

# Improvements in Infant Mortality From Congenital Cardiovascular Abnormalities Differ by Race in Wisconsin and the US, 1995-2022

Michael Rolfs, BS; Dirk Haselow, MD, PhD

## ABSTRACT

**Background:** Infant mortality from congenital cardiovascular defects (CCDs) is the leading cause of death among individuals with birth defects.

**Methods:** A descriptive analysis of infant mortality due to CCDs in Wisconsin and the United States was performed using data from the Centers for Disease Control and Prevention's Wide-ranging ONline Database for Epidemiological Research (WONDER) from 1995 to 2022.

**Results:** Congenital cardiovascular defect-related infant mortality (CCDIM) declined during this period in the United States ( $P < .0001$ ) and in Wisconsin ( $P = .024$ ). In the United States, African American and American Indian or Alaska Native populations experienced higher rates than Asian or White populations. In Wisconsin, non-White populations experienced higher CCDIM rates than White populations.

**Discussion:** CCDIM in Wisconsin has declined over time. However, an excess of CCDIM in non-White populations persists compared with White populations. Because many risk factors for CCDIM are related to behavioral, environmental, and socioeconomic factors, these observed differences may represent opportunities for targeted prevention efforts.

## BACKGROUND

Congenital cardiovascular defects (CCDs) are abnormalities in which the structure of the heart or major blood vessels does not form correctly. There are numerous specific types of CCDs, which, due to their relative individual rarity, are combined in this analysis. CCDs are the leading cause of infant mortality among persons with birth defects in the United States, causing about 40% of infant deaths among children with any congenital abnormalities.<sup>1</sup> They affect 8 to 9 per 1000 live births in the United States,<sup>2</sup> and from 2006 to 2015,

• • •

**Author affiliations:** University of Wisconsin-Madison, Madison, Wisconsin (Rolfs); University of Arkansas for Medical Sciences, Little Rock, Arkansas (Haselow).

**Corresponding author:** Dirk Haselow, MD, PhD, Little Rock, AR 72205-7199; email [haselowdirk@uams.edu](mailto:haselowdirk@uams.edu); ORCID ID 0000-0003-1905-0860

infant mortality from CCDs was estimated to be 0.34 per 1000 live births.<sup>3</sup>

Risk factors for CCDs are complex and multifaceted. Both genetic factors and environmental factors—such as smoking during pregnancy, pregestational diabetes, poverty, obesity, and maternal age—have been associated with an increased risk of CCDs.<sup>4</sup>

Racial/ethnic disparities in CCDs have been observed in previous studies. A high-risk racial or ethnic status is likely a surrogate marker for socioeconomic factors mediating environmental and behavioral risks. Although true genetic factors likely exist, they are expected to account for only a minority of the increased risk.<sup>5</sup>

Congenital cardiovascular defect-related infant mortality (CCDIM) decreased by 24% from 1999 to 2006 in the United States.<sup>6</sup> This decline may be attributable to improved health care quality as well as enhanced newborn screening resulting in earlier identification and treatment. These improvements are strongly associated with well-resourced settings. In comparison, less well-resourced settings outside the United States have not seen comparable improvement in CCDIM.

We conducted this study to assess whether deaths from CCDs are changing over time in Wisconsin and whether these trends differ by race.

## METHODS

We conducted a descriptive epidemiologic study using data from the Centers for Disease Control and Prevention's (CDC) Wide-ranging ONline Database for Epidemiological Research (WONDER) online data repository ([wonder.cdc.gov](http://wonder.cdc.gov)) using the search term “congenital malformations of the circulatory system.”

CDC WONDER includes 5 separate queryable infant mortality databases covering the years 1995 through 2022. Numbers of infant deaths (defined as death in the first 12 months of life) and total births were assembled, along with CCDIM data and racial designation for each year for both the United States and Wisconsin. These data were concatenated into a single analytic database covering 1995-2022. Stratum-specific death rates per 1000 births were calculated in Excel (Microsoft Corp). Excel was also used to generate tables and figures and to calculate linear regression statistics and *P* values for differences in means.

Due to CDC WONDER confidentiality rules relating to small numbers, races other than White, Black or African American, American Indian or Alaskan Native, or Asian or Pacific Islander were not included in this analysis, even for national-level data. Similarly, when assembling Wisconsin data, the data source suppressed race-specific CCD data for all races except White due to small numbers. As a result, all non-White races were grouped into a single category for Wisconsin analyses.

