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# THE LATINO ADOLESCENT MALE MORTALITY PEAK REVISITED: ATTRIBUTION OF HOMICIDE AND MOTOR VEHICLE CRASH FATALITY

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## Abstract

**OBJECTIVE**—The Latino Epidemiologic Paradox describes favorable health profiles for Latinos compared to non-Latino Whites despite poverty, low education, and low access to health care. Our study objective was to determine if the anomaly to the Latino Epidemiological Paradox and the Latino Adolescent Male Mortality Peak in California mortality data persists.

**METHODS**—Cases were California residents (1999–2006) of any race and ethnicity that died ( $N = 1,866,743$ ) in California from any cause of death. Mortality rates and rate ratios were calculated according to causes of death for 5 year age groups.

**RESULTS**—For males and females combined, age-adjusted mortality rates were 509 for Latinos and 681 for non-Latino Whites per 100,000/yr. Latino male mortality rate ratios exceeded 1.0 compared to non-Latino White males only for 15–19 yrs (1.41 95%CI 1.35–1.49) and 20–24 yrs (1.24 95%CI 1.19–1.29). Latinas had lower mortality rates than non-Latino White females for all ages over 15 years. Male homicide rates for Latinos increased over the study period, but did not reach the rates reported for the years 1989–1997. Both male homicide and motor vehicle crash mortality rates were higher for Latinos than non-Latino Whites and peaked at 20–24 yrs. Latino crash mortality rate exceeded the rate for non-Latino Whites overall and for each year 2003–2006. Crash mortality for males 15–24 yrs increased from 2000–2006.

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**Contributors:** FEV and CLA contributed equally to this study. FEV and CLA had full access to all data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: FEV and CLA. Acquisition of data: FEV and CLA. Analysis and interpretation of data: FEV and CLA. Drafting of the manuscript: FEV, CLA and DEH-B. Critical revision of the manuscript for important intellectual content: FEV, CLA and DEH-B. Statistical analysis: FEV and CLA. Obtained funding: FEV. Administrative, technical and material support: FEV and CLA. Study supervision: FEV.

**Competing Interests:** None.

**CONCLUSION**—The anomaly and the mortality peak persist with notable attribution to homicide and crashes. Without homicide, the mortality peak would not exist. Mortality disparities for Latino adolescent males from these two causes of death in California appear to be growing.

### Keywords

Anomaly; Disparity; Injury; Latino; Paradox

## INTRODUCTION

Despite development and implementation of national recommendations to address health disparities, United States (U.S.) Department of Health and Human Services and Institute of Medicine reports acknowledge slow progress toward eliminating disparate health status.[1–3] This has significant implications for Latino populations, particularly because the Latino population growth is out pacing both the elimination of health disparities and the overall U.S. population growth.

The Latinos population size in the U.S. continues to flourish. Its growth rate from 2000–2006 was three times greater than that of the total U.S. population.[4] In California, the 2008 population estimates show Latinos making up nearly 37% of the state's population compared to 15% of the nation's population.[5]

Because of its historic rapid population growth coupled with attempts by investigators to understand socioeconomic and cultural determinants of health in this vulnerable group, Latinos have long been the focus of discussion and research in the public health and programmatic context regarding health disparities. A key example of this points to a landmark study by Markides and Coreil and their original description of the Latino Epidemiologic Paradox (LEP, also known as the Hispanic Paradox).[6] This paradox describes favourable health profiles for Latinos compared to non-Latino Whites despite poverty, low education, and low access to health care. Close examination by Markides and Coreil of Latino key health indicators such as life-expectancy, infant mortality, mortality from cardiovascular diseases, and measures of functional health supported their claim.

While this construct has been supported and contested, it remains a focus of considerable interest in public health in hopes of arriving at a clear delineation of protective factors that account for health resiliency that can be applied to other vulnerable populations.[7–11]

Subsequent to Markides and Coreil's work, Hayes-Bautista et al, identified the LEP and an anomalous increased mortality of Latino adolescent and young adult males in California mortality data (1989 – 1997).[12] This anomaly was graphically identified as the Latino Adolescent Male Mortality Peak (LAMMP) and showed that homicide and motor vehicle crash fatalities constituted the largest proportion of the mortality burden encompassed in this anomaly.

Adolescence has been described as a dual paradox life stage where adolescents encounter rapid increase in physical strength and capacity for decision-making yet are highly vulnerable to injury-related morbidity and mortality.[13] While the public health literature is replete with studies pointing to health risk factors in youth, there is a paucity of literature that characterizes racial and ethnic adolescent injury disparities.

The construct of the anomaly to the LEP in California mortality data from the injury perspective has not been re-evaluated or expanded upon since the 2002 publication by Hayes-Bautista, et al. [12] In that study, the authors reflected on the California youth population (15 to 24 years) of 1997 that at that time was 4.3 million. Now this population is

over 5.4 million.[14] We believe that the population growth coupled with ongoing health disparities raises the urgency to re-evaluate the anomaly to the LEP. The objective of our study is to determine if the anomaly to the LEP and the LAMMP in California mortality data 1999–2006 persists and to assess contributions of various causes of death to the anomaly.

## METHODS

We obtained mortality data from the California Department of Public Health.[15] We selected data from 1999, when California began using the tenth revision of the International Classification of Diseases (ICD-10), through 2006 (most recent data available). Deaths were restricted to California residents dying in the U.S.

