

Measured 25(OH)D in US Pregnant Women by Race/Ethnicity Over Time vs. the Within-Group Rise in Hypertensive Disorders of Pregnancy

Measured vitamin D status cannot explain the post-2010 rise in hypertensive disorders of pregnancy (HDP) within any US racial/ethnic group. Where 25(OH)D has been tracked over time, it was flat from 1988 to 2006 and then rose modestly from 2007 to 2023 in White, Black and (more weakly) Hispanic women. [nih](#) [cdc](#) Over the same years, NCHS's National Vital Statistics Reports Vol. 75 No. 4 (Gregory, July 2026) shows gestational hypertension rising in each of the six largest race and Hispanic-origin groups, by 66% for Black mothers (7.4% to 12.3%) up to 103% for Asian mothers (3.5% to 7.1%). [cdc](#) Either the two series move in opposite directions, or vitamin D is flat while hypertension surges.

TL;DR

- **No published US series follows 25(OH)D in pregnant women by race over time.** NHANES oversampled pregnant women only in 1999–2006, which gives the only national pregnant-by-race 25(OH)D means (from 2001–2006). After 2007 there are too few pregnant women for race-by-cycle estimates (e.g., 223 in 2007–2014). [nih](#) The best within-group trend evidence therefore comes from two sources: non-pregnant women and adults of the same groups, and stored pregnancy blood samples from two eras (1959–1966 vs. later Pittsburgh pregnancies).
- **Vitamin D levels within each group did not fall while HDP rose.**
 - Standardized NHANES data show no trend from 1988 to 2006, then increases. [nih](#) [cdc](#)
 - Black adults went from 44.6 to 50.5 nmol/L (17.8 to 20.2 ng/mL) between 2007–2010 and 2011–2014. White adults rose 2.7 nmol/L, and Mexican Americans were flat.
 - Per the CDC 2026 Nutrition Report, the population mean was about 20% higher (adjusted for demographic changes) by 2021–2023, and the racial gap was smaller. [cdc](#)
 - In stored pregnancy samples, the share below 50 nmol/L (20 ng/mL) was lower in later Pittsburgh pregnancies than in 1959–1966, for both Black and White women without preeclampsia.
 - The only weak contrary signal is a reported increase in severe deficiency among pregnant/lactating Black women in 2021–2023, based on very small numbers. [springer](#)
- **The observed vitamin D changes are far too small to matter, even using the strongest observational vitamin D–preeclampsia effect size.** Bodnar 2007 (JCEM) found an

adjusted OR of 2.4 (95% CI 1.1–5.4) per 50 nmol/L decline. [nih](#) At that rate, a +73% rise in HDP would need a population-wide fall of about 31 nmol/L (12 ng/mL). The actual change was a small increase. Vitamin D may still contribute to the Black–White HDP gap at any one time, but it does not explain the rise within groups over time.

