Sudden Unexpected Infant Deaths: 2015–2020

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abstract

OBJECTIVE: Although the US infant mortality rate reached a record low in 2020, the sudden infant death syndrome (SIDS) rate increased from 2019. To understand if the increase was related to changing death certification practices or the coronavirus disease 2019 (COVID-19) pandemic, we examined sudden unexpected infant death (SUID) rates as a group, by cause, and by race and ethnicity.

METHODS: We estimated SUID rates during 2015 to 2020 using US period-linked birth and death data. SUID included SIDS, unknown cause, and accidental suffocation and strangulation in bed. We examined changes in rates from 2019 to 2020 and assessed linear trends during prepandemic (2015–2019) using weighted least squares regression. We also assessed race and ethnicity trends and quantified COVID-19–related SUID.

RESULTS: Although the SIDS rate increased significantly from 2019 to 2020 ($P < .001$), the overall SUID rate did not ($P = .24$). The increased SIDS rate followed a declining linear trend in SIDS during 2015 to 2019 ($P < .001$). Other SUID causes did not change significantly. Our race and ethnicity analysis showed SUID rates increased significantly for non-Hispanic Black infants from 2019 to 2020, widening the disparities between these two groups during 2017 to 2019. In 2020, <10 of the 3328 SUID had a COVID-19 code.

CONCLUSIONS: Diagnositic shifting likely explained the increased SIDS rate in 2020. Why the SUID rate increased for non-Hispanic Black infants is unknown, but warrants continued monitoring. Interventions are needed to address persistent racial and ethnic disparities in SUID.

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DOI: https://doi.org/10.1542/peds.2022-058820

Accepted for publication Jan 3, 2023

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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WHAT'S KNOWN ON THIS SUBJECT: United States infant mortality reached a record low in 2020. The sudden infant death syndrome (SIDS) rate increased 15% from 2019 to 2020. Because of diagnostic shifting, changes in SIDS rates must be considered with other sudden unexpected infant deaths.

WHAT THIS STUDY ADDS: Increased SIDS rates in 2020 was likely attributed to diagnostic shifting. Evidence does not support direct or indirect effects of the coronavirus disease 2019 pandemic on increased rates of sudden unexpected infant death, except for non-Hispanic Black infants.

To cite: Shapiro-Mendoza CK, Woodworth KR, Cottengim CR, et al. Sudden Unexpected Infant Deaths: 2015–2020. *Pediatrics*. 2023;151(4):e2022058820

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In 2020, the United States achieved a record low infant mortality rate: 541.9 infant deaths per 100 000 live births.[1] Concurrently, the sudden infant death syndrome (SIDS) rate increased 15% from 2019 to 2020, moving from the fourth to the third leading cause of infant death.[1] It is unknown why the SIDS rate increased, but potential reasons may be related to the coronavirus disease 2019 (COVID-19) pandemic or changing death certification practices.

The COVID-19 pandemic may have affected sudden unexpected infant deaths (SUID) in several ways. Increased pressures on families, caregivers, and communities during the pandemic may have limited opportunities for clinical follow-up after birth (eg, early postpartum discharges and timely well-baby visits after birth hospitalization) and access to safety-net supports (eg, Women, Infants, and Children Supplemental Nutrition Program; Healthy Start).[2] Limited access to these encounters and services might have increased the risk of SIDS and other SUIDs. Clinical follow-up and support services are times when safe sleep messages are communicated, smoking cessation is encouraged, immunizations are administered, and breastfeeding counseling is given, all of which are protective factors against SIDS and SUID.[3–5] Furthermore, pandemic-related losses of or changes in child care arrangements may also have led to an increased SIDS or SUID risk due to unaccustomed infant sleep positioning and other unsafe sleep practices.[6,7] Monitoring changes in SUID rates before and during the COVID-19 pandemic can provide insight to understand if pandemic factors affected SIDS and SUID rates.

