JAMA | US Preventive Services Task Force | EVIDENCE REPORT

Screening for Hypertensive Disorders of Pregnancy
Updated Evidence Report and Systematic Review for the US Preventive Services Task Force

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IMPORTANCE Hypertensive disorders of pregnancy are a leading cause of pregnancy-related morbidity and mortality in the US.

OBJECTIVE To conduct a targeted systematic review to update the evidence on the effectiveness of screening for hypertensive disorders of pregnancy to inform the US Preventive Services Task Force.

DATA SOURCES MEDLINE and the Cochrane Central Register of Controlled Trials for relevant studies published between January 1, 2014, and January 4, 2022; surveillance through February 21, 2023.

STUDY SELECTION English-language comparative effectiveness studies comparing screening strategies in pregnant or postpartum individuals.

DATA EXTRACTION AND SYNTHESIS Two reviewers independently appraised articles and extracted relevant data from fair-or good-quality studies; no quantitative synthesis was conducted.

MAIN OUTCOMES AND MEASURES Morbidity or mortality, measures of health-related quality of life.

RESULTS The review included 6 fair-quality studies (5 trials and 1 nonrandomized study; N = 10 165) comparing changes in prenatal screening practices with usual care, which was routine screening at in-person office visits. No studies addressed screening for new-onset hypertensive disorders of pregnancy in the postpartum period. One trial (n = 2521) evaluated home blood pressure measurement as a supplement to usual care; 3 trials (total n = 5203) evaluated reduced prenatal visit schedules. One study (n = 2441) evaluated proteinuria screening conducted only for specific clinical indications, compared with a historical control group that received routine proteinuria screening. One additional trial (n = 80) only addressed the comparative harms of home blood pressure measurement. The studies did not report statistically significant differences in maternal and infant complications with alternate strategies compared with usual care; however, estimates were imprecise for serious, rare health outcomes. Home blood pressure measurement added to prenatal care visits was not associated with earlier diagnosis of a hypertensive disorder of pregnancy (104.3 vs 106.2 days), and incidence was not different between groups in 3 trials of reduced prenatal visit schedules. No harms of the different screening strategies were identified.

CONCLUSIONS AND RELEVANCE This review did not identify evidence that any alternative screening strategies for hypertensive disorders of pregnancy were more effective than routine blood pressure measurement at in-person prenatal visits. Morbidity and mortality from hypertensive disorders of pregnancy can be prevented, yet American Indian/Alaska Native persons and Black persons experience inequitable rates of adverse outcomes. Further research is needed to identify screening approaches that may lead to improved disease detection and health outcomes.

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Hypertensive disorders of pregnancy include gestational hypertension; preeclampsia-eclampsia; and chronic hypertension with superimposed preeclampsia.[1,2] The incidence of hypertensive disorders of pregnancy has been steadily increasing over the last several decades, from 500 cases per 10 000 deliveries in 1993 to 1021 cases per 10 000 deliveries in 2016 to 2017, with more than half of these having a diagnosis of preeclampsia-eclampsia (555 cases per 10 000 deliveries).[3] Between 2014 and 2017 hypertensive disorders of pregnancy were responsible for 6.8% of pregnancy-related deaths overall, with the majority of deaths (65%) occurring in the 6 weeks following delivery.[4,5] In addition to risks of mortality to pregnant individuals, hypertensive disorders of pregnancy contributes to pregnancy-related morbidity and risks to the fetus, including fetal growth restriction and indicated preterm delivery.[6-10]

Hypertensive disorders of pregnancy account for a larger proportion of pregnancy-related mortality and morbidity among Black populations than among White populations.[11-16] Due to higher incidence and severity, alongside inequities in the quality of health care due to structural and systemic factors,[17,18] the risk of dying of preeclampsia-eclampsia complications is about 5 times greater for Black individuals (3.93 per 100 000 live births) than for White individuals (0.78 per 100 000 live births).[12,16] Hypertensive disorders of pregnancy are also a leading cause of pregnancy-related mortality (≈13% of deaths) among American Indian/Alaska Native people and contributes to higher pregnancy-related mortality among American Indian/Alaska Native persons compared with White persons (29.7 compared with 12.7 per 100 000 live births in 2007-2016).[7,11,19]

In 2017, the US Preventive Services Task Force (USPSTF) recommended screening pregnant women for preeclampsia with blood pressure measurements throughout pregnancy (grade B).[20] Routine screening for new-onset hypertension via office-based blood pressure measurement can identify individuals who develop hypertensive disorders of pregnancy, allowing for evidence-based interventions that reduce the risk of pregnancy complications for the pregnant individual and infant.[1,20,21] This review of comparative effectiveness studies sought evidence on potential refinements to recommended screening practice.