Key Findings

- 1. Data on pregnant women are sparse and stop being race-specific after 2006.** The only nationally representative pregnant-by-race means come from NHANES 2001–2006 (n = 928 pregnant women). They were measured with the original DiaSorin radioimmunoassay, not the standardized LC-MS/MS method: [nih](#)
 - non-Hispanic White: 77 nmol/L (30.8 ng/mL) [nih](#)
 - non-Hispanic Black: 39 nmol/L (15.6 ng/mL) [nih](#)
 - Hispanic: 56 nmol/L (22.4 ng/mL) [nih](#)
 - other: 54 nmol/L (21.6 ng/mL) [nih](#)NHANES stopped oversampling pregnant women in 2007. [umich](#) [cdc](#) CDC’s own 2026 trend analysis left pregnant women out because only 223 were surveyed in 2007–2014. [nih](#)
- 2. Pregnant women have higher levels than non-pregnant women of the same race, mainly because of prenatal vitamins.** In 2001–2006, 66% of pregnant women took ≥400 IU/day vitamin D vs. 29% of non-pregnant women. Pregnant women not taking supplements averaged only 46 nmol/L (18.4 ng/mL). [nih](#) The racial ordering (White > Hispanic > Black) is the same in pregnant and non-pregnant women, so non-pregnant trends are a reasonable guide to direction. [nih](#)
- 3. The national 25(OH)D trend runs opposite to the HDP trend.**
 - From 1988 to 2006, standardized NHANES data show no change in mean 25(OH)D. [nih](#) Birth-certificate HDP was roughly stable at about 3–4% in those years.
 - From 2007 to 2014, 25(OH)D rose: by 5–6 nmol/L in 2007–2010, with further increases through 2014. [cdc](#) [cdc](#)
 - The CDC 2026 Nutrition Report (Pfeiffer 2026b) finds that, “adjusting for demographic changes over time, mean concentrations of 25(OH)D increased ~20% from NHANES 2001–2002 to August 2021–August 2023.” [cdc](#) [cdc](#)
 - Over that same stretch, NVSR Vol. 75 No. 4 reports gestational hypertension on birth certificates rose 73%, from 6.0% in 2016 to 10.4% in 2024 (about 7% a year). [contemporaryobgyn](#) [cdc](#)
- 4. The rise in 25(OH)D was, if anything, larger in Black adults than White adults (+5.9 vs. +2.7 nmol/L from 2007–2010 to 2011–2014), and the Black–White gap narrowed by 4.3 nmol/L.** [nih](#) CDC reports that race and Hispanic-origin differences were smaller in 2021–

2023 than in 2001–2002. [cdc](#) Yet HDP among Black women rose 66%, close to the 77% rise among White women. [cdc](#)

5. Asian women have the largest relative HDP increase but national vitamin D data only from 2011 on.

- NVSR 75-4 reports that their gestational hypertension rate more than doubled (3.5% to 7.1%, +103%), though it remained the lowest absolute rate in 2024. [contemporaryobgyn](#)
- Their vitamin D status has been roughly stable: about 7.6–8% below 30 nmol/L in both 2011–2014 and 2017–2018, with a median of 60.0 nmol/L (24.0 ng/mL) in 2017–2018. [sciencedirect](#) [nih](#)
- No national 25(OH)D series exists for American Indian/Alaska Native or Native Hawaiian/Pacific Islander women.

6. Studies link low 25(OH)D to preeclampsia, mainly severe preeclampsia, but the link is not large enough to drive the trend. In the 1959–1966 Collaborative Perinatal Project (CPP), 25(OH)D ≥ 50 nmol/L was associated with a 35% lower risk of severe preeclampsia. After adjustment, it was not associated with preeclampsia overall or with mild preeclampsia. [nih](#) The VDAART trial (4,400 vs. 400 IU/day starting at 10–18 weeks) did not reduce preeclampsia in its intention-to-treat analysis. [mendeley](#) [jci](#)

Details

1. Pregnant women: national data (NHANES)

NHANES III (1988–1994) and 2000–2004. Looker et al. (AJCN 2008) reported that in NHANES 2000–2004, pregnant women aged 13–56 had a higher adjusted mean 25(OH)D (69.5 nmol/L; 27.8 ng/mL; $n = 739$) than non-pregnant women (61.5 nmol/L). [sciencedirect](#)

These are pre-standardization radioimmunoassay values and were not published by race for pregnant women.

NHANES 2001–2006 (Ginde et al., AJOG 2010). This is the key pregnant-by-race dataset: 928 pregnant and 5,173 non-pregnant women aged 13–44. [sciencedirect](#)

- Pregnant women averaged 65 nmol/L (26.0 ng/mL) vs. 59 nmol/L for non-pregnant women. [sciencedirect](#)
- By trimester: 55 nmol/L in the first, 62 in the second and 80 in the third. [nih](#)
- Pregnant women were 56% non-Hispanic White, 16% non-Hispanic Black, 20% Hispanic and 8% other. [nih](#)
- Season could not be controlled, because the month of examination was not in the public file. [nih](#)
- The assay was the DiaSorin RIA. CDC later released LC-MS/MS-equivalent values for 2001–2006, but Ginde’s published means are the original values. [cdc + 2](#)

NCHS Data Brief 59 (2001–2006). Pregnant or lactating women (n = 1,067) had a median 25(OH)D of 62.4 nmol/L (25.0 ng/mL), with the 5th percentile at 24.5 nmol/L. [cdc](#) After adjusting for age and season, they were less likely than other women of childbearing age to be at risk of deficiency (<30 nmol/L). [cdc](#) [cdc](#) Race-specific values for pregnant women were not reported.