The increased SIDS rate previously reported in 2020[1] may also be related to diagnostic shifting as opposed to indirect and direct effects of the COVID-19 pandemic. To understand reasons for the increase, it is important to examine SUID rates as a group in addition to cause-specific rates, and not solely SIDS in isolation. The reported 2020 increase was surprising because in recent years, the term SIDS had fallen out of favor among some medical examiners and coroners; SIDS is used less frequently in favor of other SUID causes, namely unknown cause and accidental suffocation and strangulation in bed (ASSB).[8–12] This diagnostic shifting is well recognized. Until we have standardized reporting practices, monitoring SUID as a group, and not solely monitoring SIDS, is important given the variability in reporting practices and resultant diagnostic shift in the classification of SUID and its subtypes.[10–13]

We explore US mortality data to better understand the epidemiology of SIDS and SUID during 2015 to 2020 and what may have led to the increased SIDS rate from 2019 to 2020. First, we describe overall and cause-specific SUID rates by year and assess trends during 2015 to 2020. Second, we explore changes in SUID rates by race and ethnicity. Because SUID rates may have been affected by COVID-19 or efforts to mitigate COVID-19 exposure, we quantify the number of SUID cases in 2020 that also had COVID-19 listed as a contributing cause of death. Having a complete understanding of changing SUID rates and disparities can help program planners and policymakers adapt and promptly implement risk reduction strategies and interventions for infants at highest risk.

METHODS

We used US period-linked birth and infant death files for 2015 to 2020.[14] This period file was selected to examine changes in SUID before (2015–2019) and during (2020) the COVID-19 pandemic; 2020 is the last year final national SUID data currently available. We calculated overall and cause-specific SUID rates per 100 000 live births along with 95 confidence intervals. In the period-linked file, infants (<365 days) who died in the United States in a given calendar year are linked back with the corresponding birth certificate.[15] Analyses were restricted to infants born to US residents from the 50 states and District of Columbia. SUID included 3 underlying cause-of-death classifications[16,17] coded per the International Classification of Diseases, 10th Revision (ICD-10): SIDS (R95), unknown cause (R99), and ASSB (W75).[18] The ICD-10 is used for official reporting of mortality statistics in the United States and other nations.[15] By law, the official cause of death for SUID cases must be determined and reported by the medicolegal death investigation system (ie, medical examiner and coroners).

We used the overall SUID rate (as opposed to cause-specific rates) to assess rates by race and ethnicity. Using this SUID grouping allowed for consistent comparisons unaffected by death certifier variations in reporting.[8] In addition, the overall SUID rate is less likely to be affected by random variation in small death counts that might occur with some racial and ethnic groups.[8] SUID rates by race and ethnicity were calculated as the number of SUID per 100 000 live births in the specified race and ethnic group in a given year.

We report single race and Hispanic origin groups per the 1997 Office of Management and Budget (OMB) standards[19]: non-Hispanic White, non-Hispanic Black, non-Hispanic American Indian or Alaska Native, non-Hispanic Asian, non-Hispanic

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Native Hawaiian or Other Pacific Islander, and Hispanic. The 2017 period-linked file was the first year for which all 50 states and Washington DC had birth certificate data on race and Hispanic-origin categories by using the 1997 OMB standards. For consistency, analyses of single race and Hispanic origin groups were restricted to 2017 to 2020. Data before 2017 did not follow the 1997 standards and used bridged-race categories (not available in the 2020 data).[15]

COVID-19 status was estimated by using the ICD-10 code, U07.1.[20] This code should be reported when COVID-19 is assumed to have caused or contributed to death. The code was implemented March 24, 2020, in the United States and applied retroactively to cover the entire year.

To quantify the magnitude and direction of changes in SUID rates from 2019 to 2020, we calculated percent change[15,21]; significance levels were adjusted for multiple comparisons by using the Bonferroni method.[22] We then compared the direction of rate changes from 2019 to 2020 to prepandemic trends (2015–2019 and 2017–2019 for race and ethnicity). Prepandemic trends were measured using a weighted least squares regression of the mortality rates over time (years). Finding an increasing or decreasing rate from 2019 to 2020 inconsistent with the prepandemic rates and trends may provide preliminary evidence of a changing pattern. To guide our statistical testing and analysis for linear trends, we followed guidance by National Center for Health Statistics.[22] P values $<.05$ were considered statistically significant.

Line graphs were plotted to show SUID changes over time by cause of death and race-ethnicity groups. Analyses were conducted by using SAS version 9.4 (SAS Institute, Inc, Cary, NC). SUID rates based on <20 deaths were flagged unreliable and suppressed. This analysis did not require institutional review board review because it used deidentified public-use data sets without identifiable private information.

RESULTS

SUID Mortality

Of the 19 446 infant deaths in 2020, 3328 (17.1%) were classified as SUID (combination of R95, R99, and W75). The SUID rate per 100 000 live births increased from 89.5 in 2019 to 92.1 in 2020, but this increase was not significant (Table 1 and Fig 1). In addition, a significant linear trend was not observed for 2015 to 2019 (Fig 1).