Methods

An analytic framework and 3 key questions (KQs) guided the evidence update (**Figure 1**). Detailed methods and results of this systematic review are available in the full evidence report.[23] This review examines the comparative effectiveness of different screening protocols for hypertensive disorders of pregnancy, including preeclampsia.

A search of MEDLINE and the Cochrane Central Register of Controlled Trials was conducted for literature published between January 1, 2014, and January 4, 2022 (eMethods in the Supplement). These searches were supplemented by examining reference lists of primary studies and reviews. ClinicalTrials.gov was searched for ongoing trials. From January 2022 through February 1, 2023, ongoing surveillance of the literature to identify new studies that might affect the review conclusions or interpretation of the evidence was conducted using article alerts and targeted searches of journals with high impact factors; we identified no new studies that would meet inclusion criteria for this review.

For all KQs, studies were eligible if they addressed the comparative effectiveness of screening for hypertensive disorders of pregnancy using approaches that varied the frequency, setting, or methods of measurement using either randomized or nonrandomized designs. Studies that evaluated the changes in the frequency or timing of prenatal care visits were included if frequency of blood pressure measurement could be determined from study methods. Included studies enrolled populations of pregnant women and pregnant persons of all genders without a known diagnosis of HDP or chronic hypertension. Gender of the included populations in this review and in epidemiologic evidence tends to be inferred based on physiology (ie, pregnancy) rather than reported by patients. Therefore, we adopt inclusive language throughout this review, recognizing that not all pregnant individuals are cisgender women.

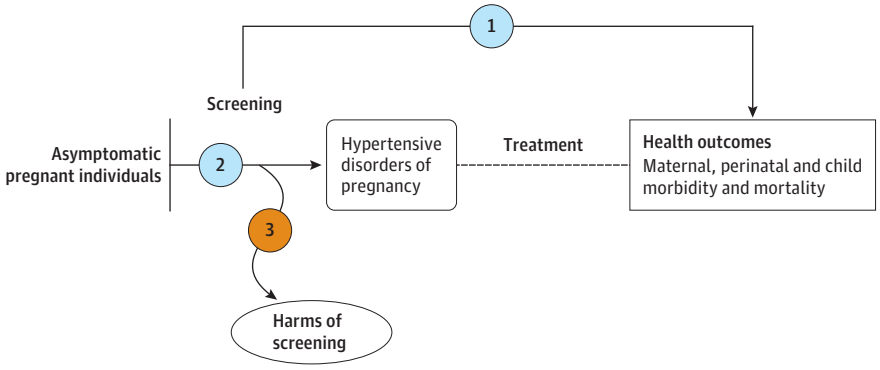
Studies were excluded if effects of changes to screening programs could not be separated from the effects of concurrent interventions (eg, patient education, service delivery model). Studies that evaluated the effectiveness of diagnostic testing or monitoring among people with hypertensive disorders of pregnancy, including those with chronic hypertension in pregnancy, were not eligible for inclusion. The definition of hypertensive disorders of pregnancy includes pregnant individuals with chronic hypertension. However, this review only included studies evaluating screening for new-onset hypertension because individuals entering pregnancy with a diagnosis of chronic hypertension would be subject to ongoing monitoring and assessment recommended for individuals with hypertensive disorders of pregnancy. Studies of the performance of risk prediction tools were not included in this review, although comparative effectiveness trials involving risk assessment would have been eligible for inclusion (eTable 1 in the Supplement).