As defined by the U.S. Census, Hispanics or Latinos are people who classified themselves in one of the specific Spanish, Hispanic, or Latino categories listed on the Census 2000 questionnaire -"Mexican, Mexican Am., Chicano," "Puerto Rican", or "Cuban"- as well as those who indicate that they are "other Spanish/Hispanic/Latino." Persons who indicated that they are "other Spanish/Hispanic/Latino" include those whose origins are from Spain, the Spanish-speaking countries of Central or South America, the Dominican Republic or people identifying themselves generally as Spanish, Spanish-American, Hispanic, Hispano, Latino, and so on. Origin can be viewed as the heritage, nationality group, lineage, or country of birth of the person or the person's parents or ancestors before their arrival in the United States. [16]

Population estimates for each calendar year by year of age, sex, race and ethnicity were obtained from the California Department of Finance-Demographic Research Unit (DOF). [17,18] These population estimates are based on demographic projections beginning with the 2000 U.S. Census. The population estimates for Latinos and non-Latino Whites, were compared to the U.S. Census American Community Survey (ACS) for 2006, which is based on a sample of 3,000,000 households nationally (ACS does not provide separate tables for non-Latino Blacks and it was not fully implemented until 2005).[19] Compared to the ACS survey results, the overall DOF projections were 1% lower for Latinos, and 5% lower for non-Latino Whites. The difference in estimates is the result of different statistical methods used by ACS and DOF. When the two sets of estimates were grouped into compatible 5- or 10-year age groups, the inter-quartile range for the DOF projections compared to the ACS survey results was -5% to +4% for Latinos, and -8% to -2% for non-Latino Whites. For males age 15–24 years, the DOF estimates were 2% higher for Latinos, 5% lower for non-Latino Whites.

### Case Definition

Deaths were restricted to California residents dying in the U.S. with a known age on the death certificate. The ICD-10 underlying cause of death codes were grouped as follows: disease (001–294), motor vehicle (296–306), suicide (331–337), homicide (338–346), and all other injury (295, 307–330, 347–358). We restricted the data to three racial and ethnic groups: Latinos (defined as having Hispanic ethnicity and any race), non-Latino Whites, and non-Latino Blacks. We used race and ethnicity data recorded on the death certificate.

In the population estimates, Latinos were similarly identified irrespective of race, and non-Latinos were categorized by race. In 2000, up to three values could be recorded for race and ethnicity on the death certificate and the population estimates included a multi-race category (projection of those that would have self-identified with more than one race). Four-tenths of 1% of all deaths in 1999–2006 and 0.7% of deaths in 2006 were non-Latinos with more than one race code. The percent of estimated population in the multi-race category rose from

1.9% in 2000 to 2.1% in 2006. We did not include the multi-race category in the calculation of rates for any of the racial/ethnic groups.

## Statistical Methods

Mortality rates per 100,000 population were computed for Latinos, non-Latino Whites and non-Latino Blacks by sex and by five-year age groups (with ages 90 and older forming one age group). For the overall comparisons, mortality rates were adjusted to the age distribution of the 2000 California Department of Finance population estimates. To compare Latino and non-Latino Black mortality to non-Latino White mortality, we calculated mortality rate ratios. For both mortality rates and rate ratios, confidence intervals (CI) were calculated using the log-normal approximation to the Poisson distribution. Trends were assessed using variance weighted least squares regression. This study was exempted by the University of California, Irvine, Human Subjects Research Institutional Review Board.

## RESULTS

From 1999–2006, 1,866,743 deaths occurred to California residents. We excluded 587 deaths with unknown age. For both sexes, age-adjusted mortality rates were 509 for Latinos, 681 for non-Latino Whites and 948 for non-Latino Blacks per 100,000/year. Figure 1 shows that Latino male mortality rate ratios exceeded 1.0 compared to non-Latino White males only for 15–19 years (1.41 95%CI 1.35–1.49) and 20–24 years (1.24 95%CI 1.19–1.29). The Latino male mortality rate ratios ranged from 0.97–1.05 for age 5–14 and 25–29 years, and from 0.75–0.83 for ages 35–84 years. The non-Latino Black male mortality rate ratios exceeded 1.0 for ages 0–89.

As shown in Figure 2, Latinas had mortality rate ratios close to 1.0 for ages 5–14 and had lower mortality rates than non-Latino White females for all age groups 15 years and older. The non-Latino Black female mortality rate ratios exceeded 1.0 for ages 0–89.

Thus, the only two groups of Latinos where the mortality rate ratios exceeded 1.0 were male 15–19 and 20–24 years. Combining these two age groups, mortality rates for the major causes of death for California males age 15–24 years are shown by race/ethnic group in Table 1.

Male homicide mortality rates were highest for non-Latino Blacks and higher for Latinos than for non-Latino Whites. The rates peaked at 20–24 years (158.3, 45.3 and 8.4 per 100,000/yr.) respectively (Figure 3). When homicide was excluded from overall mortality rates (Figure 4) the confidence intervals of the rate ratio comparing Latinos to non-Latino Whites was less than 1.0 for all age groups above 10 years. Thus, without homicide the adolescent male anomaly to the Latino epidemiologic paradox no longer exists. Excluding homicide from the overall male mortality rates, resulted in a significant decrease in mortality rate ratios for non-Latino Black males (Figure 4.). Even so, all non-Latino Black male age groups up through 85–89 yrs exceeded a mortality rate ratio of 1 except for the 15–19 and 20–24 year age groups. For both Latino and non-Latino Black males, homicide rates among those 15–24 years increased over the study period, but did not reach reported rates for 1989–1997 (Figure 5.).[12]

Male motor vehicle crash mortality rates were higher for Latinos than for non-Latino Whites. For Latino and non-Latino Whites males less than 80 years, rates peaked at 20–24 years (34.9 and 30.8 per 100,000/yr.) respectively (Figure 6). Crash mortality for Latino and non-Latino Whites males 15–24 years increased from 2000–2006 (Figure 7). The Latino crash mortality rate exceeded the rate for non-Latino Whites overall (29.4 vs. 27.8) and for each year 2003–2006. In 2006, the Latino crash mortality rate was 29% higher than the non-

Latino White rate (36.5 vs. 28.3). Although the rate for non-Latino Blacks increased by a greater percentage than non-Latino Whites, the confidence intervals were wider and included no change.