In our analyses of specific causes of SUID, we observed that the SIDS (R95) rate was higher than rates for unknown cause (R99) and ASSB (W75) for all study years (Table 1 and Fig 1). Unlike the SUID rate, the SIDS rate increased significantly from 33.3 in 2019 to 38.2 in 2020, and a significant decreasing linear trend in the SIDS rate was observed during 2015 to 2019 (<0.001) (Fig 1). For unknown cause and ASSB, the rates did not change significantly from 2019 to 2020 (30.8 vs 28.9 and 25.4 vs 25.0, respectively), and no significant trend was observed during 2015 to 2019.

The proportion of SUID by each cause fluctuated during 2015 to 2020 (Fig 2). Among SUID in 2020, 41% were classified as SIDS (range 37%–43% during 2015–2019). For all years, the percentage of SUID classified as SIDS was higher than deaths classified as cause unknown (range 31%–37%) and ASSB (range 24%–28%).

Race and Ethnicity

In 2020, the SUID rate per 100 000 live births was highest among non-Hispanic Black (214.0) and non-Hispanic American Indian or Alaskan Native (AIAN) infants (205.1), nearly 3 times the rate for non-Hispanic White infants (75.6) (Table 1 and Fig 3). Non-Hispanic Asian (23.3) and Hispanic infants (59.0) had the lowest rates. The 2020 SUID rate for non-Hispanic Black infants (214.0) was higher than any time during 2017 to 2019 (range 187.3–192.1). The 2020 SUID rates for non-Hispanic AIAN and non-Hispanic White infants were lower than any time during 2017 to 2019. A significant decreasing trend was observed for non-Hispanic White infants during 2017 to 2019 ($P = .02$). For Hispanic and non-Hispanic Asian infants, SUID rates generally increased, but no significant trends were observed. The SUID ratio for non-Hispanic Black infants compared to non-Hispanic White infants increased yearly during 2017 to 2020 from 2.2 in 2017 to 2.8 in 2020.

COVID-19

Among the 19 446 infant deaths in 2020, 35 deaths (0.2%) had COVID-19 listed as an underlying cause of death. Among the 3328 SUID in 2020, <10 deaths had a COVID-19 code indicating an additional (not an underlying) cause of death.

DISCUSSION

Although the SIDS rate increased significantly from 2019 to 2020, a significant increase in the overall SUID and other cause-specific SUID rates were not found. Interestingly, the increase in SIDS was unique to 2020 and contrasted to the declining linear trend in SIDS rates during 2015 to 2019. The lack of increasing SUID rates together with the small number of SUID that also had a COVID-19 cause-of-death code makes it unlikely that increased

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TABLE 1 SUID Mortality Rates by Cause (2015–2020) and Race-Ethnicity (2017–2020), United States

	Number of SUID						SUID Rate per 100 000 Live Births[a] (95% Confidence Interval)					
	2015	2016	2017	2018	2019	2020	2015	2016	2017	2018	2019	2020
Total SUID[b]	3661	3585	3577	3428	3354	3328	92.0 (89.0–95.0)	90.9 (87.9–93.8)	92.8 (89.7–95.8)	90.4 (87.4–93.4)	89.5 (86.5–92.5)	92.1 (89.0–95.2)
Cause-specific												
SIDS	1563	1494	1357	1327	1247	1380	39.3 (37.3–41.2)	37.9 (35.9–39.8)	35.2 (33.3–37.1)	35.0 (33.1–36.9)	33.3 (31.4–35.1)	38.2 (36.2–40.2)
Unknown	1180	1234	1275	1266	1155	1046	29.7 (28.0–31.4)	31.3 (29.5–33.0)	33.1 (31.3–34.9)	33.4 (31.5–35.2)	30.8 (29.0–32.6)	28.9 (27.2–30.7)
ASSB	918	857	945	835	952	902	23.1 (21.6–24.6)	21.7 (20.3–23.2)	24.5 (22.9–26.1)	22.0 (20.5–23.5)	25.4 (23.8–27.0)	25.0 (23.3–26.6)
Race and ethnicity[c]												
Hispanic[d]	—	—	502	487	523	511	—	—	55.9 (51.0–60.7)	55.0 (50.1–59.8)	59.0 (53.9–64.1)	59.0 (53.8–64.1)
NH AIAN	—	—	69	61	59	55	—	—	230.3 (179.2–291.5)	209.7 (160.4–269.3)	207.4 (157.9–267.5)	205.1 (154.5–267.0)
NH Asian	—	—	46	65	52	51	—	—	18.5 (13.5–24.6)	27.0 (20.8–34.4)	21.8 (16.3–28.6)	23.3 (17.3–30.6)
NH Black	—	—	1077	1034	1041	1134	—	—	192.1 (180.6–203.6)	187.3 (175.9–198.7)	189.9 (178.4–201.5)	214.0 (201.6–226.5)
NH NHOPI	—	—	13	25	14	11	—	—	[e]	[e]	[e]	[e]
NH White	—	—	1703	1584	1509	1393	—	—	85.5 (81.4–89.5)	81.0 (77.0–85.0)	78.8 (74.8–82.7)	75.6 (71.6–79.5)

