provide solid evidence that there are important racial disparities in mortality within the Hispanic population and that the disparities also affect non-black racial minorities. It is also clear that nativity mediates the Hispanic racial-mortality relationship.

Table 6
Gompertz hazard models of all-cause mortality of the US born Hispanic population ages 25 and older.

	Male		Female	
	Coefficient	SE	Coefficient	SE
Baseline Hazard				
Constant	−8.898***	0.227	−9.888***	0.230
Age-25	0.0779***	0.002	0.0840***	0.002
Gamma	0.0809***	0.010	0.0820***	0.010
Record Has SSN				
No	——		——	
Yes	1.936***	0.199	2.176***	0.200
Race				
White	——		——	
Black	0.3587*	0.170	0.1736	0.174
AIAN	0.4282**	0.146	0.0517	0.201
API	−0.4166	0.362	0.3222	0.277
Some Other Race	−0.0209	0.062	0.1693**	0.061
Multiple Race	0.1672	0.150	0.3488*	0.149
Hispanic Sub-Group				
Mexican	——		——	
Cuban	−0.0540	0.166	−0.3613	0.240
Dominican	−0.6698	0.420	0.0725	0.350
Central American	−0.8660*	0.350	−0.1176	0.272
Puerto Rican	0.0602	0.089	0.0437	0.103
South American	−0.2957	0.255	0.0802	0.226
Other Hispanic	0.0668	0.059	0.0373	0.060
Marital Status				
Married	——		——	
Never Married	0.5760***	0.070	0.4494***	0.087
Separated, Divorced or Widowed	0.4085***	0.051	0.2470***	0.053
Educational Attainment				
Less than High School	——		——	
High School Graduate	−0.1530*	0.061	−0.2594***	0.058
Some College	−0.3784***	0.065	−0.4659***	0.072
Four Years of College or More	−0.5225***	0.085	−0.7422***	0.118
Household Income				
First Quartile	——		——	
Second Quartile	−0.3222***	0.058	−0.1353*	0.062
Third Quartile	−0.4292***	0.073	−0.2390**	0.079
Fourth Quartile	−0.6127***	0.084	−0.2552**	0.094
Sample Size	50,500		55,500	
Events	3,100		2,900	

*p < .05, **p < .01, ***p < .001.
Notes: Estimates are calculated using MDAC sampling weights.
Sample Ns have been rounded as per the Census Bureau's Disclosure Review Board (DRB) to ensure that no confidential information is disclosed. The DRB release number is: CBDRB-FY19-091.
Source: Mortality Disparities in American Communities (MDAC) database.

3.3. Racial Mortality Disparities and the Hispanic Mortality Paradox

Given the racial disparities we identified within the adult Hispanic population, we wanted to see how they played out in the context of the Hispanic mortality advantage relative to the non-Hispanic white population. We estimated Gompertz hazard models as in the previous analyses but with the US born non-Hispanic white population as the comparison group (results not shown). Consistent with the racial disparities in mortality we observed within the Hispanic population, we found that all foreign-born Hispanic-race groups, both male and female, had substantially lower mortality rates than their non-Hispanic white counter parts, with the exception of AIAN males. In contrast, among the US born, only Hispanic white and SOR males maintained a mortality advantage relative to non-Hispanic white males and only Hispanic white females maintained an advantage relative to non-Hispanic white females. In effect, these results demonstrate that the Hispanic mortality advantage is mediated not only by nativity, as has been previously shown, but also by race.

Finally, Table 7 presents estimates of life expectancy at age 25 by Hispanic origin, race, nativity status and sex. First, to assess the reliability of our life expectancy estimates we compared those for the non-Hispanic white and black populations to official US national life table values for 2008, the start of the mortality follow-up period in the MDAC (Arias, 2010). Our estimates are consistent with the national values. We estimated life expectancy at age 25 for non-Hispanic white males to be 51.7 years. The national life table value was 52.2 years. The values were 55.7 vs. 56.5 years for non-Hispanic white females; 48.1 vs. 47.6 for non-Hispanic black males; and, 53.0 vs. 53.4 for non-Hispanic black females.