Two investigators independently evaluated whether articles met the review inclusion criteria and rated the risk of bias of included studies following USPSTF procedures for assessing the internal validity of randomized clinical trials (RCTs) and nonrandomized studies of interventions (eTable 2 in the Supplement).[22] Discrepancies were resolved through discussion and consultation with a third investigator as needed. Study data were extracted into structured forms and checked for errors by a second investigator. Included outcomes were mortality, morbidity related to hypertensive disorders of pregnancy, measures of health-related quality of life, and adverse events (including missed diagnosis). The strength of the overall body of evidence for each KQ was judged using an adaptation of the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) Working Group approach.[24] The Evidence-based Practice Center adaptation[25] addresses 4 domains: consistency, precision, reporting bias, and study quality. Strength of evidence was independently assessed as "High," "Moderate," "Low," or "Insufficient" by at least 2 investigators, with discrepancies resolved through consensus discussion. Given the limited number of studies and their clinical heterogeneity, we did not conduct any quantitative synthesis. Detailed results are available in the full evidence synthesis report.[23]

Results

The search identified 6316 titles and abstracts and 82 full-text articles (**Figure 2**). Six fair-quality studies, 5 RCTs[26-30] and 1 nonrandomized study with a historical control[31] (N = 10 165) were included (**Table 1**).

Figure 1. Analytic Framework and Key Questions: Screening for Hypertensive Disorders of Pregnancy



Key questions

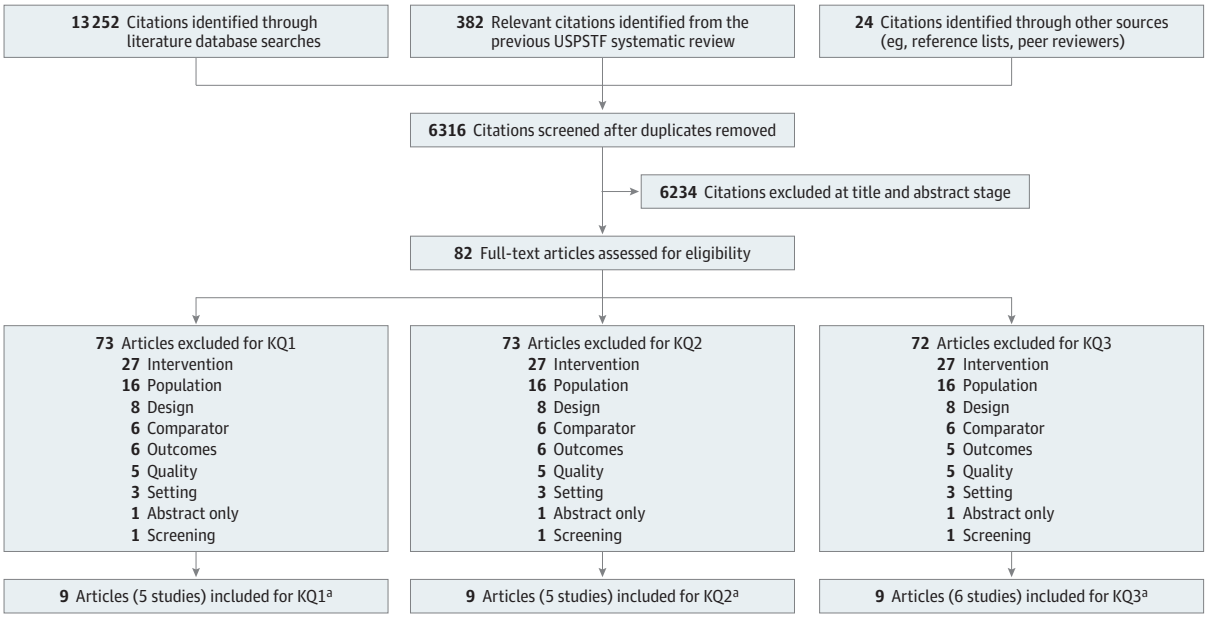
1 How effective are different screening programs used to identify hypertensive disorders of pregnancy for reducing maternal and perinatal morbidity and mortality?

2 How effective are different screening programs for identifying people with hypertensive disorders of pregnancy?

3 What are the harms of different screening programs used to identify hypertensive disorders of pregnancy?

Evidence reviews for the US Preventive Services Task Force (USPSTF) use an analytic framework to visually display the key questions that the review will address to allow the USPSTF to evaluate the effectiveness and safety of a preventive service. The questions are depicted by linkages that relate to interventions and outcomes. A dashed line depicts a health outcome that follows an intermediate outcome. Further details are available in the USPSTF Procedure Manual.[22]

Figure 2. Literature Search Flow Diagram: Screening for Hypertensive Disorders of Pregnancy



Articles could be reviewed for more than 1 key question (KQ). Reasons for exclusion: Intervention: Study intervention included prognostic evaluations to inform disease management, secondary diagnostic evaluations, or other interventions in addition to screening. Population: Study was not conducted in an included population. Design: Study did not use an included design. Comparator: Study not conducted with an included comparison group. Outcomes: Study did not have relevant outcomes or had incomplete outcomes. Quality: Study was poor quality. Setting: Study was not conducted in a country relevant to US practice. Screening: Study did not have an included screening test.