Male mortality rates due to suicide and for other injuries among Latinos and non-Latino Black were lower than rates in non-Latino Whites (Table 1). The male mortality rate for suicide among Latinos increased over the study period, but remained lower than the rate among non-Latino Whites. The male mortality rate for other injuries did not change in any of the three groups. The mortality rate for other diseases was similar for male Latinos and male non-Latino Whites, but much higher among non-Latino Blacks. The male mortality rate for other diseases increased only among Latinos.

## DISCUSSION

Our results show that despite considerable decreases in mortality rates for young males since 1989 – 1997, mortality disparities between Latinos, Non-Latino Whites and Non-Latino Blacks remain substantial across several causes of death. While the LEP is debated in the literature, our findings show persistence of the LEP, the anomaly to the LEP and the LAMMP in California mortality data.

The greatest difference in mortality rates for males age 15–24 years among the three racial/ethnic groups were for homicide. These rates were higher for Latinos than for non-Latino Whites, and higher still for non-Latino Blacks. In 1989–1997, non-Latino Blacks had a homicide mortality rate above 150/100,000 for most of the time period and above 200/100,000 for three years. [12] In that same time, the Latino homicide mortality rate was 50 – 100/100,000 for all years except 1989. While increases in homicide death rates in our study period are of concern for Latinos and non-Latino Black males, they are significantly less than those previously reported for 1989–1997. [12] The difference in homicide mortality rates is large enough to account for the entire LAMMP. [12]

Even though our study was Latino population focused, we could not ignore the greatest notable disparity in homicide cause of death seen in non-Latino Black males. Although the mortality rates have decreased in the last 17 years, from a rate of nearly 250/100,000 in 1993 to 130/100,000 in 2006 for those 15 – 24 years, this vulnerable population remains in overwhelming and unacceptable risk of premature death. Effective and innovative prevention programs and policies with the greatest promise at further reducing youth homicide should be identified, meaningfully supported, and their strategies disseminated throughout communities with the most need.

Motor vehicle crash mortality rates increased among males age 15–24 years. The greatest increase was among young Latino males. By the end of the study period, Latino rates exceeded those of young non-Latino White males. These increases are in contrast to decreases observed in the same rates from 1989–1997, and decreases in overall U.S. crash death rates during the study period. [12,20] Similar increased rates have been noted in national data, with rates among young Latino males exceeding those of non-Latino Whites in 2005 and 2006.[21] In those data, Latinos had higher restraint use and a higher frequency of elevated blood alcohol, but there were no changes in these risk factors that could account for the increase in crash fatality rates among young Latino males. The California graduated driver license statute (California Vehicle Code 12814.6) went into effect at the beginning of 1998, a year before the beginning of the study period, so that this law would not have influenced changes in motor vehicle crash mortality rates during the study period. [22]

Data for the 1989–2006 period show an important anomaly within the overall LEP; the persistent high mortality rates of adolescent and young adult Latino males, age 15–24. From

the death-record data alone, the fundamental reasons for this anomaly are unclear. There remains limited injury disparities research coupled with a Latino adolescent development focus, and the available literature does not reveal the reasons for this anomaly. This is particularly unfortunate as in key states such as California, Texas and New Mexico, it is projected that over half of all adolescents will be Latino in the next 10–20 years.[23] Unfortunately, the knowledge base to understand the unique patterns of development and behaviour observed within this rapidly growing demographic remains thin.

A distinguishing feature of Latino adolescence is the influence of culture, ethnicity and identity. For example, most Latino adolescents in California are U.S. born of immigrant parents.[24] Different from both non-Latino White and African American adolescents, Latino adolescents of necessity have to deal with issues of immigration, acculturation and identity. Acculturation can have both positive and negative effects. Vega et. al. discovered that the stress of acculturation increased the rate of Latino adolescent drug use.[25] Yet, in terms of overweight and obesity, acculturation appears to play a beneficial role, in terms of improving diet and increasing levels of physical activity. [26] Acculturation may well have some role to play in the formation of ethnic identity, which is viewed by French et. al. as an important part of the adolescent development of youth of colour. [27] Being raised with immigrant parents plays a role in adolescent development, and the strong family orientation characteristic of Latino families appears to carry through with their U.S. born adolescents. [28] However, the families do not operate in isolation. Supple et. al. showed the influence of neighbourhood characteristics offsetting much of parental influence in developing ethnic identity.[29] Moreover, the influence of peer-group support can play a large role, for example in weakening academic achievement. [30]

Therefore, this large and growing vulnerable group of adolescents is not well researched. At times, it appears to behave similar to immigrant groups, but at other times similar to U.S.-born racial/ethnic minority groups.[31,32] As a result of population growth and knowledge dearth, a number of calls have gone out for increased research efforts. Nearly fifteen years ago, Zaslow and Takanishi raised the issue of the need for increased research on “American youth from under-studied racial and ethnic minority groups”. [33] A 2004 comprehensive literature review article came to an unavoidable conclusion: “Given the population demographic shifts of the last two decades as well as the projections for the future, it is imperative that we develop a coherent framework for investigating and understanding Latino youth development.”[34]

## LIMITATIONS

Rates reported here are subject to three types of errors. First, Latinos are undercounted on death certificates by about 5%. [11,35,36] However, Latinos under age 25 are overcounted on death certificates by about 4%. [11] Secondly, if ACS figures are correct, the DOF population projections underestimate Latinos by about 1% and non-Latino Whites by about 5% in 2006. The DOF population projections are based on the 2000 U.S. Census, so they may be more accurate early in the study period. Finally, multiple-race responses were less frequent on death certificates than in population projections. [23] We believe that most of the individuals reported in the population estimates as having more than one race would have been classified as members of a minority race if they had died. Even so, Latino ethnicity was assessed independent of race.