NH, Non-Hispanic; NHOPI, Native Hawaiian or Other Pacific Islander; —, not applicable.

[a] For SUID rates by race and ethnicity, denominator per live births of the specified race and ethnicity.

[b] SUID included 3 underlying cause-of-death classifications coded per the ICD-10: SIDS (R95), unknown cause (R99), and ASSB (W75).

[c] Race and Hispanic origin are reported separately on birth certificates; persons of Hispanic origin may be of any race. Single race is defined as only 1 race reported on the birth certificate. In this table, non-Hispanic women are classified by race. Race categories are consistent with the 1997 Office of Management and Budget standards. Because the 2017 period-linked file was the first year for which all 50 states and Washington DC had birth certificate data on race and Hispanic-origin categories using the 1997 standards, analyses of single race and Hispanic origin groups were restricted to 2017 to 2020.

[d] Includes all persons of Hispanic origin of any race.

[e] SUID rates with a death count less than 20 are considered "unreliable" and, therefore, not presented.

SIDS and SUID rates from 2019 to 2020 were directly related to infant COVID-19 infection. However, the significant increased rate of SUID among non-Hispanic Black infants from 2019 to 2020, but not among other single race and Hispanic infants, deserves further attention because it could be attributable to the COVID-19 pandemic and its impact on social determinants of health.

The declining SIDS trend during 2015 to 2019 without an increasing overall SUID trend is consistent with trends observed during 1990 to 2015[23] and provides evidence of a continued diagnostic shift. Conversely, the 2020 uptick in the SIDS rate compared to 2019 may be initial evidence of new changes in reporting practices. New guidelines for certification and reporting of sudden deaths in pediatrics were published by the National Association of Medical Examiners[24] and the Radcliffe Congress[25] in 2019. If the new guidance was followed, this could have led to increased reporting of SIDS. Both guidance documents state that the presence of sleep environment risk factors (eg, sleep surface sharing, soft bedding, or prone sleep) without adequate evidence for airway obstruction is considered insufficient to certify a death as ASSB and that these deaths may be more appropriately certified as unexplained sudden death or SIDS. However, widespread uptake of this new guidance is unlikely in 1 year's time, and thus too early, to find direct evidence of an effect of these guidelines on reporting. Jurisdictional changes in reporting would likely occur before nationwide changes are detectable. If some larger jurisdictions adopted this guidance, it may have affected reporting practices and resulted in the increased US SIDS rate in 2020. Because SUID occurs infrequently, and the number of yearly jurisdictional deaths is small, yearly cause-specific SUID rates by jurisdiction or state could not be explored. As additional years of data become available, it will be important to use the more stable estimates attainable through combined years of data to monitor jurisdictional trends.[23] It is also possible that changes in reporting may have resulted from medical examiner and coroner offices being overburdened by pandemic-related deaths.[26] Changes in reporting may have affected the ability to conduct thorough and timely death investigations and autopsies and, consequently, made differentiating