The studies compared usual screening with strategies involving home blood pressure measurement (2 studies, n = 2521), prenatal care schedules with less frequent office visits compared with the usual number (3 studies, n = 5203), and urine screening tests conducted for patients selected based on specific clinical indications, rather than routinely (1 study, n = 2441). Five of the studies[26,28-31] were included for examination of benefits of alternative screening strategies (KQ1, KQ2), and 1 study[27] of home blood pressure measurement screening was

Table 1. Characteristics of Included Studies

Source, country	Study design[a]	Study years	Study population	Study-described race and ethnicity, %	Screening intervention	Screening control
Home blood pressure measurement						
Tucker et al,[29] 2022 UK	RCT	2018 to 2019	2441 Pregnant individuals at higher risk of preeclampsia[b], enrolled at 16 to 24 wk of gestation	Asian or Asian British: 10 Black or Black British: 8 White (British, Irish, other): 74 Other/mixed: 7	Standard prenatal visit schedule plus home blood pressure measurement 3 times/wk with automated feedback via a mobile-phone application	Standard prenatal visit schedule with blood pressure measurement by usual antenatal care team
Ross-McGill et al,[27] 2000 UK	RCT	1996 to 1997	80 Low-risk pregnant individuals, enrolled at 24 to 28 wk of gestation	Member of an ethnic minority"[c]: 7.5 (12.5 in intervention group; 2.5 in control group)	Reduced prenatal visit schedule in second half of pregnancy (3 visits) with home blood pressure measurement	Standard visit schedule in the second half of pregnancy (every 2 wk from 28 to 36 wk of gestation and weekly thereafter until delivery)
Reduced prenatal visit schedule						
Walker and Koniak-Griffin,[30] 1997 US	RCT	1993 to 1994	81 Low-risk pregnant individuals, entered prenatal care before 26 wk of gestation	Asian American: 1.2 Hispanic: 74 White: 22	Reduced prenatal visit schedule (8 visits)	Standard prenatal visit schedule (every 4 wk until 28 wk of gestation, every 2 wk from 28 to 36 wk of gestation, weekly thereafter until delivery)
McDuffie et al,[26] 1996 US	RCT	1992 to 1994	2328 Low-risk pregnant individuals assessed in first trimester	Black: 4 Hispanic: 12 White: 81 Other: 2[d]	Reduced prenatal visit schedule (9 visits)	Standard prenatal visit schedule (14 visits)
Sikorski et al,[28] 1996 UK	RCT	1993 to 1994	2794 Low-risk pregnant individuals attending prenatal care by 24 wk of gestation	Member of an ethnic minority[c]: 32	Reduced prenatal visit schedule (7 visits for nullipara, 6 visits for multipara)	Standard prenatal visit schedule (13 visits)
Indicated vs routine urinary screening						
Rhode et al,[31] 2007 US	NRSI	2000 to 2004	2441 General population accessing prenatal care	Black: 9 Hispanic: 75 White: 19 Other: 6[d]	Urinary screening only when specific clinical criteria present[e]	Routine urine screening at every prenatal visit

Abbreviations: NRSI, nonrandomized study of an intervention; RCT, randomized clinical trial.

[a] All studies were fair quality.

[b] Age 40 years or older, nulliparity, pregnancy interval of more than 10 years, family history of preeclampsia, previous history of preeclampsia or gestational hypertension, body mass index 30 or greater (calculated as weight in kilograms divided by height in meters squared) at booking for pregnancy care, chronic kidney disease, twin pregnancy, prepregnancy diabetes (type 1 or 2), or autoimmune disease (eg, systemic lupus erythematosus or antiphospholipid disease).

[c] Language used in original study.

[d] No other details reported.