In sum, for most age groups, the undercount of Latinos deaths and the underestimate of the non-Latino White population would have resulted in higher rate ratios, and may account for a part of the LEP. However, for Latino males 15–24 years, an overcount in the numerator for Latinos and an undercount in the denominator for non-Latino Whites would have

overestimated rates in both groups but would have had a smaller effect on the rate ratios. Similarly, the exclusion of the multi-race category from the denominator may have inflated rates for non-Latino Blacks but would have had a smaller effect on the rate ratios.

Our analysis does not take into consideration the differences in mortality rates and causes of death within Latino origin subgroups. We recognize that important differences within the larger collective Latino population group studied here may exist. However, for the state of California, Latinos of Mexican decent supersede the population size of any other Latino subgroup by more than an order of magnitude. In the 2006 U.S. Census ACS, 83% of the California Latino population was of Mexican origin.[19]

## CONCLUSION

We believe that the continued observation of the anomaly (LAMMP) within the LEP serves to substantially raise the urgency to address both the paradox and anomaly, as this population will only continue to grow over the next 25 years.

### WHAT IS ALREADY KNOWN ON THE SUBJECT

- The Latino Epidemiologic Paradox describes favorable health profiles for Latinos compared to non-Latino Whites despite poverty, low education, and low access to health care.
- An anomaly to the Latino Epidemiologic Paradox is increased mortality of Latino adolescent and young adult males.

### WHAT THIS STUDY ADDS

- The anomaly to the Latino Epidemiologic Paradox and the Latino Adolescent Male Mortality Peak have persisted in California with notable attribution to homicide and motor vehicle collisions.
- Without the contribution of homicide to mortality, the Latino Adolescent Male Mortality Peak in California mortality data would not exist.
- Injury-related mortality disparities for Latino adolescent males in California appear to be growing.

## Acknowledgments

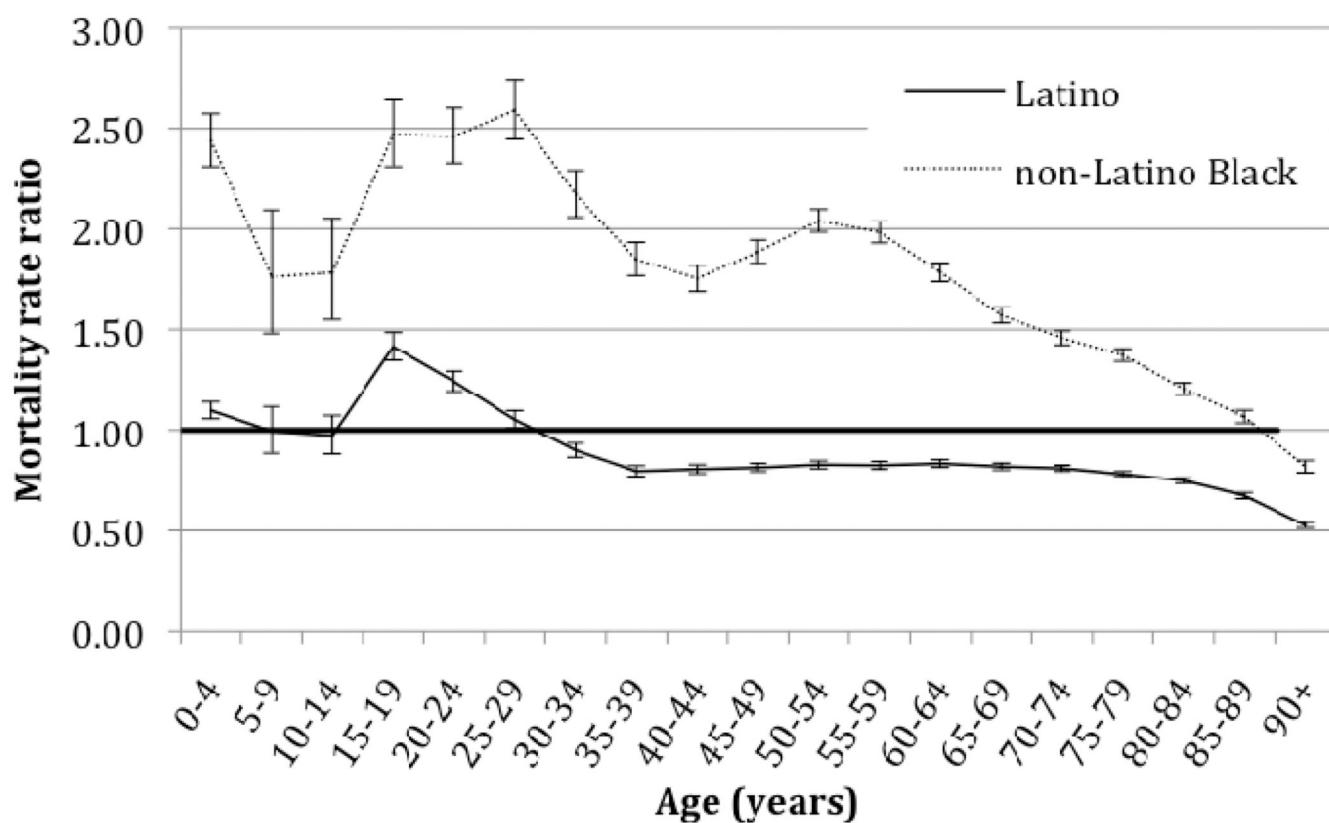
**Funding:** The project described was supported by Grant Number K23HD050630 from the National Institute of Child Health and Human Development