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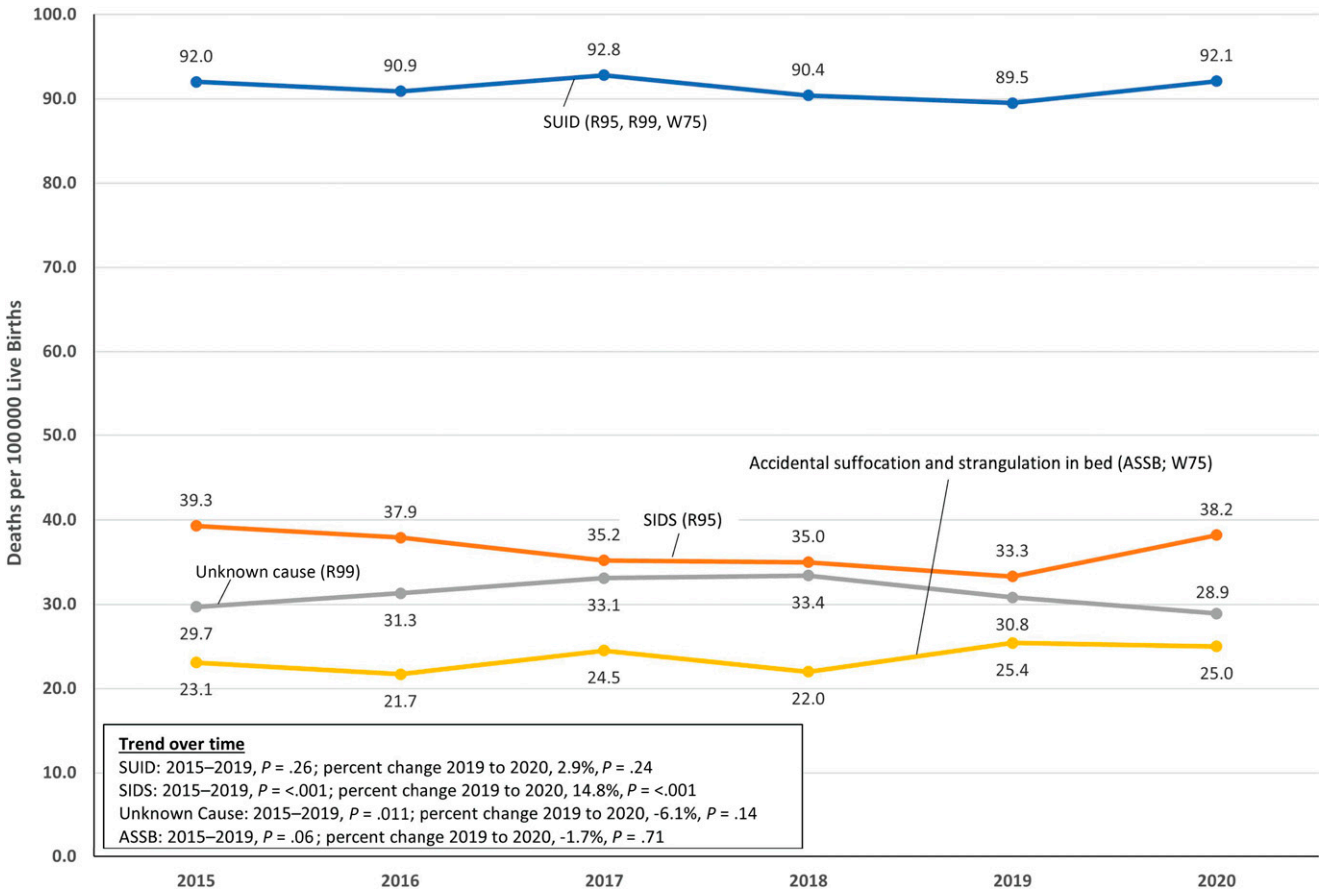

FIGURE 1
SUID and cause-specific SUID rates per 100 000 live births, United States, 2015 to 2020. SUID included 3 underlying cause-of-death classifications coded per the ICD-10: SIDS (R95), unknown cause (R99), and ASSB (W75).

SUID-specific causes more challenging.

Our finding of significantly increased rates of SUID from 2019 to 2020 among non-Hispanic Black infants, but not for other single race or Hispanic infant groups, was unexpected. The COVID-19 pandemic disproportionately affected communities of color compared to non-Hispanic White families through exacerbation of crowded housing, food insecurity,[27] unemployment,[28,29] limited health care access,[30] altered child care, and social or emotional health stressors.[31,32] Infants from these communities were also vulnerable to these effects. Factors exacerbated by the COVID-19 pandemic and related stay-at-home orders (eg, access to health care, changes to or loss of childcare, parental or caregiver financial and emotional stressors, and increased parental or caregiver substance use) may have also influenced the increased SUID rate among non-Hispanic Black infants in 2020.[33–35] These factors affect family vulnerability and may have increased unsafe sleep practices (eg, bedsharing), thereby increasing the occurrence of SIDS and other sudden unexpected infant deaths (SUID).[36,37]

