

Research Article

Temporal Trends in United States Infants: Implications for Achieving Health Equity

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Abstract

Objective: In this descriptive study, we explored temporal trends and racial inequities in US infant mortality, low birth weight, and preterm births.

Method: The Centers for Disease Control and Prevention (CDC) Wide-ranging Online Data for Epidemiologic Research (WONDER) was used to access Natality Data and the Linked Birth/Infant Death Records (LBIDR) from 2007 to 2019. Annual infant mortality per 1000 live births was obtained, as well as low birth weight and preterm birth rates. Annual percent changes (APCs) with 95% Confidence Intervals (CIs) and joinpoint regression were used to test for the significance of differences in trends.

Results: From 2014 to 2019, infant mortality fell, while low birth weight and preterm births rose. For all three indices, there are significant inequities between Whites and Blacks. Blacks, compared with Whites, experienced a significant 2-fold greater infant mortality and low birth weight and a 1.5-fold greater preterm birth rate.

Conclusions: These descriptive data indicate that the overall US infant mortality rate declined but low birth weight and preterm birth rates increased. These data suggest that infant mortality alone may be insufficient as a health indicator. While analytic studies are necessary to test the many hypotheses formulated by these descriptive data, there are clinical and public health challenges that arise from these findings.

ABBREVIATIONS

HP: Healthy People; US: United States; CDC: Centers for Disease Control; WONDER: Wide-ranging ONLINE Data for Epidemiologic Research; LBIDR: Linked Birth/Infant Death Records; APCs: Annual Percent Changes; CIs: Confidence Intervals

INTRODUCTION

While overall infant mortality rates have improved in the United States (US), the differences between Blacks and Whites remain largely unchanged for decades [1]. The Black infant mortality rate in 2018 approximated the White infant mortality rate of 1981[2,3]. Since 1980, the Healthy People (HP) initiative has drafted objectives to improve US health and well-being [4,5]. HP 2010 hoped to eliminate racial inequities [5]. Concerns about health equity have evolved in recent years [6]. HP 2030 opined that infant mortality is a leading health indicator [4]. Although improvements in obstetric and perinatal care have increased the survival of preterm infants, the US has a higher infant mortality

rate than many other developed countries, with worse outcomes observed in Black infants compared to White infants [1].

In this descriptive study, we explored temporal trends and racial inequities in US infant mortality rates, low birth weight, and preterm births.

METHODS

We used the Centers for Disease Control and Prevention (CDC) Wide-ranging ONLINE Data for Epidemiologic Research (WONDER) search tool to access Natality Data and the Linked Birth/Infant Death Records (LBIDR) from 2007 to 2018. Data were obtained by year and mother's bridged race. We defined White as Non-Hispanic White and Black as Non-Hispanic Black [2,7]. Data were also collected for all infants born from 2007 to 2018, regardless of the mother's bridged race.

We calculated annual infant mortality rates per 1000 live births and low birth weight as well as preterm birth rates per

100,000 live births. Newborns of low birth weight were classified as those <2500 grams. Preterm births were classified as 20-36 weeks' gestation using the Obstetric/Clinical Gestation Estimate. We followed the National Center for Health Statistics guidelines and utilized annual percent changes (APCs) as measures of effect. For significance testing, we utilized 95% Confidence Intervals (CIs) and joinpoint regression to test for the significance of differences in trends [7,8]. We utilized the National Cancer Institute's Joinpoint Regression Program for trend analysis.

Specifically, we used 95% CIs to estimate the range within which the APC is likely to lie. We consider the APC to be significant if the range excludes zero. Joinpoint takes trend data and fits the simplest best-fit line model that the data allow, starting with the minimum number of joinpoints, or inflection points [7].

This research was considered exempt by the Institutional Review Board of the Baylor College of Medicine due to the use of publicly available de-identified data.

RESULTS

A total of 47 474 176 infant births from the LBIDR from

2007 to 2018 were analyzed, out of which 7 111 385 and 25 735 338 were the number of White and Black US infant births, respectively. The infant mortality rate, low birth weight rate, and preterm birth rate for all infants as well as Whites, and Blacks, during the years 2007 to 2018 are shown in Figure 1. Further, the APCs with 95% CIs and P-values are shown in Table 1.

