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Trends in prepregnancy cardiovascular health in the United States, 2011–2019



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ABSTRACT

Objective: To evaluate contemporary patterns in prepregnancy cardiovascular health (CVH) in the United States (US).

Methods: We conducted a serial, cross-sectional study of National Center for Health Statistics Natality Data representing all live births in the US from 2011 to 2019. We assigned 1 point for each of four ideal prepregnancy metrics (nonsmoking and ideal body mass index [18.5–24.9 kg/m²] provided by maternal self-report, and absence of hypertension and diabetes ascertained by the healthcare professional at delivery) to construct a prepregnancy clinical CVH score ranging from 0 to 4. We described the distribution of prepregnancy CVH, overall and stratified by self-reported race/ethnicity, age, insurance status, and receipt of the Women, Infants, and Children program (WIC) for supplemental nutrition. We examined trends by calculating average annual percent changes (AAPCs) in optimal prepregnancy CVH (score of 4).

Results: Of 31,643,982 live births analyzed between 2011 and 2019, 53.6% were to non-Hispanic White, 14.5% non-Hispanic Black, 23.3% Hispanic, and 6.6% non-Hispanic Asian women. The mean age (SD) was 28.5 (5.8) years. The prevalence (per 100 live births) of optimal prepregnancy CVH score of 4 declined from 42.1 to 37.7 from 2011 to 2019, with an AAPC (95% CI) of -1.4% per year (-1.3,-1.5). While the relative decline was observed across all race/ethnicity, insurance, and WIC subgroups, significant disparities persisted by race, insurance status, and receipt of WIC. In 2019, non-Hispanic Black women (28.7 per 100 live births), those on Medicaid (30.4), and those receiving WIC (29.1) had the lowest prevalence of optimal CVH.

Conclusions: Overall, less than half of pregnant women had optimal prepregnancy CVH, and optimal prepregnancy CVH declined in each race/ethnicity, age, insurance, and WIC subgroup between 2011–2019 in the US. However, there were persistent disparities by race/ethnicity and socioeconomic status.

Cardiovascular risk factors present before pregnancy are associated with increased risk of adverse pregnancy outcomes and subsequent risk of cardiovascular disease (CVD) [1]. Given rising trends in maternal morbidity and mortality in the US due, in part, to CVD [2], defining contemporary patterns in prepregnancy cardiovascular health (CVH) is needed to inform strategies to optimize CVH before conception, when interventions may be most effective because there is a longer time period to modify cardiovascular risk than during pregnancy. Therefore, we sought to determine trends in a composite measure of prepregnancy CVH between 2011 and 2019.

1. Methods

We conducted a serial, cross-sectional study of National Center for Health Statistics birth certificate data representing all live births in the US. Birth certificates are recorded by the medical professional (e.g. physician, certified nurse midwife) present at delivery [3] and include data on four maternal metrics that are part of the American Heart Association CVH framework [4]: prepregnancy smoking, body mass index (BMI), hypertension, and diabetes. These metrics are based on a combination of maternal self-report (pregnancy smoking, height, and weight) and health record data (pregnancy hypertension and diabetes) [5]. We included women aged 15–44 years with data avail-

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Table 1
Maternal characteristics of the analytic sample in the United States, 2011–2019.