With respect to racial disparities within the Hispanic population, the life expectancy estimates are consistent with our model results (Table 7). First, in every case where we were able to produce life expectancy estimates, the foreign born experienced higher life expectancy at age 25 than the US born. Second, differences in life expectancy between Hispanic-race groups for both foreign born males and females were relatively small. In contrast, differences were substantially larger among US born males and females. For example, Hispanic-white males had a life expectancy that was 6.4, 1.0, and 0.8 years greater than Hispanic black, Multiple Race, and SOR males, respectively. Hispanic-white females had a life expectancy advantage of 3.9, 3.2, and 2.2 years relative to their Multiple Race, SOR, and black counterparts. Third, relative to the US born non-Hispanic white population all foreign-born Hispanic-race groups had a life expectancy advantage ranging from 4.2 to 6.3 years. In contrast, among the US born only Hispanic white males and females had an advantage relative to their non-Hispanic white counterparts, although the advantages were relatively small (0.7 and 1.8 years for Hispanic white males and females, respectively). All other US born Hispanic-race/sex groups experienced disadvantages relative to their non-Hispanic white counterparts, ranging from a disadvantage of 5.7 years for Hispanic black males to 0.1 years for Hispanic SOR males.

4. Discussion and conclusions

In this study, we addressed three research questions: (1) Are there racial mortality disparities in the adult Hispanic population that resemble those observed in the non-Hispanic population in the US? (2) Does nativity mediate the race-mortality relationship in the Hispanic population? and (3) What does the Hispanic mortality advantage relative to the non-Hispanic white population look like when Hispanic race is considered?

We found racial mortality disparities within the Hispanic population that closely resemble those observed in the non-Hispanic population. US-born Hispanic black and AIAN males and Hispanic SOR and Multiple Race females experience greater mortality risks than their Hispanic white counterparts, net of country/region of origin and demographic and socioeconomic characteristics known to be highly correlated with mortality. Similarly, foreign-born Hispanic AIAN males experience greater mortality risks than their Hispanic white counterparts. We found that for the most part racial disparities are concentrated among the US born segment of the Hispanic population. With the only exception of Hispanic AIAN males, there were no racial disparities within the foreign-born Hispanic population.

Table 7
Life expectancy at age 25 by hispanic origin and race.

	Male		
	Total	Foreign Born	US Born
Hispanic White	54.6	56.5	52.3
Hispanice Black	53.9	—	45.9
Hispanic AIAN	47.8	—	—
Hispanic SOR	54.3	55.8	51.5
Hispanic Multiple	55.0	—	51.3
Non Hispanic White	51.7	55.5	51.6
Non Hispanic Black	48.1	58.2	48.5
	Female		
	Total	Foreign Born	US Born
Hispanic White	58.8	60.0	57.3
Hispanice Black	59.3	61.8	55.1
Hispanic SOR	57.8	60.1	54.1
Hispanic Multiple	57.2	—	53.4
Non Hispanic White	55.7	59.0	55.5
Non Hispanic Black	53.0	60.1	52.6

—: Estimates are unreliable.

With respect to the Hispanic mortality advantage relative to the non-Hispanic white population, we found that in addition to nativity Hispanic race plays a very important role. Our results show that the foreign-born Hispanic population experiences lower mortality than the US-born non-Hispanic white population and that this advantage diminishes among the US-born, consistent with previous research (Markides & Eschbach, 2011). However, we also found large racial differences in the Hispanic mortality advantage. Among the US-born, only Hispanic white and SOR males and Hispanic white females experience an advantage relative to the non-Hispanic white population. All other Hispanic race groups experience no advantage or a disadvantage.

These findings are consistent with previous studies that showed that Hispanic black adults experienced poorer health outcomes than their Hispanic white counterparts (Borrell, 2006; Borrell & Crawford, 2006; Cuevas, Araujo; Borrell and Dallo, 2007; Chinn & Hummer, 2016; Dawson, and Williams, 2016). Our findings also concur with the one study that examined adult Hispanic mortality disparities by race relative to the non-Hispanic white population and found Hispanic white adults experienced a mortality advantage while Hispanic black adults did not (Borrell & Crawford, 2009). Our study adds important information to these previous findings. We identified other specific Hispanic racial minority groups in addition to Hispanic black adults that experience mortality disadvantages relative to their Hispanic white counterparts. We found that Hispanic AIAN males are particularly disadvantaged relative to Hispanic white males. Their disadvantage was not confined to the US born segment of the Hispanic population. We also found that Hispanic SOR and Multiple Race females experienced higher mortality risks than their Hispanic white counterparts among the US born. SOR and Multiple Race are the second and third largest racial sub-groups within the Hispanic population.