Figure 2 shows APCs with 95% CIs in infant mortality, low birth weight, and preterm birth rate for all infants, Whites, and Blacks from 2014 to 2018. During this period, infant mortality, on average, declined across all groups, and low birth weight and preterm births rose. There was a statistically significant increase in low birth weight and preterm birth rate overall and among Blacks. While infant mortality appears to be down-trending in all groups, a statistically significant decrease is notable only among Whites between 2014 and 2018.

For all three indices, there are significant inequities between Whites and Blacks. Blacks, compared with Whites, experienced a significant 2-fold greater infant mortality and low birth weight and a 1.5-fold greater preterm birth rate.

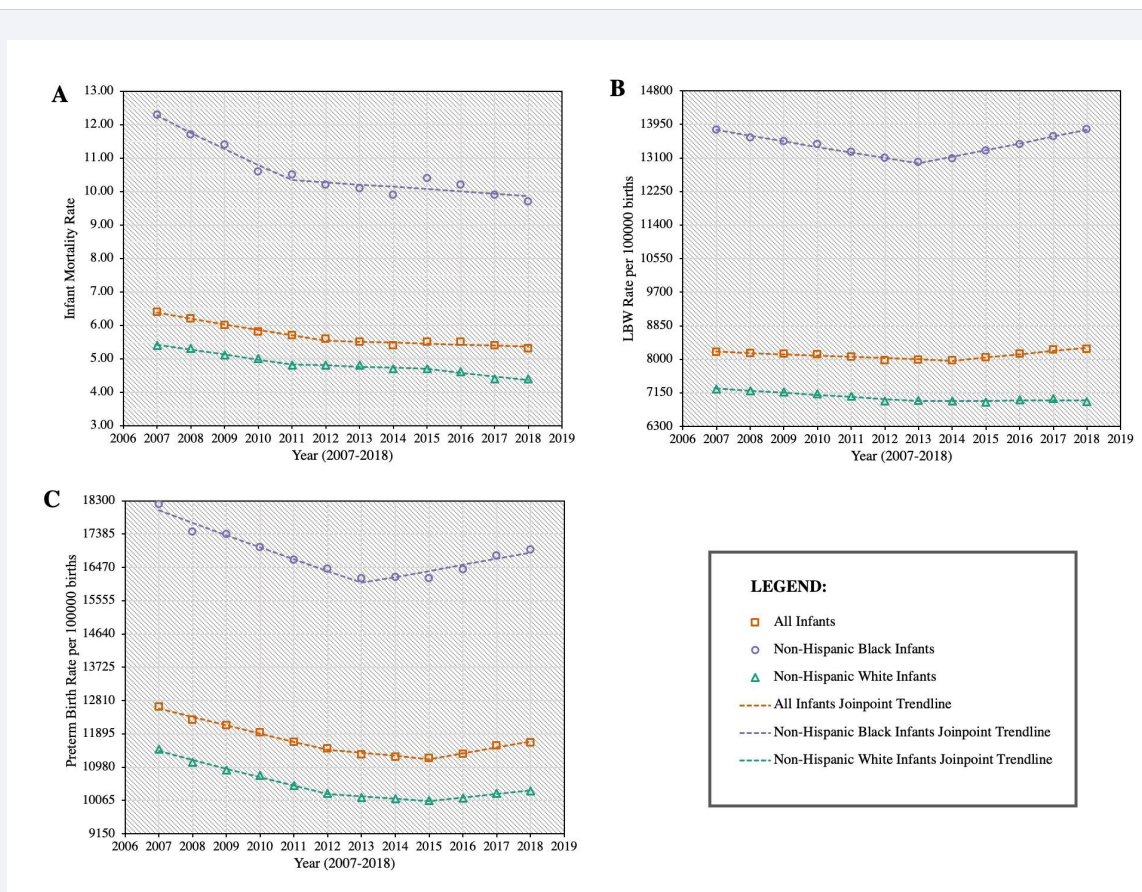


Figure 1 (A) Trends in Infant Mortality in the United States from 2007-2018. (B) Trends in Low-Birth-Weight rate per 100,000 births in the United States from 2007-2018. (C) Trends in Preterm Birth rate per 100,000 births in the United States from 2007-2018.