During 1995 to 2022, racial designations varied across the 5 CDC WONDER datasets. To make them directly comparable, persons listed as Chinese, Filipino, or Other Asian race coded in 1995 to 2002 and 2019 to 2022 were recoded as Asian or Pacific Islander for this analysis.

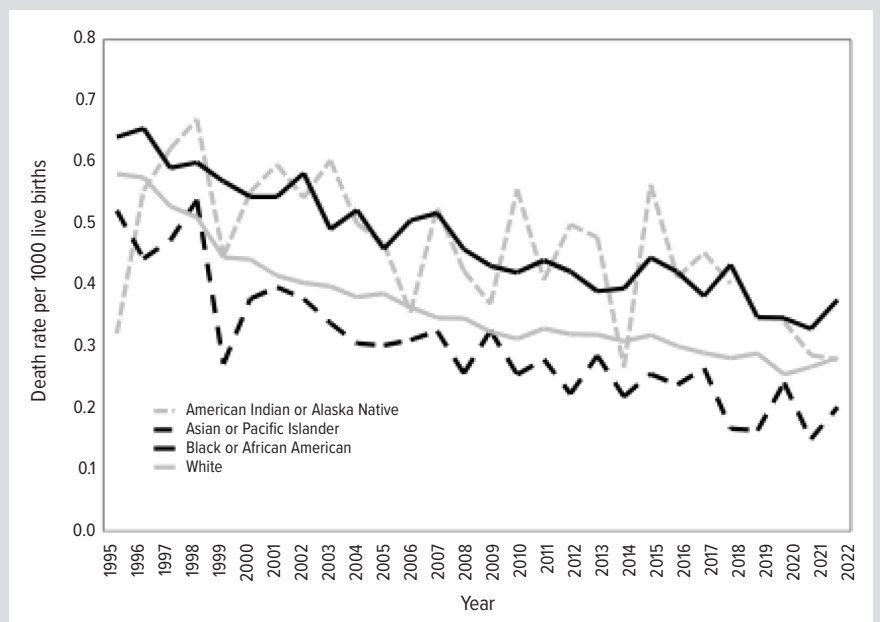
## RESULTS

Rates of CCDIM in the United States have decreased in all racial groups from 1995 to 2022 (Figure 1,  $P < .0001$  for linear trend in all cases). Black or African American and American Indian or Alaskan Native populations had the highest rates. Black or African American individuals had higher rates than White individuals ( $P < .00001$ ), and White individuals had higher rates than Asian or Pacific Islander individuals ( $P = .007$ ).

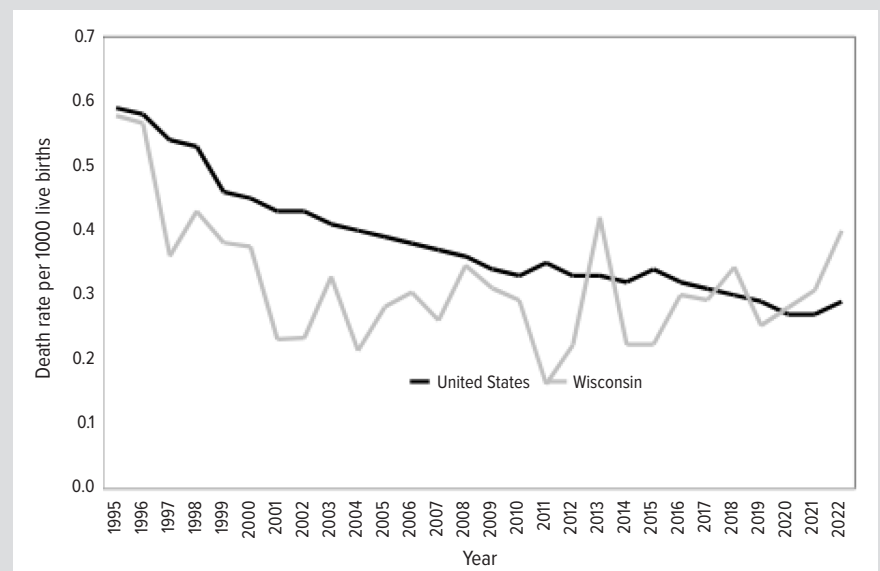
Rates of CCDIM have decreased in both the United States ( $P$  for linear trend  $< .0001$ ) and in Wisconsin ( $P = .024$  for linear trend) during 1995 to 2022 (Figure 2). Overall, Wisconsin's rates were lower than national rates ( $P$  for linear trend  $= .0001$  for linear trend), but from 2012 through 2022, rates became more similar ( $P = .35$  for differences in means).