[e] First prenatal visit; symptoms of urinary tract infection (eg, dysuria, frequency, pain, fever); vaginitis symptoms; severe vomiting; weight loss of 0.9 kg or greater since previous visit; elevated systolic blood pressure (≥140 mm Hg); elevated diastolic blood pressure (≥90 mm Hg); or any pregnancy requiring periodic urine testing (eg, chronic hypertension, kidney disease).

additionally included for harms (KQ3). All studies were conducted during the prenatal period, with no studies examining screening for new-onset hypertensive disorders of pregnancy during the postpartum period. Overall, the strength of the evidence was judged to be insufficient for nearly all comparisons and outcomes available (**Table 2**).

The effectiveness of home blood pressure measurement in addition to office-based measurement was addressed in 1 fair-quality RCT conducted in the UK (n = 2441).[29] The BUMP 1 (Blood Pressure Monitoring in High Risk Pregnancy to Improve the Detection and Monitoring of Hypertension 1) trial examined the effect of home blood pressure measurement and automated feedback from a mobile-phone application as supplements to routine office-based prenatal care screening. The comparison group received routine office-based screening. Individuals were recruited into the trial based on an increased risk of a hypertensive disorder of pregnancy based on common clinical risk factors (eg, nulliparity, age, pregnancy, family history, previous preeclampsia, body mass index >30 [calculated as weight in kilograms divided by the square of height in meters], twin pregnancy, diabetes). The study population was reported as Asian or Asian British (10%), Black or Black British (8%), White (British, Irish, other) (74%), and "other or mixed" race and ethnicity (not specified by authors) (7%). Approximately 1 of 5 (17%) had a clinical history of a hypertensive disorder of pregnancy in a prior pregnancy, and a majority were nulliparous (61%). The study examined several serious maternal and infant health outcomes; none were statistically significant between study groups, but most were rare events with imprecise estimated effects. A composite outcome defined as 1 or more serious maternal health complications related to hypertensive disorders of pregnancy (eclampsia; transient ischemic attack; stroke; HELLP [hemolysis, elevated liver enzyme levels, low platelet count] syndrome; pulmonary edema; and liver, kidney, or hematologic involvement) was not statistically different between groups (relative risk [RR], 0.79 [95% CI, 0.40-1.55]). The primary study outcome, mean difference between groups in days to detection of hypertensive disorder of pregnancy, was less than 2 days (SD, 1.6) and not statistically significant (95% CI, −8.1 to 4.9). The BUMP 1 trial[29] and an additional RCT (n = 80)[27] met inclusion criteria for examining harms of home blood pressure measurement in addition to regular office-based screening (KQ3). Neither study reported differences in anxiety or health-related quality of life during pregnancy or postpartum for individuals using home blood pressure measurement devices.

We identified 3 fair-quality RCTs (n = 5203) that compared different prenatal visit schedules among individuals identified as at low risk for pregnancy complications.[26,28,30] Those in the intervention group were assigned to reduced prenatal care visit schedules (6-9 visits) relative to standard visit schedules (≈14 visits), thus receiving fewer in-office blood pressure measurements to screen for a hypertensive disorder of pregnancy, as well as other counseling and screening services. In all 3 of these trials, the difference in the overall number of visits between study groups was smaller than intended by the trial design, with the difference between groups ranging from 2.2 to 3.2 visits. The studies were underpowered for rare, serious health outcomes and reported no differences between study groups in preterm delivery, perinatal mortality, placental abruption, or postpartum hemorrhage; nor were there differences in the proportion diagnosed with preeclampsia. No differences in anxiety or depression were identified between groups receiving standard compared with reduced prenatal visit schedules.

We identified 1 fair-quality single nonrandomized study that compared a historical control group with routine urine screening at every prenatal visit vs screening only when clinically indicated (eg, based on weight loss, elevated blood pressure, urinary symptoms) (n = 2441).[31] The study enrolled Black women (9%), Hispanic women (75%), White women (19%), and "others" without race and ethnicity information reported (6%). There was no difference in the proportion of individuals diagnosed with a hypertensive disorder of pregnancy after the transition to indicated urine screening only (RR, 1.00 [95% CI, 0.74-1.36]). There was a reduced risk of preterm delivery with indicated screening compared with the historical comparison group that underwent routine screening (RR, 0.64 [95% CI, 0.45-0.90]); no other differences in health outcomes were found. However, reviewers assessed this study as having considerable risk of bias owing to changes in the population and the health care setting over the course of the study.