Legend: Square marker: rate per year for all infants; circle marker: rate per year for Blacks; triangle marker: rate per year for Whites. Orange dashed line: joinpoint line fit for all infants from 2007-2018; purple dashed line: joinpoint line fit for Blacks from 2007-2018; green dashed line: joinpoint line fit for Whites from 2007-2018.

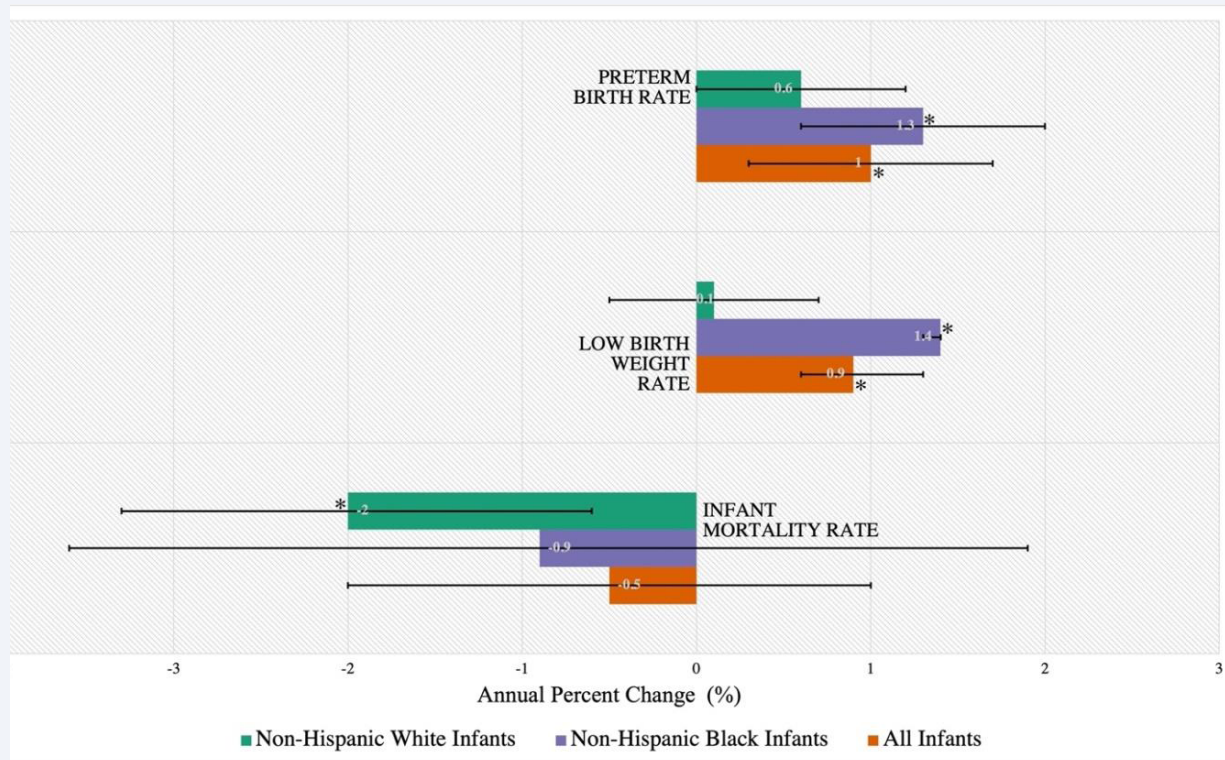


Figure 2 Annual Percent Change with 95% Confidence Intervals in Rates of Infant Mortality, Low Birth Weight, and Preterm Birth among Infants of At Least 20 Weeks' Gestation. United States of America. 2014-2019.

*Indicates that the APC is significantly different from zero at the alpha = 0.05 level.

Table 1: Trends in Infant Mortality, Low Birth Weight, and Preterm Birth Rates among Infants of At Least 20 Weeks' Gestation. United States of America. 2007-2018.