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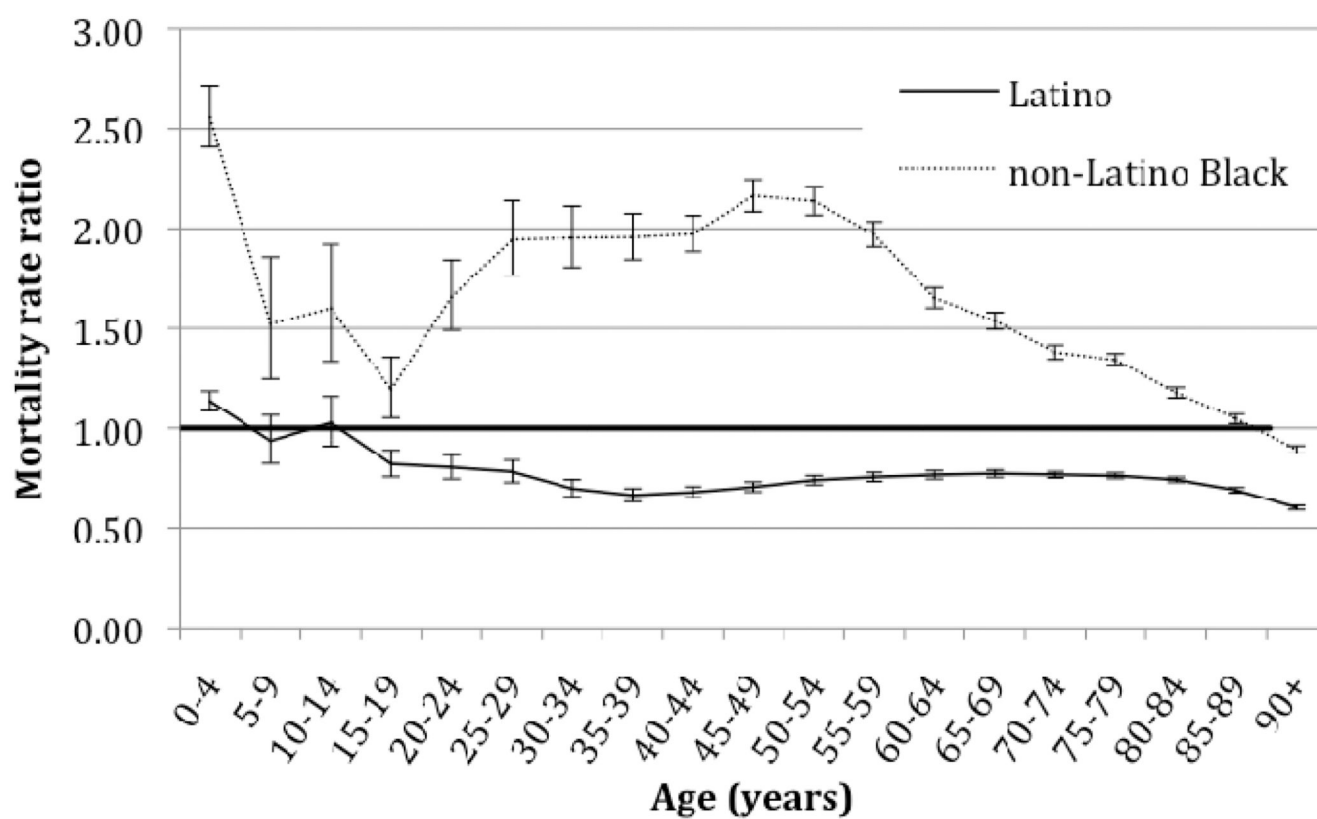
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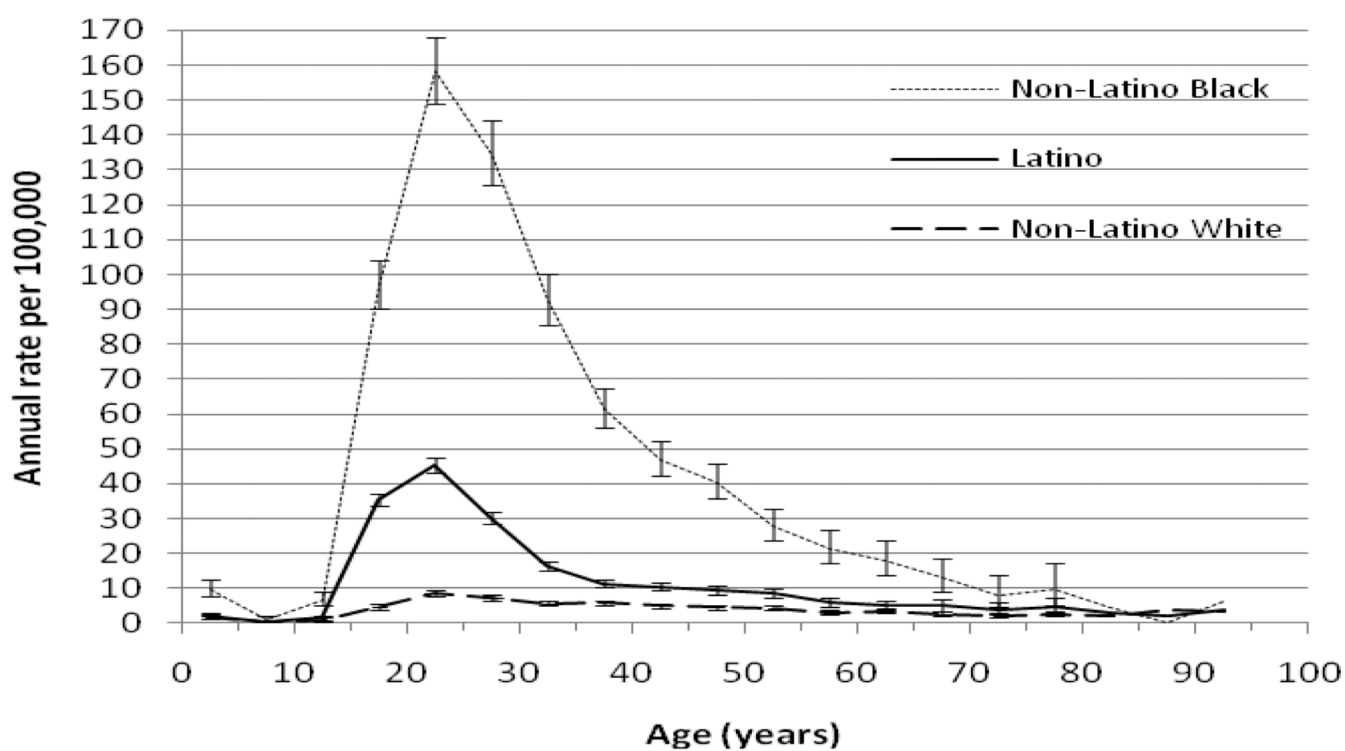
**FIGURE 1.**

Male All-cause Mortality Rate Ratios Comparing Latino and Non-Latino Black Mortality to Non-Latino White Mortality, by 5-Year Age Groups with 95% CI, California, 1999–2006.