Characteristic	Overall	Optimal CVH (4)	Suboptimal CVH (0-3)
N	31,643,982	12,717,518	18,926,464
Age, mean (SD)	28.5 (5.8)	28.6 (5.9)	28.4 (5.8)
Age category, N (%)			
15–24 years	8,605,389 (27.2%)	3,335,594 (26.2%)	5,269,795 (27.8%)
25–34 years	17,869,267 (56.5%)	7,269,198 (57.2%)	10,600,069 (56.0%)
35–44 years	5,169,326 (16.3%)	2,112,726 (16.6%)	3,056,600 (16.1%)
Race/ethnicity, N (%)			
Non-Hispanic White	16,969,241 (53.6%)	7,065,645 (55.6%)	9,903,596 (52.3%)
Non-Hispanic Black	4,600,710 (14.5%)	1,418,417 (11.2%)	3,182,293 (16.8%)
Hispanic	7,388,754 (23.3%)	2,775,995 (21.8%)	4,612,759 (24.4%)
Non-Hispanic Asian	2,101,849 (6.6%)	1,252,042 (9.8%)	849,807 (4.5%)
Other	583,428 (1.8%)	205,419 (1.6%)	378,009 (2.0%)
Education, N (%)			
Less than high school	4,507,924 (14.4%)	1,521,392 (12.1%)	2,986,532 (15.9%)
High school graduate	7,902,746 (25.2%)	2,611,015 (20.8%)	5,291,731 (28.2%)
Greater than high school	18,899,430 (60.4%)	8,438,262 (67.1%)	10,461,168 (55.8%)
Insurance, N (%)			
Medicaid	13,479,003 (42.9%)	4,379,619 (34.7%)	9,099,384 (48.5%)
Private Insurance	15,317,725 (48.8%)	7,091,354 (56.2%)	8,226,371 (43.8%)
Self Pay	1,265,984 (4.0%)	608,204 (4.8%)	657,780 (3.5%)
Other	1,326,799 (4.2%)	536,237 (4.3%)	790,562 (4.2%)
Received WIC, N (%)	12,824,644 (41.0%)	4,133,256 (32.9%)	8,691,388 (46.4%)
Received prenatal care, N (%)	30,462,564 (98.6%)	12,417,885 (98.7%)	18,486,348 (98.5%)
Multiparous, N (%)	19,318,227 (61.2%)	7,167,529 (56.5%)	12,150,698 (64.4%)
Singleton, N (%)	30,580,298 (96.6%)	12,717,518 (96.8%)	18,926,464 (96.5%)

CVH, cardiovascular health; WIC, Women, Infants, and Children program

able for all 4 CVH metrics (representing 96.1% of eligible records). We created a clinical CVH score ranging from 0 to 4 by assigning 1 point for each optimal prepregnancy metric (non-smoking, normal BMI [18.5–24.9 kg/m²], no hypertension, and no diabetes). We described the distribution of prepregnancy CVH, overall and stratified by self-reported race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, and non-Hispanic Asian), age (15–24, 25–34, and 35–44 years), insurance status (Medicaid and private insurance), and receipt of the Women, Infants, and Children program (WIC) for supplemental nutrition (WIC and no WIC). We then calculated average annual percent changes (AAPCs) to describe relative changes in the prevalence of optimal prepregnancy CVH (score of 4) per 100 live births from 2011 to 2019. The data used in this study are publicly available at <https://www.cdc.gov/nchs/nvss/births.htm>, and this study was exempt from IRB review given the deidentified, publicly available data. We used Joinpoint Regression Program version 4.9 to compute AAPCs and Stata version 15.1 for all other analyses.

2. Results

Of 31,643,982 live births analyzed between 2011 and 2019, 53.6% were to non-Hispanic White, 14.5% non-Hispanic Black, 23.3% Hispanic, and 6.6% non-Hispanic Asian women (Table 1). The age distribution was 27.2% aged 15–24 years, 56.5% aged 25–34 years, and 16.3% aged 35–44 years, with a mean age (SD) of 28.5 (5.8) years. 42.9% of women had Medicaid, 48.8% had private insurance, and 41.0% of women received WIC during pregnancy. Compared to women with suboptimal prepregnancy CVH (score of 0 to 3), those with optimal prepregnancy CVH (score of 4) had a greater proportion of non-Hispanic White and non-Hispanic Asian race/ethnicity, greater educational attainment, a greater proportion of private insurance, and a lesser proportion of receipt of WIC and multiparity.