Discussion

This review did not find evidence that specific strategies for screening for hypertensive disorders of pregnancy in addition to or as an alternative to standard prenatal visit schedules with in-office blood pressure assessment improved health outcomes or led to earlier or increased detection relative to standard prenatal care. The available evidence on the comparative effectiveness of screening did not suggest that any specific features of screening programs improved health outcomes relative to standard prenatal care. However, the studies addressing these questions were few in number and were underpowered for important pregnancy health outcomes and potential harms of different screening programs. A 2022 literature review of screening for hypertensive disorders of pregnancy also examined evidence regarding prenatal visit schedules and the use of telehealth visits for routine antenatal care and similarly found limited evidence available for comparing different prenatal schedules and virtual care approaches for antenatal health care and their effects on health outcomes.[32] Telehealth interventions using home blood pressure measurements could improve access to care and strengthen health care connections over the course of pregnancy, especially in settings that have instituted virtual care for some prenatal visits, but the evidence available to assess whether specific innovations involving telehealth might improve outcomes or lead to adverse or unintended consequences is limited. Whether telehealth could help address inequities in health also is uncertain. Evidence from natural experiments in telehealth-delivered prenatal care during the COVID-19 pandemic may stimulate further research and innovation.[33,34]

None of the studies identified in this review had adequate power to evaluate outcomes specifically for American Indian/Alaska Native or Black persons, who are the US populations with the highest rates of hypertensive disorders of pregnancy. Few or none of the participants in the included studies were from these populations. Inequities in hypertensive disorders of pregnancy and related morbidity and mortality for Black individuals are well documented and persistent.[35,36] Several frameworks have been developed to describe the individual, interpersonal, community, and societal factors contributing to health inequities and the higher incidence of hypertensive disorders of pregnancy and greater disease severity and mortality among American Indian/Alaska Native and Black individuals.[17,37-40]

Table 2. Summary of Evidence: Screening for Hypertensive Disorders of Pregnancy

Intervention	No. of studies, study design (No. of observations)	Summary of findings	Consistency and precision	Other limitations	Strength of evidence	Applicability
KQ1. How effective are different screening programs used to identify hypertensive disorders of pregnancy for reducing maternal and perinatal morbidity and mortality?						
Home blood pressure measurement	1 Fair-quality RCT (2441)	Less than 2% of participants experienced serious pregnancy complications related to hypertensive disorders of pregnancy Difference between groups was not statistically significant (RR, 0.79 [95% CI, 0.40-1.55]) Estimated risk of SGA/IUGR was not statistically significant (RR, 1.15 [95% CI, 0.87-1.53]), with slightly more cases in the home measurement group (8.3% vs 7.0%)	NA, imprecise	Underpowered for precise estimation of small differences and rare outcomes Single study in 1 setting, lack of replication Slight imbalance in baseline characteristics not accounted for in analysis	Insufficient	Individuals attending prenatal care by 16 to 24 wk of gestation (in the UK) at increased risk for preeclampsia based on established clinical risk factors
Reduced prenatal screening visit schedule	3 Fair-quality RCTs (5203)	Few cases of perinatal mortality, risk lower or the same in large trials (RR, 0. 72 and 1.00), with wide 95% confidence intervals Similar proportions with preterm delivery, SGA/IUGR, and low birth weight in 2 large trials (RRs ranged from 0.94 to 1.13); 95% confidence intervals contained null Placental abruption rarely occurred and was similar between groups in 1 large trial; 95% confidence intervals contained null Risk for postpartum hemorrhage was the same or reduced with fewer visits (RR, 1.01 and 0.94)	Reasonably consistent, precise for postpartum hemorrhage, placental abruption Reasonably consistent, imprecise for perinatal mortality and preterm delivery NA, imprecise for fetal loss, neonatal sepsis, neonatal respiratory distress NA/inconsistent, precise for placental abruption, low birth weight, SGA/IUGR	Modest risk of bias mostly related to absent information on long-term follow-up, but attrition low Two larger trials underpowered to detect small differences in rare, serious outcomes; 1 small trial had too few events to estimate effects with any precision	Low for no difference for postpartum hemorrhage Insufficient for all other outcomes	US and UK populations of people at low risk for pregnancy complications Change to number of blood pressure measurements resulted from a change in number of prenatal visits Confounding of blood pressure measurement with other clinical interventions that occur during prenatal visits limits conclusions
Indicated rather than routine urine screening	1 Fair-quality NRSI (2441)	Risk of preterm delivery was reduced with indicated urine screening (4.9%) compared with routine urine screening (7.7%); RR, 0.64 (95% CI, 0.45-0.90)	NA, reasonably precise	Only 1 health outcome reported, possible selective reporting Analysis unadjusted; increase in Medicaid health insurance eligibility and decrease in self-pay in indicated screening period compared with routine screening Observational study design with inherent risk of concurrent changes (history)	Insufficient	US population obtaining prenatal care in safety-net settings serving Medicaid-eligible populations, especially pregnant people reporting Hispanic ethnicity
KQ2: How effective are different screening programs for identifying people with hypertensive disorders of pregnancy?						
Home blood pressure measurement	1 Fair-quality RCT (2441)	No statistical difference in days to detection of hypertensive disorders of pregnancy (mean days, −1.58 [95% CI, −8.10 to 4.94]) No difference in hypertensive disorder of pregnancy (RR, 0.98 [95% CI, 0.81-1.18]) Slightly higher incidence of severe hypertension in home measurement group (6.0% vs 4.8%) but not statistically different (RR, 1.22 [95% CI, 0.87-1.70])	NA, reasonably precise	Low risk of bias for health outcomes collected from medical record; minor group imbalance at baseline could bias toward null Single study in 1 setting Underpowered for precise estimation of small differences and rare outcomes	Insufficient	Individuals attending prenatal care by 16 to 24 wk of gestation (in the UK) at increased risk for preeclampsia based on established clinical risk factors