NHANES 2007 onward.

- The 1999–2006 supplemental sample of pregnant women was dropped in 2007 so the survey could oversample all Hispanics. Non-Hispanic Asians were added as an oversampled group in 2011–2014. [sciencedirect](#) [epa](#)
- NHANES now releases pregnancy status only for women aged 20–44. [cdc](#)
- CDC’s 2026 trend paper (Pfeiffer et al.) explicitly left pregnant women out of its trend analysis because the numbers were small. [nih](#)
- Pooled analyses exist (e.g., 1,054 pregnant women across 2001–2018 and 2021–2023 in a cadmium study), but none reports 25(OH)D by race and period. [springer](#)

Sun (J Racial Ethn Health Disparities, 2025/2026). This is the only post-2007 national statement on pregnant/lactating women by race: “An increase in severe 25(OH)D deficiency was also observed in pregnant and lactating African American women during the 2021–2023 period.” [nih](#) The study also found that 61.4% of pregnant/lactating Black women consumed <400 IU/day in 2007–2020. [springer](#) [nih](#) Treat this as a weak signal:

- The abstract gives no percentages by period.
- Pregnant and lactating women are combined.
- Single-cycle NHANES counts of pregnant Black women are very small.
- It concerns 2021–2023, well after the HDP acceleration began (about 2010).

2. Pregnant women: cohort data across eras

The only true within-group comparison across eras in pregnancy uses stored blood samples measured with LC-MS/MS in two case-control studies by Bodnar’s group. [nih](#) The figures below are for controls (women without preeclampsia).

- **CPP (1959–1966, 12 US sites):** 70% of Black mothers and 40% of White mothers had 25(OH)D <50 nmol/L (<20 ng/mL). The geometric mean in Black mothers was 36.6 nmol/L (14.6 ng/mL). [nih](#)
- **EVITA (later Pittsburgh pregnancies; exact years not stated in the source reviewed):** 53% of Black and 9% of White mothers were <50 nmol/L. The geometric mean in Black mothers was 45 nmol/L (18.0 ng/mL). [nih](#)

Both groups therefore had better vitamin D status in the later era, while HDP was much more common in recent decades than in the 1960s–1980s. The comparison is imperfect (different

sites, case-control sampling, latitude), but it points the same way as NHANES.

Contemporary cohorts from a single era consistently show the same racial ordering but cannot show trends:

- **Pittsburgh, 1997–2001 (Bodnar, J Nutr 2007):** 29% of Black and 5% of White pregnant women had 25(OH)D <37.5 nmol/L (15 ng/mL). [nih](#) [nutrition](#)
- **Charleston, SC (Hollis/Wagner group):** at <14 weeks, means were 15.5 ng/mL (38.8 nmol/L) in African American, 24.1 ng/mL (60.3 nmol/L) in Hispanic and 29.0 ng/mL (72.5 nmol/L) in Caucasian women (RIA). [nih](#)
- **Boston, Brigham and Women's, 2007–2009:** first-trimester 25(OH)D was <50 nmol/L in 75% of Black vs. 19% of White women. Prenatal vitamin use was reported by 56% of Black vs. 86% of White women. [nature](#)
- **South-eastern US, 2009–2011 (n = 504):** vitamin D insufficiency (as defined by the authors) affected 47% of non-Hispanic White, 91% of non-Hispanic Black and 75% of Hispanic women. [nih](#)
- **ECHO (5 sites, n = 912):** 25(OH)D was <20 ng/mL (50 nmol/L) in 56.9% of Black vs. 31.0% of White mothers. [contemporaryobgyn](#)