Figure 3 depicts trends in CCDIM in White versus non-White

**Figure 1.** Infant Deaths From Congenital Cardiovascular Abnormalities in the US by Race, 1995–2022



**Figure 2.** Infant Deaths From Congenital Cardiovascular Abnormalities, Wisconsin and the US, 1995–2022



populations in Wisconsin. There is substantial variability in both lines, particularly among non-White individuals, reflecting small numbers. This variability limits the ability to make strong temporal inferences. Nevertheless, across the entire study period, White individuals consistently had lower rates than non-White individuals ( $P = .0004$ ).

## DISCUSSION

This study is a secondary analysis of publicly available data and is therefore subject to limitations related to missing and, most notably, suppressed data. The analysis is inherently limited in breadth and scope owing to limited data granularity. Specifically, due to

CDC WONDER data suppression rules, the analysis could not include important socioeconomic variables such as income, maternal education, marital status, maternal age, timing of prenatal care, gestational age, and infant birthweight. In addition, racial specificity among non-White populations was suppressed in the Wisconsin-specific analyses.

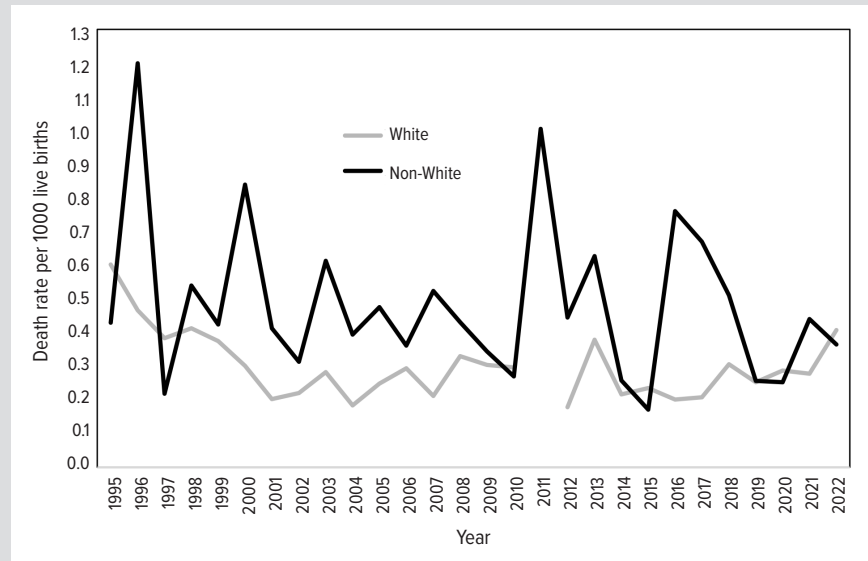
Future investigations could improve upon this work through a collaborative effort involving multiple birth defect registries. Such registries could include the aforementioned variables and provide greater granularity to the results.

It is encouraging that CCDIM has decreased in both the United States and Wisconsin during 1995 to 2022. Nationally, Black or African American individuals experienced higher CCDIM rates than White individuals, whereas Asian or Pacific Islander individuals experienced lower rates. Despite notable year-to-year variability, Wisconsin data also demonstrate higher CCDIM rates among non-White populations compared with White populations. This pattern reflects broader national trends in all-cause infant mortality, which varies by race. Although the persistence of racial disparities in CCDIM is not unexpected, it is encouraging that the magnitude of these disparities has narrowed over time. Nonetheless, continued efforts are needed to eliminate racial disparities in CCDIM.