(continued)

Table 2. Summary of Evidence: Screening for Hypertensive Disorders of Pregnancy (continued)

Intervention	No. of studies, study design (No. of observations)	Summary of findings	Consistency and precision	Other limitations	Strength of evidence	Applicability
Reduced prenatal screening visit schedule	3 Fair-quality RCTs (5203)	No differences in diagnoses of hypertensive disorder of pregnancy A large US trial showed a trend toward fewer individuals diagnosed with preeclampsia and more with gestational hypertension but equal diagnoses of preeclampsia with severe features (RR, 1.01 [95% CI, 0.68-1.62])	Reasonably consistent, reasonably precise	Differences between the intervention and control schedules were smaller than planned (difference between groups ranged from 2.2 to 3.2 visits)	Low for no difference	US and UK populations at low risk for pregnancy complications of people attending prenatal care Change to number of blood pressure measurements resulted from a change in number of prenatal visits Confounding of blood pressure measurement with other clinical interventions that occur during prenatal visits limits conclusions
Indicated rather than routine urine screening	1 Fair-quality NRSI (2441)	Fewer diagnoses of preeclampsia (RR, 0.58 [95% CI, 0.35-0.98]) and a trend toward more with gestational hypertension; no difference in diagnoses of hypertensive disorder of pregnancy overall (RR, 1.00 [95% CI, 0.74-1.36])	NA, reasonably precise	Analyses unadjusted; increase in Medicaid health insurance eligibility and decrease in self-pay in indicated screening period compared with routine screening control period	Insufficient	US populations obtaining prenatal care in safety-net settings serving Medicaid-eligible populations, especially pregnant people reporting Hispanic ethnicity
KQ3: What are the harms of different screening programs used to identify hypertensive disorders of pregnancy?						
Home blood pressure measurement	2 Fair-quality RCTs (2521)	One large trial reported similar rates of induction of labor and cesarean delivery for hypertension-related complications (RR, 1.09 [95% CI, 0.82-1.44]) and similar rates of emergency cesarean delivery (RR, 0.89 [95% CI, 0.76-1.03]) Two trials reported no difference in anxiety (STAI) during pregnancy or postpartum	NA, reasonably precise for delivery outcomes Reasonably consistent, reasonably precise for mental health/HRQoL	Risk of bias higher for anxiety outcome measures due to high loss to follow-up and missing data Single study in 1 setting, lack of replication	Insufficient	Individuals attending prenatal care by 16 to 24 wk of gestation (in the UK) at increased risk for preeclampsia based on established clinical risk factors
Reduced prenatal screening visit schedule	3 Fair-quality RCTs (5203)	Two large trials reported similar levels of cesarean delivery or induction of labor for any reason and for reasons related to hypertension or fetal distress (between-group differences ≤1.5%, RRs 0.81 to 1.06) One small trial had too few cases to test differences in cesarean delivery None of the trials found differences in anxiety or postnatal depression between study groups; different measures and time points reported	Inconsistent, reasonably precise for delivery outcomes NA, reasonably precise for mental health/HRQoL	Risk of bias higher for anxiety outcomes due to higher loss to follow-up and incomplete data	Insufficient	US and UK populations at low risk for pregnancy complications of people attending prenatal care Change to number of blood pressure measurements resulted from a change in number of prenatal visits Confounding of blood pressure measurement with other clinical interventions that occur during prenatal visits limits conclusions
Indicated rather than routine urine screening	1 Fair-quality NRSI (2441)	Similar risk for cesarean delivery (RR, 0.96 [95% CI, 0.79-1.16])	NA, reasonably precise	Analyses unadjusted; increase in Medicaid health insurance eligibility and decrease in self-pay in indicated screening period compared with routine screening Reason for cesarean delivery not reported	Insufficient	US populations obtaining prenatal care in safety-net settings serving Medicaid-eligible populations, especially pregnant people reporting Hispanic ethnicity