The increasing trend in SUID rates among non-Hispanic Black infants has resulted in a widening racial-ethnic disparity in rates among non-Hispanic Black infants relative to non-Hispanic White infants (2.8-fold in 2020). The disproportionate burden of COVID-19 illness among communities of color and low-income communities may have widened SUID disparities further, especially among non-Hispanic Black infants.[38,39] In addition, the persistently higher rates of SUID among non-Hispanic Black and non-Hispanic AIAN infants found in our study and others[40,41] suggest there may be unique drivers of SUID among these populations, including community-level factors and social determinants of health. Higher rates among these racial and ethnic groups are not unique to SUID; they also exist with other infant health outcomes.[42] By understanding how social determinants of health

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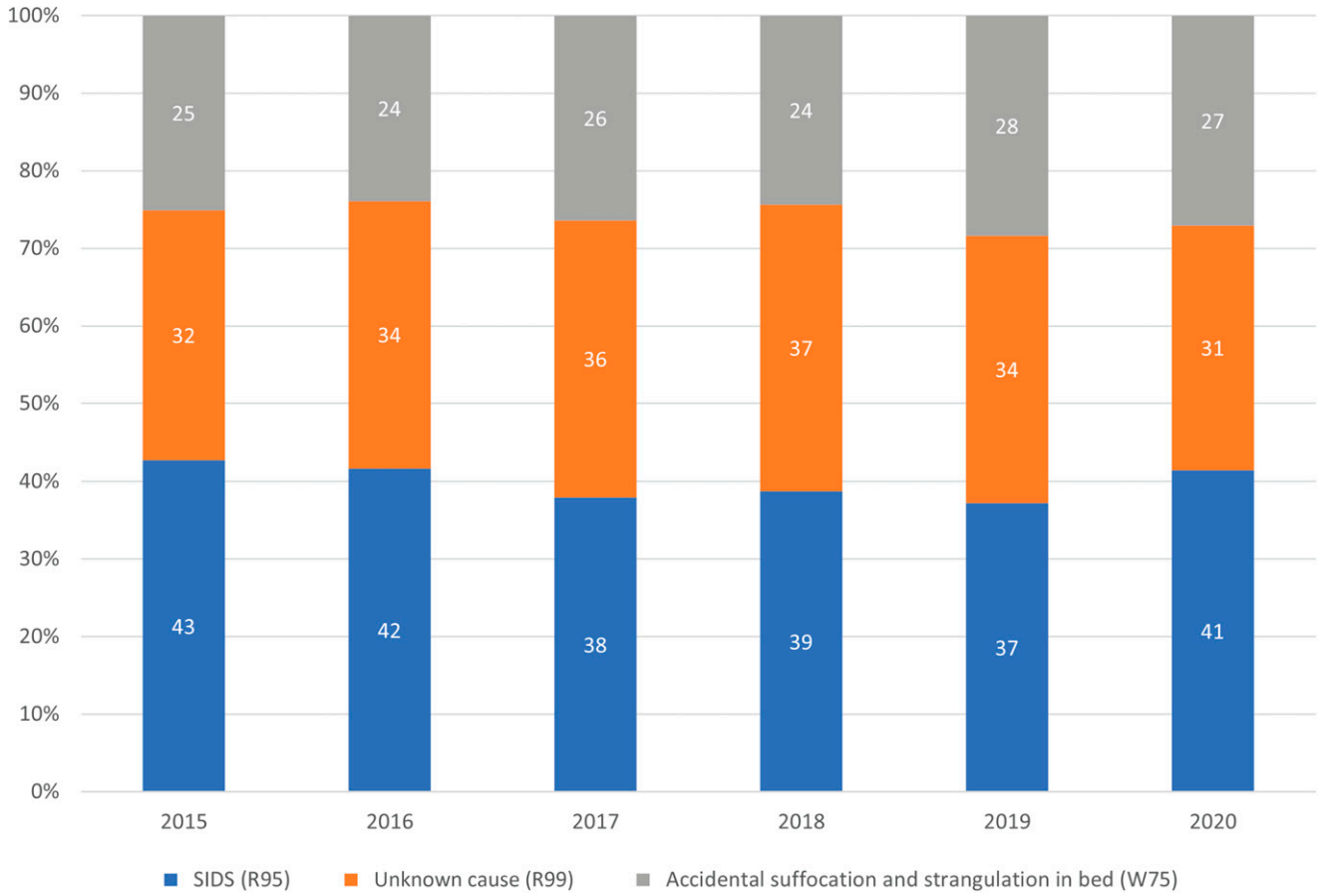

FIGURE 2
Percent distribution of sudden unexpected infant deaths by cause of death and year, United States, 2015 to 2020. Percentages may not sum to 100 because of rounding. SUID included 3 underlying cause-of-death classifications coded per the ICD-10: SIDS (R95), unknown cause (R99), and ASSB (W75).