The etiology of most CCDs remains poorly understood.<sup>1</sup> However, a range of social determinants of health may help explain racial disparities in CCDIM, as they have been shown to exert greater influence on health outcomes than genetic factors or access to care alone.<sup>7</sup> Factors negatively associated with infant mortality among African American women include lower rates of prenatal care utilization, smoking, not completing high school, and maternal age younger than 18 years.<sup>7</sup> Infants born to mothers with pregestational diabetes (type 1 or type 2) have a fivefold higher risk of CCD,<sup>8</sup> and diabetes prevalence is closely linked to racial, ethnic, and socioeconomic inequity. Exposures such as cigarette smoke, wood smoke, and low socioeconomic status during pregnancy have also been associated with increased CCD severity.<sup>9</sup>

Collectively, these social and environmental factors have been associated with later CCD diagnosis (postnatal vs prenatal), higher incidence, increased hospital readmission, poor neurodevelopmental outcomes, and death.<sup>10</sup> The racial disparities in CCDIM observed in this study may therefore reflect the cumulative impact of social determinants of health and structural inequities, including differences in health care infrastructure across communities. Public health professionals and clinicians may be well served to

**Figure 3.** Infant Deaths From Congenital Cardiovascular Abnormalities in Wisconsin, White vs Non-White Race, 1995–2022



focus on prevention efforts on these social factors to reduce both racial disparities and overall CCDIM rates.

**Financial disclosures:** None declared.

**Funding/support:** None declared.

## REFERENCES

- Lopez KN, Morris SA, Sexson Tejtel SK, Espallat A, Salemi JL. US mortality attributable to congenital heart disease across the lifespan from 1999 through 2017 exposes persistent racial/ethnic disparities. *Circulation*. 2020;142(12):1132-1147. doi:10.1161/CIRCULATIONAHA.120.046822
- Ossa Galvis MM, Bhakta RT, Tarmahomed A, et al. Cyanotic heart disease. In: StatPearls. StatPearls Publishing; 2025. Updated June 26, 2023. Accessed May 27, 2026. <http://www.ncbi.nlm.nih.gov/books/NBK500001/>
- Udine ML, Evans F, Burns KM, Pearson GD, Kaltman JR. Geographical variation in infant mortality due to congenital heart disease in the USA: a population-based cohort study. *Lancet Child Adolesc Health*. 2021;5(7):483-490. doi:10.1016/S2352-4642(21)00105-X
- Khallilipalandi S, Lemieux A, Lauzon-Schnittka J, et al. Systematic review and meta-analysis of prenatal risk factors for congenital heart disease: part 1, maternal chronic diseases and parental exposures. *Can J Cardiol*. 2024;40(12):2476-2495. doi:10.1016/j.cjca.2024.07.004
- Richards AA, Garg V. Genetics of congenital heart disease. *Curr Cardiol Rev*. 2010;6(2):91-97. doi:10.2174/157340310791162703
- Gilboa SM, Salemi JL, Nembhard WN, Fixler DE, Correa A. Mortality resulting from congenital heart disease among children and adults in the United States, 1999 to 2006. *Circulation*. 2010;122(22):2254-2263. doi:10.1161/CIRCULATIONAHA.110.947002
- Orischak M, Fru DN, Kelly E, DeFranco EA. Social determinants of infant mortality amongst births to non-Hispanic Black women. *Am J of Obstet Gynecol*. 2022;226(1S):S706. Society for Maternal-Fetal Medicine 42nd Annual Meeting—The Pregnancy Meeting. doi:10.1016/j.ajog.2021.11.1164
- Øyen N, Diaz LJ, Leirgul E, et al. Prepregnancy diabetes and offspring risk of congenital heart disease: a nationwide cohort study. *Circulation*. 2016;133(23):2243-2253. doi:10.1161/CIRCULATIONAHA.115.017465
- Forero-Manzano MJ, Triana-Palencia E, Figueroa-Rueda JA, et al. Association of social determinants with the severity of congenital heart disease. *Pediatr Res*. 2023;93(5):1391-1398. doi:10.1038/s41390-022-02205-6
- Davey B, Sinha R, Lee JH, Gauthier M, Flores G. Social determinants of health and outcomes for children and adults with congenital heart disease: a systematic review. *Pediatr Res*. 2021;89(2):275-294. doi:10.1038/s41390-020-01196-6

advancing the art & science of medicine in the midwest

**WMJ**

*WMJ* (ISSN 2379-3961) is published through a collaboration between The Medical College of Wisconsin and The University of Wisconsin School of Medicine and Public Health. The mission of *WMJ* is to provide an opportunity to publish original research, case reports, review articles, and essays about current medical and public health issues.

© 2026 Board of Regents of the University of Wisconsin System and The Medical College of Wisconsin, Inc.

**Visit [www.wmjonline.org](http://www.wmjonline.org) to learn more.**