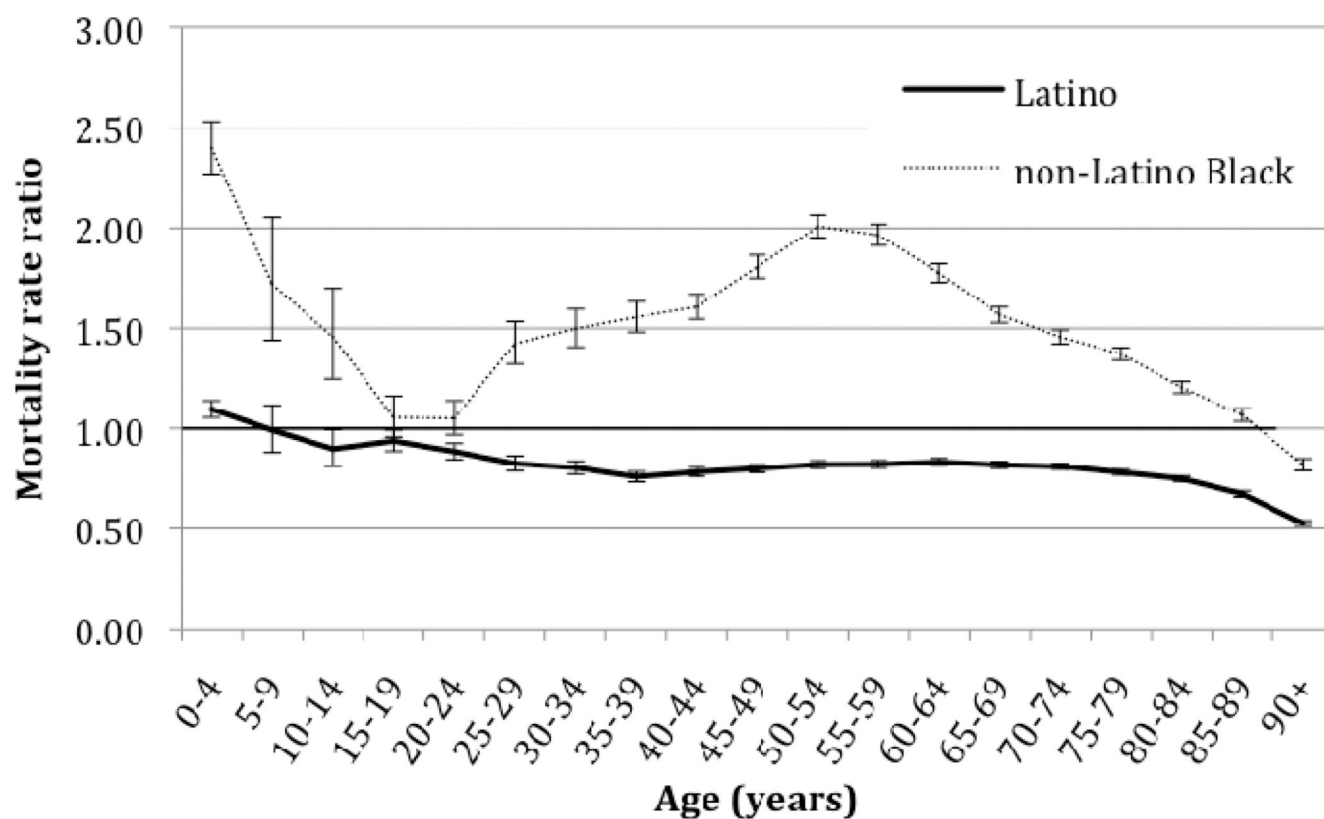


**FIGURE 2.**

Female All-cause Mortality Rate Ratios Comparing Latino and Non-Latino Black Mortality to Non-Latino White Mortality, by 5-Year Age Groups with 95% CI, California, 1999–2006.