disproportionately affect infant health and the risks for SUID, health care providers can better support amelioration of those factors.[43] Increased clinical training and quality improvement efforts for safe sleep education, and identification of methods for removing barriers to implementing safe sleep practices may be effective in reducing risk, particularly among disproportionately affected populations.[44] It is important for clinicians to assess additional ways to support, follow-up, and follow-through with families.[44]

Multidisciplinary fatality reviews, such as child death review, and surveillance systems, such as the SUID and Sudden Death in the Young Case Registry, are especially valuable in increasing understanding of the drivers of the racial disparity and SUID.[45,46] Multidisciplinary review teams have access to jurisdictional information not available in death certificate data (eg, reports from death scene investigation, autopsy, child protective services, social services, law enforcement, and medical records).[47] In addition, review teams often have participation from medical providers and social service agencies that know and work directly with families who are affected, and as such, teams can comprehensively review SUID cases, including those that occurred during the COVID-19 pandemic.[47] With this additional information and active participation from multidisciplinary professional membership, child death review and the SUID and Sudden Death in the Young Case Registry are well positioned to analyze these data to better understand disparities and risk factors, as well as establish partnerships to drive prevention activities.

A strength and unique quality of our analysis was the application of the single race (as opposed to bridged race) and Hispanic origin groups standards. As of 2020, the bridged race groups that did not follow 1997 OMB guidance are no longer available in birth certificate data, including the linked birth and infant death files. For consistency, the single race standards will need to be

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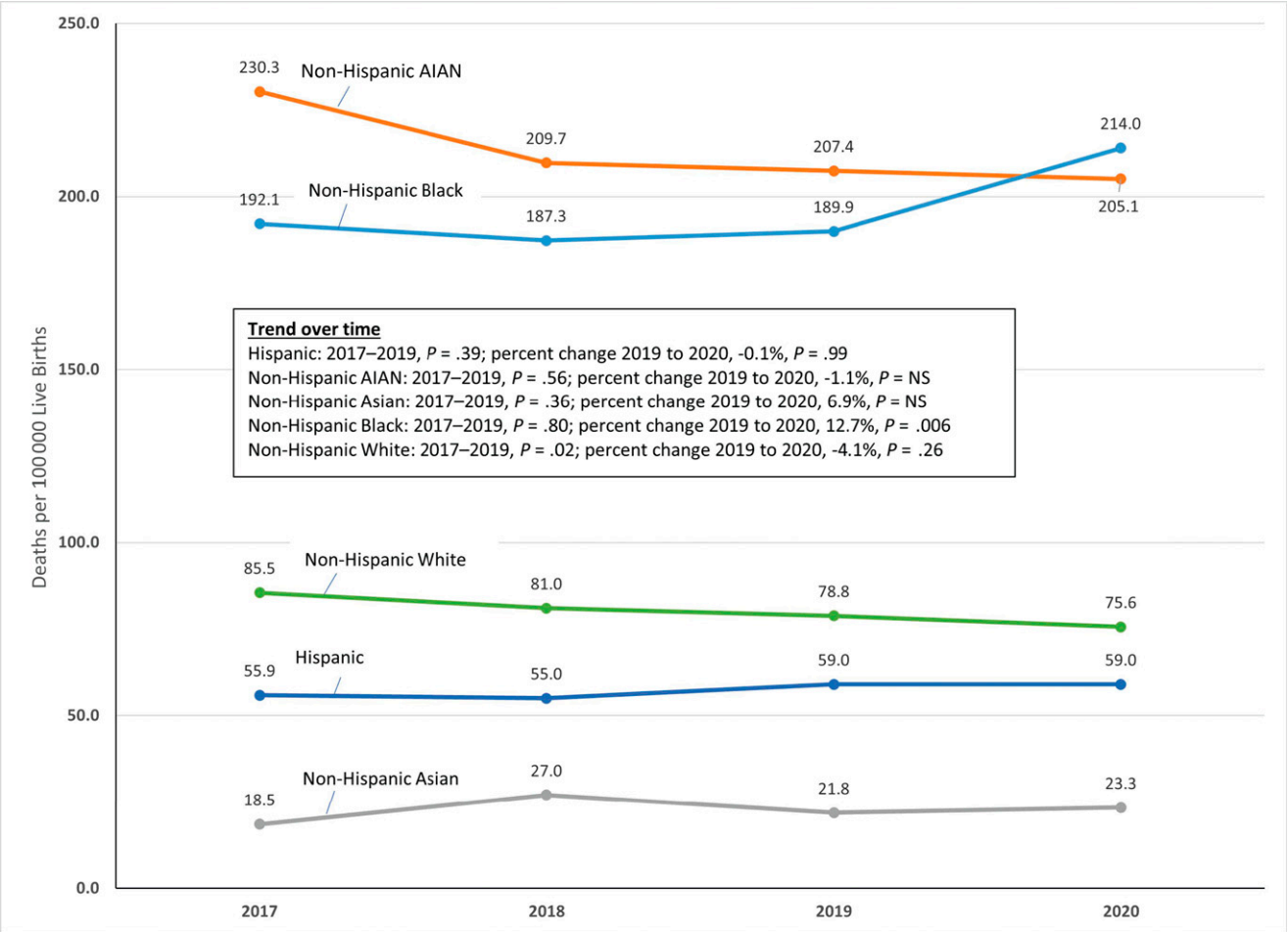