3. Non-pregnant proxy data (women of reproductive age and adults), not pregnant women

- **1988–2006 (standardized):** Schleicher et al. (AJCN 2016), using LC-MS/MS-equivalent values, found no time trend in mean 25(OH)D across 1988–2006. A 5–6 nmol/L rise followed in 2007–2010, coinciding with higher-dose supplement use. [nih + 2](#) Older, unstandardized NCHS analyses had reported that risk of deficiency among females ≥12 rose from 7% (1988–1994) to 11% (2001–2002). [cdc](#) That apparent worsening was largely an assay artifact, so the standardized data should be preferred. [nih](#)
- **2001–2006, non-pregnant women (Ginde, RIA):** non-Hispanic White 67 nmol/L (26.8 ng/mL), Black 33 nmol/L (13.2 ng/mL), Hispanic 48 nmol/L (19.2 ng/mL), other 46 nmol/L (18.4 ng/mL). [nih](#)
- **2007–2010, all ages ≥12:** non-Hispanic Black 46.6 nmol/L (18.6 ng/mL) vs. non-Hispanic White 75.2 nmol/L (30.1 ng/mL). [nih](#)
- **2007–2010 → 2011–2014, adults (Schleicher, J Nutr 2021):**
 - Non-Hispanic Black adults rose from 44.6 to 50.5 nmol/L (17.8 to 20.2 ng/mL), an increase of 5.9 nmol/L. White adults rose 2.7 nmol/L. [nih](#)
 - Mexican Americans were essentially unchanged, and women's mean rose about 4 nmol/L. [nih](#)
 - The share taking ≥1,000 IU/day supplements rose from 4% to 16%. [cdc](#) [cdc](#)
- **2011–2014 (Herrick, AJCN 2019):** prevalence <30 nmol/L (12 ng/mL) was 17.5% in non-Hispanic Black, 7.6% in non-Hispanic Asian, [sciencedirect](#) 5.9% in Hispanic and 2.1% in

non-Hispanic White persons. [sciencedirect](#)

- **2017–2018 (Kalra, Nutrients 2024):** weighted medians were 76.1 nmol/L (30.4 ng/mL) for non-Hispanic White, 47.7 (19.1 ng/mL) for non-Hispanic Black, 55.5 (22.2 ng/mL) for Mexican American, 62.8 (25.1 ng/mL) for other Hispanic and 60.0 (24.0 ng/mL) for non-Hispanic Asian persons. [nih](#) Non-Hispanic Black females aged 20–39 had a median of 38.9 nmol/L (15.6 ng/mL), the lowest of any subgroup. [nih](#) [nih](#)
- **2001–2002 → 2017–2018:** one NHANES analysis reports deficiency among non-Hispanic Black adults falling from 72.4% to 53.1% (P for trend <0.001), and among non-Hispanic White adults from 14.0% to 12.2% (P = 0.027). [frontiersin](#)
- **2001–2002 → August 2021–August 2023 (CDC 2026 Nutrition Report factsheet), persons ≥6 years:**
 - Insufficiency (<50 nmol/L) fell from 28% to 22%. [cdc](#) [cdc](#)
 - Excess (>125 nmol/L) rose from <1% to 8%. It was highest in females (13.2%) and non-Hispanic White persons (12.3%). [cdc](#) [cdc](#)
 - Race and Hispanic-origin differences narrowed but persisted. [cdc](#)

4. Supplement use and intake among pregnant women

- In NHANES 1999–2018, 78.0% of pregnant women aged 20–44 reported using dietary supplements vs. 46.4% of non-pregnant women. [jamanetwork](#)
- A JAMA Network Open analysis found pregnant women’s vitamin D intake was 11.5 µg/d (460 IU) in 1999–2000 and 14.8 µg/d (592 IU) in 2013–2018. The trend was not statistically significant (P = .31). [jamanetwork](#)
- Prenatal supplement use is most common among non-Hispanic White and higher-income pregnant women. [nationalacademies](#) In the Boston cohort, not taking prenatal vitamins was associated with deficiency in White women (OR 3.5) but not Black women (OR 1.0). [nature](#) [nih](#)
- Net: there is no evidence that prenatal vitamin D intake fell in any group in a way that could have lowered 25(OH)D after 2010.