The prevalence (per 100 live births) of optimal prepregnancy CVH score of 4 declined from 42.1 to 37.7 from 2011 to 2019, with an AAPC (95% CI) of -1.4% per year (-1.3, -1.5) (Fig. 1). From 2011 to 2019, the overall prevalence (per 100 live births) of suboptimal prepregnancy CVH (score of 0 to 3) changed from 49.8 to 55.1 for CVH score of 3, 7.8

to 6.8 for CVH score of 2, 0.3 to 0.4 for CVH score of 1, and 0.02 to 0.02 for CVH score of 0.

The decline in optimal prepregnancy CVH was observed across all demographic subgroups (race/ethnicity, age) from 2011–2019. Persistent racial disparities were observed, and the prevalence (per 100 live births) of optimal prepregnancy CVH (score of 4) varied 2-fold from non-Hispanic Black (28.7) to non-Hispanic Asian women (56.5) in 2019. From 2011 to 2019, the relative decline (95% CI) in optimal CVH ranged from -0.8% per year (-0.7, -1.0) in non-Hispanic White women to -2.6% per year (-2.4, -2.7) in Hispanic women. Across age subgroups, trends in optimal CVH were similar; in 2019, prevalence of CVH score of 4 was between 37 and 38 for all age ranges, and rates of decline ranged from -1.0% per year (-0.8, -1.1) in women aged 15–24 years to -1.7% per year (-1.5, -1.8) in women aged 35–44 years.

Optimal prepregnancy CVH also declined across groups reflecting socioeconomic status (insurance and WIC status). Populations with greater socioeconomic advantage had a greater prevalence of optimal prepregnancy CVH; in 2019, this prevalence (per 100 live births) was 43.1 in women with private insurance compared with 30.4 in women with Medicaid, and 42.1 in women not receiving WIC compared with 29.1 in women receiving WIC. AAPC ranged from -1.5% per year (-1.4, -1.7) in women with private insurance to -2.2% per year (-1.8, -2.6) in women receiving WIC.

3. Discussion

This analysis of maternal data from all live births in the US between 2011 and 2019 demonstrates that less than half of women had optimal prepregnancy CVH, and the prevalence of optimal CVH declined by 10.4% over the 8-year study period. Optimal prepregnancy CVH declined in each race/ethnicity, age, and socioeconomic subgroup as assessed by insurance and WIC status. However, there were persistent disparities by race, insurance, and report of WIC. Non-Hispanic Black women had the lowest prevalence and Hispanic women had the fastest rate of decline of optimal clinical CVH. There was approximately a 13 per 100 live birth difference in optimal CVH in the socioeconomic strata (Medicaid vs. private insurance, WIC vs. no WIC). An important limitation of this analysis is the potential for misclassification due to