Our results also revealed mortality disparities by country/region of origin, net of race and pertinent demographic and socioeconomic characteristics, that were mediated by nativity. Among the foreign born, Cuban and Puerto Rican males and females experienced higher mortality than did their Mexican counterparts, while Dominicans, Central Americans, and South Americans experienced lower mortality. In contrast, we found almost no mortality disparities by country/region of origin among the US-born Hispanic population. These results are consistent with findings in Palloni and Arias (2004) that showed that relative to the non-Hispanic white population foreign born Cuban and Puerto Rican adults did not experience any mortality advantages whereas foreign born Mexican and other Hispanic (Hispanic other than Cuban, Mexican or Puerto Rican) adults did so with the advantage being particularly large among other Hispanic adults. These results could be a function of differential migration effects within the Hispanic population. A characteristic that distinguishes foreign born Cuban and Puerto Rican adults from other Hispanic populations is that neither group is affected by healthy migrant or return migration effects. The bulk of Cuban migration to the US has been politically driven with practically no return migration (Perez, 2014). The Puerto Rican population does not face migration restrictions as a result of Puerto Rico being a territory of the US. Finally, race may be a distinguishing characteristic particularly among the Cuban-born population which overwhelmingly identifies as white. Mortality advantages observed by some studies (Fenelon, Chinn, & Anderson, 2017) for this population may be a function of racial composition.

Taken together, the results of our study suggest that a transformation

takes place across Hispanic immigrant generations whereby the protective effects of foreign-born status and/or country/region of origin are replaced by the adverse and detrimental effects of the US racial structure. They further indicate that the health and mortality profiles of the Hispanic population in the US are much more complex than they appear when the population is treated as a racially homogenous entity.

4.1. Limitations

This study has important limitations. First, although we included a control for SSN in the Gompertz models, we cannot with full confidence argue that we eliminated all the bias generated by differential ethnic match rates in the MDAC data set. While the SSN is the most important piece of the NDI matching algorithm, names are also important and given the relative lack of diversity in Hispanic names, the prevalence of poorer match rates may still be considerably greater for Hispanic records. Another limitation is the issue of racial self-identification among the Hispanic population in the US. There are complex cultural, economic and societal structures that affect the understanding and/or choice of ethnic and racial classifications among Hispanic persons in the US (Frank, Restone Akresh, and Lu, 2010). New immigrants may come to the US with little knowledge of the US racial structure and their place in it which likely affects how they respond to questions about race. On the other hand, US born and foreign-born Hispanic adults with long durations of residence in the US may modify their racial identification as they assimilate. For example, some research shows that with increasing assimilation Mexican Americans are more likely to identify as Hispanic white or even non-Hispanic white (Duncan & Trejo, 2011). Add to these the possible effects of incongruence between self-identification and observer ascribed classification. For instance, Hispanic persons who identify as white may not be perceived or treated as white in interactions with the majority population and experience skin-color-based discrimination detrimental to health and mortality outcomes. None of these possible effects would be captured in studies, such as ours, that depend exclusively on self-report of the OMB racial categories (Perreira & Telles, 2014).

Disclaimer

This paper is released to inform interested parties of research and to encourage discussion. Any views expressed on statistical, methodological, technical, or operational issues are those of the authors and not necessarily those of the U.S. Census Bureau. These results have been reviewed by the Census Bureau's Disclosure Review Board (DRB) to ensure that no confidential information is disclosed. The DRB release number is: CBDRB-FY19-091.

Ethical statement

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CRediT authorship contribution statement

Elizabeth Arias: Conceptualization, Software, Methodology, Writing - original draft, Writing - review & editing. **Norman J. Johnson:** Data curation, Software, Writing - review & editing. **Betzaida Tejada Vera:** Visualization, Resources.

Appendix A. Supplementary data

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