5. Studies linking measured 25(OH)D to HDP, by race, and mediation

- **Bodnar 2007 (JCEM, Pittsburgh 1997–2001):** “After confounder adjustment, a 50-nmol/liter decline in 25(OH)D concentration doubled the risk of preeclampsia (adjusted odds ratio, 2.4; 95% CI, 1.1–5.4).” Cases had a geometric mean of 45.4 nmol/L (18.2 ng/mL) vs. 53.1 nmol/L in controls. [nih](#) The study used an ELISA, not LC-MS/MS. [nih](#)
- **Bodnar 2014 (Epidemiology, CPP 1959–1966; 717 cases, 2,986 non-cases; LC-MS/MS):**
 - After adjustment, there was no association with preeclampsia overall or with mild preeclampsia. [nih](#)

- For severe preeclampsia, ≥ 50 vs. < 50 nmol/L gave an adjusted RR of 0.65 (0.43–0.98), about 3 fewer cases per 1,000 pregnancies. [nih](#)
- Race-stratified results (White vs. non-White) did not show a clear dose-response in either group. [nih](#)
- **VDAART (JCI 2016):** supplementation starting at 10–18 weeks did not reduce preeclampsia in the intention-to-treat analysis. In a cohort analysis, 25(OH)D ≥ 30 ng/mL (75 nmol/L) in both early and late pregnancy was associated with lower risk (aOR 0.28; 0.10–0.96). The control arm received 400 IU/day. [jci + 2](#)
- **nuMoM2b (2010–2013):** the published analysis of what explains the racial disparity in severe preeclampsia examined pre-pregnancy conditions, not vitamin D. Cardiovascular conditions explained 36.6% of the association between Black race and severe preeclampsia ($p = 0.07$). [plos](#) This review found no nuMoM2b analysis of whether vitamin D explains part of the HDP disparity.
- **Closest mediation example (not HDP):** in a Pittsburgh cohort, adding second-trimester 25(OH)D to the model reduced the Black-White odds ratio for small-for-gestational-age birth from 2.72 to 1.85. This suggests vitamin D may contribute to racial disparities at a point in time. [nih](#)
- **Gestational hypertension specifically,** the outcome driving the NCHS birth-certificate rise, has very little US race-stratified 25(OH)D data. Almost all studies examine preeclampsia.

6. Magnitude check

Take Bodnar 2007's aOR of 2.4 per 50 nmol/L at face value, even though it is the strongest US estimate and the larger CPP study did not replicate it for overall preeclampsia. A +73% relative increase in HDP would then require an average within-group fall in 25(OH)D of about 31 nmol/L (12.5 ng/mL). The observed within-group changes since 2007 are increases of about 3–6 nmol/L. So vitamin D status cannot account for the within-group HDP rise even under generous assumptions. At most, it could have slightly offset other drivers.