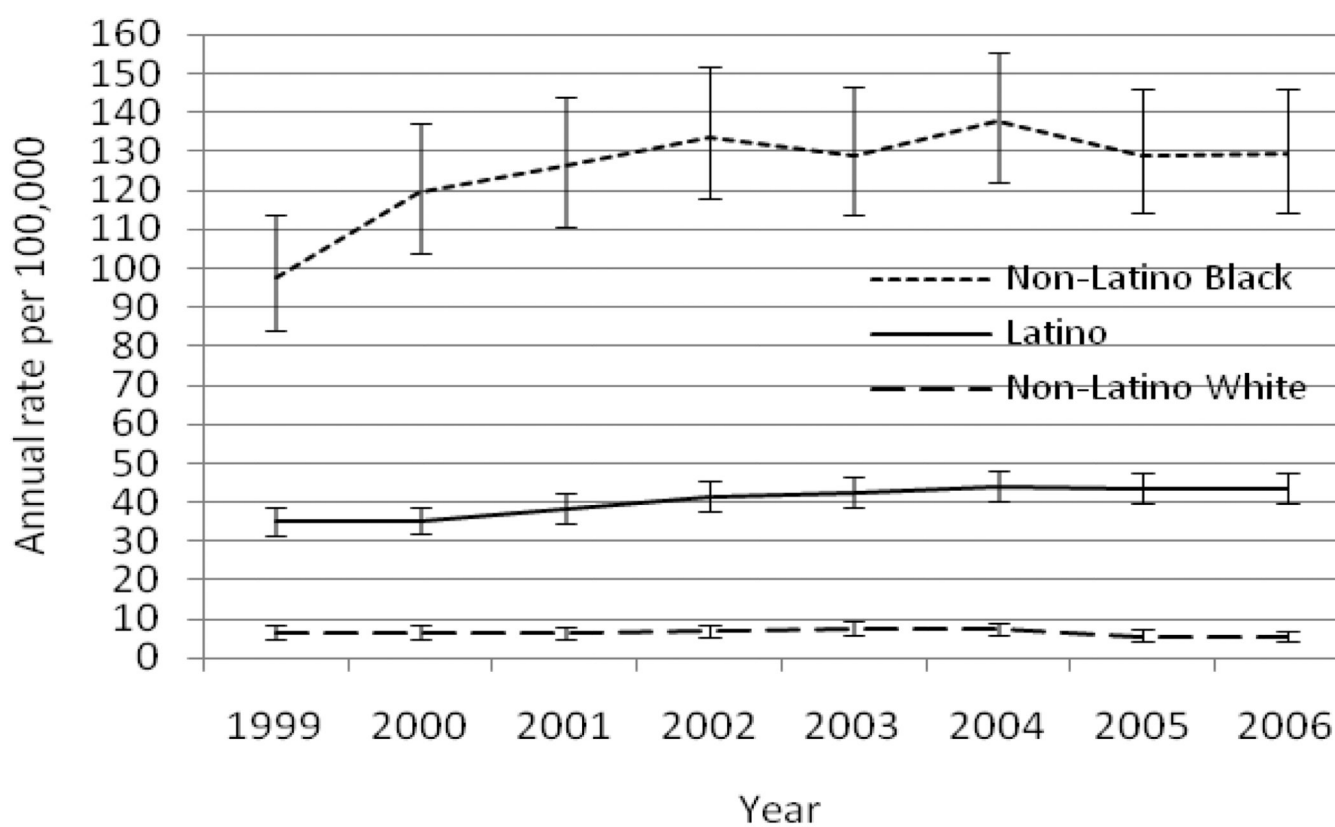


**FIGURE 3.** Male Homicide Mortality Rates, Comparing Latino, Non-Latino Black, and Non-Latino White, 5-Year Age Groups, California 1999 – 2006. (Overlapping 95% CI for age group 80 years and older not shown.)

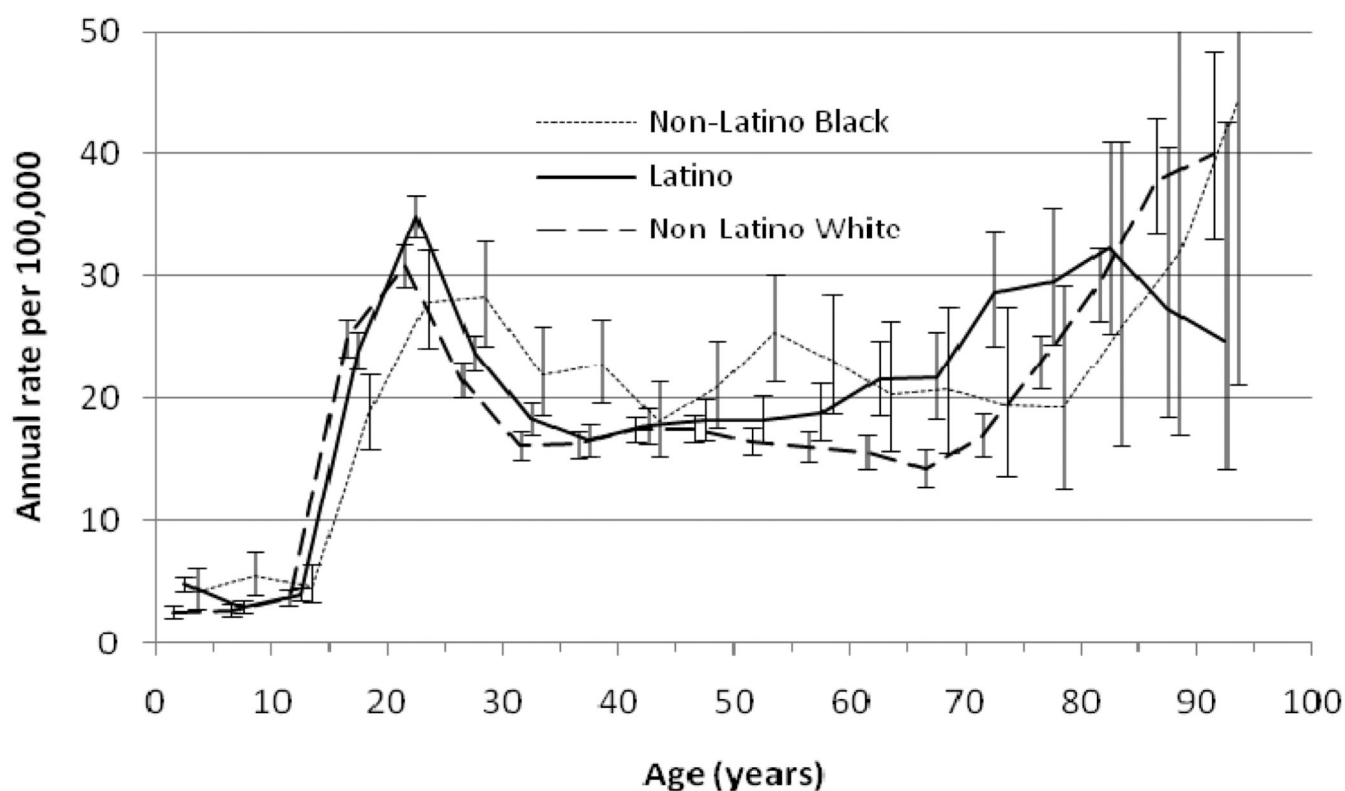


**FIGURE 4.**

Male Mortality Rate Ratios for All Causes Except Homicide, Comparing Latino and Non-Latino Black Mortality to Non-Latino White Mortality, by 5-Year Age Groups with 95% CI, California, 1999–2006.