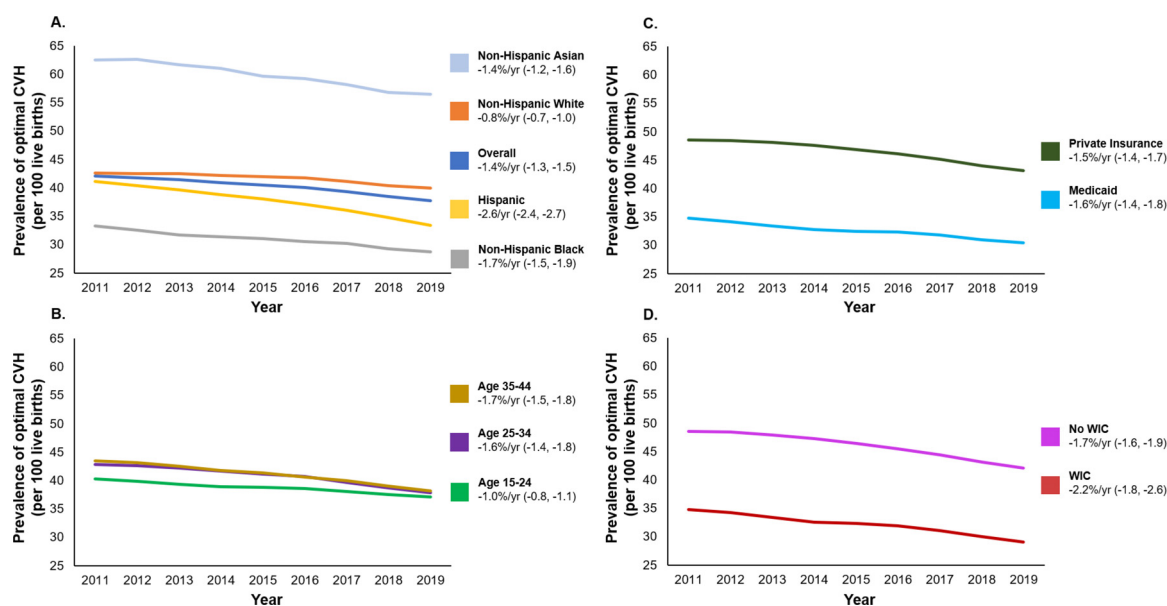


Fig. 1. Trends in the prevalence of optimal clinical prepregnancy cardiovascular health score, 2011–2019.

self-reported body mass index and smoking, and ascertainment bias of prepregnancy diabetes and hypertension. Validation studies have shown that items on birth certificates generally have variable sensitivity and high specificity [6]; for example, the sensitivity of birth certificate data for prepregnancy diabetes is approximately 50%, while the specificity is >98% [7]. Therefore, our analysis focuses on trends and relative differences over time and between race/ethnicity, age, and socioeconomic groups, but likely underestimates the true prevalence of suboptimal prepregnancy CVH. Additional limitations include the lack of objective risk factor levels and no measure of lifestyle factors (e.g., diet, physical activity).

Although data on prepregnancy CVH are sparse, our results are consistent with and complement prior findings from Perak et al. that identified a high prevalence of poor CVH when assessed during pregnancy [8]. Our analysis extends prior findings by shifting the focus upstream and suggesting that poor CVH in pregnancy begins before conception. We also include key differences over time and between subgroups to highlight persistent disparities over time and provide a greater context of the high prevalence of suboptimal prepregnancy CVH. In particular, of all subgroups, prepregnancy CVH in Hispanic women declined the fastest. While subgroup findings should be interpreted cautiously [9], the trend occurs in the context of Hispanic adults having a disproportionately high and rising prevalence of obesity [10] and diabetes [11], and the overall decline in CVH may conceal important heterogeneity among Hispanic/Latina subgroups [12]. The trend of declining prepregnancy CVH across all subgroups over the last decade is also consistent with secular increases in the prevalences of obesity [13], diabetes [14], and hypertension awareness (although the prevalence of hypertension has been stable) [15] among all young adults, which more than offset continuing decreases in smoking prevalence [16]. Future studies should seek to characterize comprehensive CVH, including all seven metrics, in the prepregnancy period, and to contextualize key social determinants of health, including structural racism [17], as upstream drivers of the observed disparities in CVH.

The high and rising prevalence of suboptimal prepregnancy CVH underscores the need to optimize CVH before conception when interventions may have the greatest benefit. While each component of CVH has been individually associated with higher risk of adverse maternal and offspring outcomes [1], the composite CVH profile has been additionally associated with adverse pregnancy outcomes [18] as well as long-term maternal [19] and offspring CVH [20]. Given these implications, tar-

geted clinical and public health efforts beginning before pregnancy are needed. One potential strategy that has been recommended by the American Heart Association and American College of Obstetricians and Gynecologists [21] is comprehensive assessment of CVH before pregnancy in women of reproductive age to achieve consistent health messaging across the life course and optimize maternal and childhood outcomes.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Disclosures

None.

Contributions

MCW and SSK designed the study. MCW conducted the statistical analysis. All authors contributed to interpretation of data. MCW and SSK drafted the manuscript. All authors revised the manuscript for important intellectual content. SSK provided supervision of the research.

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