Summary Table A: Measured 25(OH)D by group and period

Population	Group	Period	Mean/median 25(OH)D	% deficient	Source
Pregnant	All	2000–2004	69.5 nmol/L (27.8 ng/mL) adj. mean	Not reported	Looker 2008 AJCN
Pregnant	NH White	2001–2006	77 nmol/L (30.8 ng/mL)	Not reported	Ginde 2010 AJOG
Pregnant	NH Black	2001–2006	39 nmol/L (15.6 ng/mL)	Not reported	Ginde 2010 AJOG
Pregnant	Hispanic	2001–2006	56 nmol/L (22.4 ng/mL)	Not reported	Ginde 2010 AJOG
Pregnant	Other	2001–2006	54 nmol/L (21.6 ng/mL)	Not reported	Ginde 2010 AJOG
Pregnant/lactating	All	2001–2006	62.4 nmol/L (25.0 ng/mL) median	Lower than nonpregnant	NCHS DB 59
Pregnant/lactating	NH Black	2021–2023	Not reported	<25 nmol/L rose (no %)	Sun 2025
Pregnant controls	Black	1959–1966	36.6 nmol/L (14.6 ng/mL) GM	70% <50 nmol/L	CPP via Bodnar group
Pregnant controls	White	1959–1966	Not reported	40% <50 nmol/L	CPP via Bodnar group
Pregnant controls	Black	Later Pittsburgh	45 nmol/L (18.0 ng/mL) GM	53% <50 nmol/L	EVITA via Bodnar group
Pregnant controls	White	Later Pittsburgh	Not reported	9% <50 nmol/L	EVITA via Bodnar group

Population	Group	Period	Mean/median 25(OH)D	% deficient	Source
Pregnant	Black / White	1997–2001	Not reported	29% / 5% <37.5 nmol/L	Bodnar 2007 J Nutr
Pregnant	Black / White	2007–2009	Not reported	75% / 19% <50 nmol/L	Boston BWH cohort
Pregnant	Black / White	ECHO (various)	Not reported	56.9% / 31.0% <50 nmol/L	ECHO 5 sites
Non-pregnant women	NH White / NH Black / Hispanic	2001–2006	67 / 33 / 48 nmol/L	Not reported	Ginde 2010 AJOG
Adults (proxy)	NH Black	2007–2010 → 2011–2014	44.6 → 50.5 nmol/L (17.8 → 20.2 ng/mL)	Not reported	Schleicher 2021 J Nutr
Adults (proxy)	NH White	2007–2010 → 2011–2014	+2.7 nmol/L	Not reported	Schleicher 2021 J Nutr
Adults (proxy)	Mexican American	2007–2010 → 2011–2014	Essentially unchanged	Not reported	Schleicher 2021 J Nutr
Age ≥1 (proxy)	NH Asian / NH Black / NH White / Hispanic	2011–2014	Not reported	7.6% / 17.5% / 2.1% / 5.9% <30 nmol/L	Herrick 2019 AJCN
All ages (proxy)	NH White	2017–2018	76.1 nmol/L (30.4 ng/mL) median	1% <30 nmol/L	Kalra 2024 Nutrients
All ages (proxy)	NH Black	2017–2018	47.7 nmol/L (19.1 ng/mL) median	21% <30 nmol/L	Kalra 2024 Nutrients
All ages (proxy)	Mexican American	2017–2018	55.5 nmol/L (22.2 ng/mL) median	8% <30 nmol/L	Kalra 2024 Nutrients
All ages (proxy)	NH Asian	2017–2018	60.0 nmol/L (24.0 ng/mL) median	8% <30 nmol/L	Kalra 2024 Nutrients

Population	Group	Period	Mean/median 25(OH)D	% deficient	Source
Females 20–39 (proxy)	NH Black	2017–2018	38.9 nmol/L (15.6 ng/mL) median	Not reported	Kalra 2024 Nutrients
Age ≥6 (proxy)	All	2001–2002 → 2021– 2023	Mean up ~20%	28% → 22% <50 nmol/L	CDC 2026 Nutrition Report

Summary Table B: 25(OH)D trend vs. HDP trend, by group

Group	25(OH)D trend (best evidence)	HDP trend 2016→2024	Could vitamin D explain the within- group rise?
NH White	Flat 1988–2006; rising 2007–2023; most often >125 nmol/L	6.4% → 11.3% (+77%)	No — opposite direction
NH Black	Rising 2007–2014 (+5.9 nmol/L); <50 nmol/L share falling 2001–2018; weak signal of more severe deficiency in pregnant/lactating 2021– 2023	7.4% → 12.3% (+66%)	No — mostly opposite; late signal too small and too late
Hispanic / Mexican American	Flat 2007–2014; status intermediate	4.9% → 8.5% (+73%)	No — flat exposure cannot drive a 73% rise
NH Asian	Data only since 2011; roughly stable (~8% <30 nmol/L)	3.5% → 7.1% (+103%)	No — largest HDP rise with stable status
AIAN	No national 25(OH)D series	7.6% → 13.2% (+74%)	Cannot be assessed
NHOPI	No national 25(OH)D series	6.0% → 10.6% (+77%)	Cannot be assessed