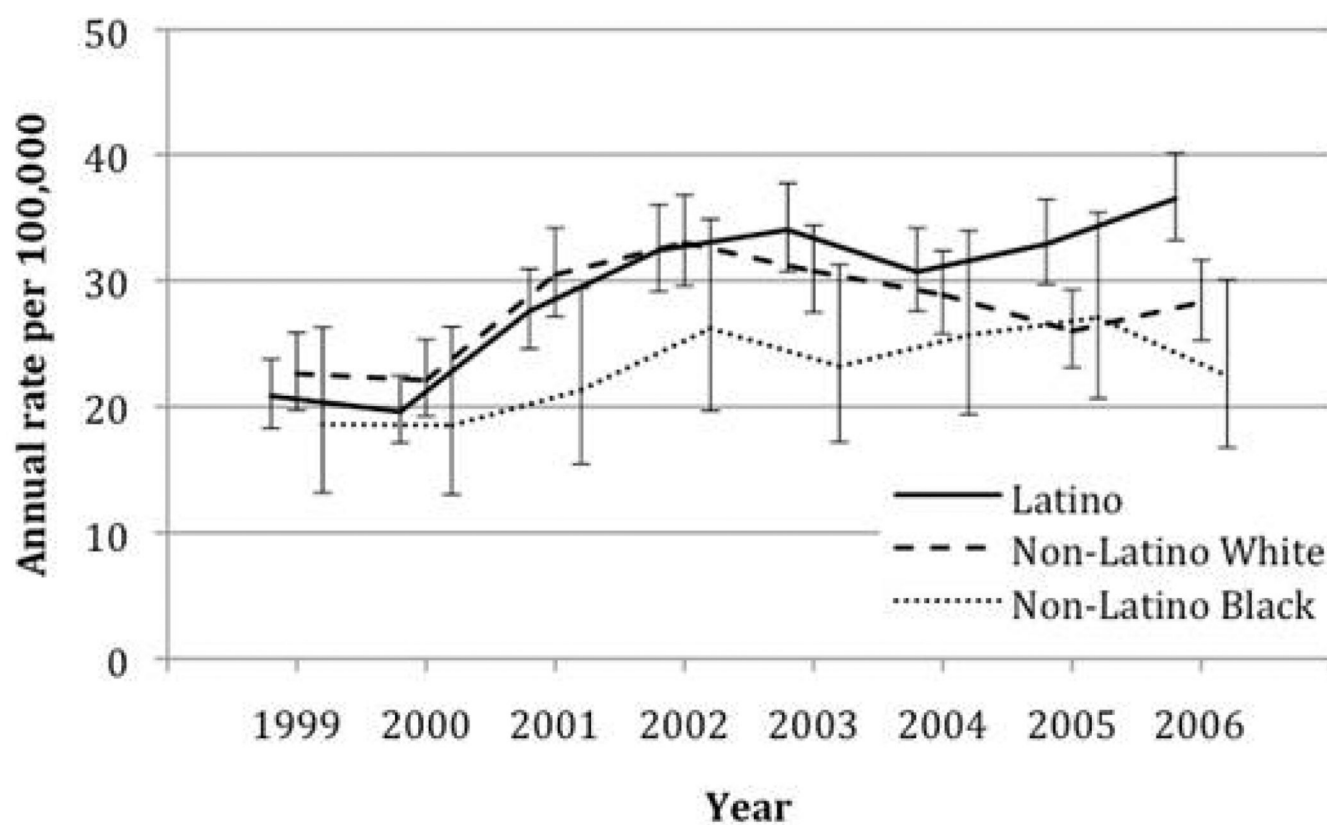


**FIGURE 5.** Homicide Mortality Rates, Among Males 15 – 24 Years of Age, Comparing Latino, Non-Latino Black, and Non-Latino White, by Year with 95% CI, California 1999 – 2006.



**FIGURE 6.**

Male Motor Vehicle Crash Mortality Rates, Comparing Latino, Non-Latino Black, and Non-Latino White, 5-Year Age Groups with 95% CI, California 1999 – 2006. (Points are offset to show CI; Upper CI above 50/100,000 not shown.)



**FIGURE 7.** Motor Vehicle Crash Mortality Rates, Among Males 15 – 24 Years of Age, Comparing Latino, Non-Latino Black, and Non-Latino White, by Year with 95% CI, California, 1999–2006.

**TABLE 1**

Annual mortality rates per 100,000 by cause of death and race/ethnic group. California males age 15–24 years, 1999–2006.

	Latino	Non-Latino White	Non-Latino Black
<b>Homicide</b>	40.3 (39.0–41.7)	6.5 (5.9–7.1)	125.7 (120.1–131.5)
<b>Motor vehicle crash</b>	29.4 (28.3–30.6)	27.8 (26.7–29.0)	23.0 (20.7–25.6)
<b>Suicide</b>	8.9 (8.3–9.6)	14.6 (13.8–15.4)	10.6 (9.1–12.5)
<b>Other injuries</b>	13.3 (12.5–14.1)	16.3 (15.5–17.3)	13.9 (12.1–16.0)
<b>Other Disease (excluding injuries)</b>	19.9 (19.0–20.9)	19.6 (18.7–20.6)	34.3 (31.4–37.4)
<b>Total</b>	111.8 (109.6–114.1)	84.8 (82.8–86.9)	207.5 (200.3–215.0)