FIGURE 3
Sudden unexpected infant deaths rates per 100 000 live births under 1 year by race and ethnicity, United States, 2017 to 2020. For groups with <100 deaths, statistical significance was assessed by comparing 95% confidence intervals. If confidence intervals overlap, the difference was not statistically significant (NS) at the 95% level.

used to examine SUID rates by race-ethnicity moving forward. Consistent and accurate reporting of race or ethnicity and SUID rate estimates is important for planning the delivery of equitable health services and prioritization of interventions to those infants at highest risk.[48]

This study has a few limitations. First, our analysis could not definitively answer whether SUID rates changed because of the COVID-19 pandemic. With additional years of data, an interrupted time series or Joinpoint analysis will be better able to detect if a changing trend in SUID rates occurred during the COVID-19 pandemic compared to prepandemic years.[22,49,50] However, this analysis was a valuable first step; early monitoring and continued surveillance activities can identify changes in risk. Second, because our study only included the first year of the pandemic, data were not inclusive of the 2021 Delta and Omicron waves, during which COVID-19 cases (and deaths) were higher among children compared with 2020.[51] Without more years of data, the direct effects of COVID-19 infection on SUID rates could not be determined. However, infants generally experience mild COVID-19 illness, although severe disease and death do occur in this age group.[52] Nevertheless, infant mortality declined to a record low in 2020[1] and COVID-19 illness did not appear to contribute to excess infant deaths in 2020 (35 infant deaths and <10 of the SUID had a COVID-19 code). A final limitation is that we did not further disaggregate racial or ethnicity groups. By not disaggregating these groups, we may have masked higher rates of infant mortality, for example among Hispanic subgroups, such as Puerto Rican infants.[53,54]

We provide new insights about why SIDS rates, as previously reported,[1]

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may have increased from 2019 to 2020 and present context about other SUID causes (ie, R95, R99, and W75) implicated in reporting variations and subsequent diagnostic shifting.[11,12] Our findings support evidence that the increased SIDS rate in 2020 as compared to 2019 was likely unrelated to direct effects of the COVID-19 illness but may be attributed to diagnostic shifting in cause-specific SUID rates. Although an overall increased SUID trend during 2015 to 2019 was not observed, continued monitoring is critical; we do not yet understand how the Delta and Omicron COVID-19 variants impacted SUID. Monitoring of indirect factors from the COVID-19 pandemic that may increase the prevalence of SUID risk factors (eg, unsafe sleep environment, smoking, substance use), especially among racial and ethnic subgroups is also important.[7] Further investigation and interventions are needed to address the persistent disparity in SUID rates among non-Hispanic Black and non-Hispanic AIAN infants compared to non-Hispanic White infants.

ABBREVIATIONS

AIAN: American Indian or Alaskan Native
ASSB: accidental suffocation and strangulation in bed
COVID-19: coronavirus disease 2019
ICD-10: International Classification of Diseases, Tenth Revision
OMB: Office of Management and Budget
SIDS: sudden infant death syndrome
SUID: sudden unexpected infant death
WONDER: Wide-ranging Online Data for Epidemiologic Research

FUNDING: Ms Erck Lambert was supported by a contract between CyberData Technologies, Inc. and the Division of Reproductive Health, National Center for Chronic Disease Prevention and Health Promotion, US Centers for Disease Control and Prevention.

CONFLICT OF INTEREST DISCLOSURES: The authors have no potential conflicts of interest relevant to this article to disclose.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

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