Recommendations

- Drop the vitamin D trend as an explanation for the within-group HDP rise.** Both the composition test (racial mix) and the within-group test (measured 25(OH)D over time)

now point the same way. Vitamin D can still reasonably be argued to raise risk at any one time, and possibly to explain part of the Black-White gap in severe preeclampsia, but that is a different claim.

2. If you want a direct series for pregnant women, build it from NHANES microdata.

- Pool pregnant women aged 20–44 across 2007–2012, 2013–2018 and 2017–March 2020/2021–2023.
- Use LC-MS/MS values, or LC-MS/MS-equivalent values for 2001–2006.
- Adjust for season and trimester, and report by three broad groups (NH White, NH Black, Hispanic).
- Expect wide confidence intervals and some cells too small to publish. Estimates for pregnant Asian, AIAN and NHOPI women will not be reportable.

3. Better sources for a true time series:

- Health-system lab data, such as Kaiser Permanente prenatal 25(OH)D tests. The caveat is that testing is not random.
- ECHO pooled prenatal 25(OH)D by enrollment year.
- Newborn dried blood spot 25(OH)D from state screening archives. These would give population-based, race-linked measures across birth years.

4. Look elsewhere for the HDP drivers. Candidates that fit a period effect across all groups include:

- rising pre-pregnancy obesity and chronic hypertension
- older maternal age
- changes in diagnostic criteria and blood pressure thresholds
- better recording on birth certificates

These were not evaluated in this review and should be tested with the same within-group logic.

Caveats

- **Assay changes:** NHANES used RIA through 2006 and LC-MS/MS from 2007, so only LC-MS/MS-equivalent data should be used for trends. [cdc](#) The Ginde 2010 and Looker 2008 pregnant means are original RIA values. Bodnar 2007 used ELISA, and Hollis/Wagner used RIA.
- **Seasonality and geography:** NHANES examines northern sites in summer and southern sites in winter. Because racial groups are unevenly distributed by region, this can bias race comparisons. [cdc](#) Ginde could not adjust for season.
- **Race categories changed:** NHANES reported Mexican American (not all Hispanic) until 2007 and added non-Hispanic Asian only in 2011. CPP used White, Black and Puerto Rican. Birth certificates use different bridged/single-race categories.

- **Proxy limitation:** non-pregnant trends show direction only, because pregnant women's 25(OH)D depends heavily on prenatal vitamin use and trimester.
- **Outcome mismatch:** most 25(OH)D studies examine preeclampsia, whereas the NCHS series is gestational hypertension on birth certificates.
- **Weak or incomplete sources:** the Sun 2025 abstract gives no numeric pregnant-by-period values. The EVITA era is not specified in the source reviewed. The 2001–2018 Black/White deficiency series uses the authors' own cutoff.
- **Interpreting the Black-White 25(OH)D gap:** CDC notes that Black persons have lower total 25(OH)D but better bone outcomes, possibly because of differences in vitamin D-binding protein and inflammation.  Total 25(OH)D may therefore overstate functional deficiency in Black women.

Conclusion

Measured 25(OH)D trends within each racial/ethnic group cannot account for the within-group HDP increases. Where national data exist (White, Black, Mexican American, and Asian since 2011), 25(OH)D was flat or rising during the years HDP accelerated. The only stored pregnancy samples spanning eras show better status in later pregnancies for both Black and White women. The main remaining gaps are:

- a nationally representative series of 25(OH)D in pregnant women by race after 2006
- any data at all for AIAN and NHOPI women
- race-stratified studies of gestational hypertension (rather than preeclampsia) that use standardized 25(OH)D