	Time of Change	APC with 95% CIs	P-value
Infant Mortality Rate			
Overall (All Infants)	2007-2012	-2.7* (-3.4 to -2.0)	<0.001
Overall (All Infants)	2012-2018	-0.6 (-1.1 to 0)	0.059
Non-Hispanic Black	2007-2011	-4.2* (-6.1 to -2.3)	0.001
Non-Hispanic Black	2011-2018	-0.7 (-1.6 to 0.2)	0.129
Non-Hispanic White	2007-2011	-2.8* (-4.0 to -1.6)	0.003
Non-Hispanic White	2011-2015	-0.7 (-2.8 to 1.4)	0.382
Non-Hispanic White	2015-2018	-2.4* (-4.5 to -0.2)	0.037
Low Birth Weight Rate			
Overall (All Infants)	2007-2014	-0.4* (-0.6 to -0.2)	0.001
Overall (All Infants)	2014-2018	+1.0* (0.6 to 1.4)	0.001
Non-Hispanic Black	2007-2013	-1.0* (-1.2 to -0.9)	<0.001
Non-Hispanic Black	2013-2018	+1.3* (1.1 to 1.4)	<0.001
Non-Hispanic White	2011-2015	-0.8* (-1.0 to -0.5)	<0.001
Non-Hispanic White	2015-2018	+0.1 (-0.1 to 0.5)	0.689
Preterm Birth Rate			
Overall (All Infants)	2007-2012	-1.9* (-2.3 to -1.5)	<0.001
Overall (All Infants)	2012-2015	-0.7 (-2.6 to 1.2)	0.337
Overall (All Infants)	2015-2018	+1.4* (0.5 to 2.4)	0.015
Non-Hispanic Black	2007-2013	-1.9* (-2.4 to -1.5)	<0.001
Non-Hispanic Black	2013-2018	+1.0* (0.4 to 1.6)	0.006
Non-Hispanic White	2007-2012	-2.1* (-2.6 to -1.7)	<0.001
Non-Hispanic White	2012-2015	-0.7 (-2.7 to 1.4)	0.431
Non-Hispanic White	2015-2018	+0.9 (-0.1 to 2)	0.068

APC: Annual Percent Change; CIs: Confidence Interval

* Indicates that the APC is significantly different from zero at the alpha = 0.05 level.

A negative sign indicates a decrease or reduction in the rate, whereas a positive sign indicates an increased rate.

DISCUSSION

These data indicate that during the 11 years from 2007 to 2018, the US infant mortality rate declined while low birth weight and preterm birth rates increased [7-9]. These findings suggest that infant mortality alone may be insufficient as a health indicator [5]. With respect to infant mortality, the US ranks 23 in the world despite experiencing marked improvements in the survival of low birthweight and preterm infants [1]. It is tempting to hypothesize about possible etiologic factors. These include social and economic factors such as maternal education, access, poverty, and crime, as well as structural racism [3,10].

The chief limitation of this study is that the data are descriptive and, therefore, useful only to formulate but not test hypotheses [8,9]. Additional limitations include those related to reliance on death and birth certificates [8]. Per the CDC WONDER tool, linked file records are weighted to compensate for the 2 to 3 percent of infant death records that could not be linked to their corresponding birth certificates [2].

While analytic studies are necessary to test the hypotheses formulated by these descriptive data, there are immediate clinical and public health challenges [8,9]. For example, these include the need for increased surveillance of adverse birth outcomes as well as to develop evidence-based programs targeted to areas with higher infant mortality, low birth weight, and preterm births. It will be important to increase surveillance beyond that of crude measures and explore complex mediators to further advance the identification of prevention strategies.

CONCLUSION

The infant mortality rate in the US is of ongoing concern. These descriptive data indicate that while the overall US infant mortality rate declined, low birth weight and preterm birth rates continue to rise, indicating significant room for improvement in infant health. Infant mortality alone may be insufficient as a health indicator. Further studies are needed to test the many hypotheses raised by these descriptive data. In the meanwhile, immediate clinical and public health challenges are raised by these findings.

CONFLICT OF INTEREST/DECLARATIONS

Ms. Diaz Ayllon, and Professor Levine have no disclosures.

Professor Hennekens reports that he serves as an independent scientist in an advisory role to investigators and sponsors as Chair of Data Monitoring Committees for Amgen and UBC, the United States Food and Drug Administration, and UpToDate; receives royalties for authorship or editorship of 3 textbooks and as co-inventor on patents for inflammatory markers and cardiovascular disease that are held by Brigham and Women's Hospital; has an investment management relationship with the West-Bacon Group within Truist Investments, which has discretionary investment authority; does not own any common or preferred stock in any pharmaceutical or medical device company.

Professor Wood serves as an independent scientist in an advisory role to investigators and sponsors as a member of an international Data Monitoring Committee for Amgen.

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