Abbreviations: HRQoL, health-related quality of life; KQ, key question; NA, not applicable; NRSI, nonrandomized study of an intervention; RCT, randomized clinical trial; RR, relative risk; SGA/IUGR, small for gestational age/intrauterine growth restriction; STAI, state component of the State-Trait Anxiety Inventory.

Despite evidence that complications from missed diagnoses or emergent hypertensive disorders of pregnancy are known to arise postpartum and contribute to poor outcomes,[41] none of the included studies evaluated hypertensive disorders of pregnancy screening in the postpartum period. Opportunities to be screened during the postpartum period may be limited due to clinician and insurance transitions, a focus on the neonate, and reduced continuity of support.[42-44] A 2019 systematic review that included 9 observational studies on postpartum monitoring of hypertensive disorders of pregnancy and gestational diabetes reported a pattern of lower rates of follow-up for Black and Hispanic people than White people in the 6 weeks after delivery.[42] Routine screening during the postpartum period could be important for reducing health inequities, especially in light of emerging evidence that the risk of postpartum preeclampsia diagnosis is twice as high for non-Hispanic Black individuals compared with non-Hispanic White individuals.[45]

Another area with limited research is the use of home blood pressure measurement to screen for new-onset hypertensive disorders of pregnancy. Although home blood pressure measurement and self-measurement have been used as part of management of care for individuals with diagnosed hypertensive disorder of pregnancy, limited evidence exists for its use as a primary screening tool. The single included trial evaluating supplemental home blood pressure measurement accompanied by automated feedback using a mobile-phone application reported null findings for health benefits but no harms associated with the intervention.[29]

Routine measurement of blood pressure during pregnancy has long been a standard of prenatal care.[46] Innovations in screening programs involving changes to standard prenatal visit schedules, virtual visits, and telehealth applications, or the use of home blood pressure measurement, have the potential to influence pregnancy outcomes. Large, well-designed studies to refine prenatal and postpartum screening programs for individuals at different levels of risk for developing hypertensive disorders of pregnancy are needed, with attention to populations at increased risk for complications from hypertensive disorders of pregnancy. Establishing evidence-based screening practices will require large studies to evaluate changes to hypertensive disorders of pregnancy screening programs that could improve health outcomes without incurring harms.

Conclusions

This review did not identify evidence that any alternative screening strategies for hypertensive disorders of pregnancy were more effective than routine blood pressure measurement at in-person prenatal visits. Morbidity and mortality from hypertensive disorders of pregnancy can be prevented, yet American Indian/Alaska Native persons and Black persons experience inequitable rates of adverse outcomes. Further research is needed to identify screening approaches that may lead to improved disease detection and health outcomes.

ARTICLE INFORMATION

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Author Contributions: Dr Henderson had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: All authors.
Acquisition, analysis, or interpretation of data: Henderson, Webber, Vesco.
Drafting of the manuscript: Henderson.
Critical revision of the manuscript for important intellectual content: Webber, Thomas, Vesco.
Administrative, technical, or material support: Webber, Thomas.
Supervision: Henderson.

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Additional Information: A draft version of this evidence report underwent external peer review from 4 content experts (Kimberly D. Gregory, MD, MPH, Cedars-Sinai Medical Center; Laura A. Magee, MD, King's College London; Alex Friedman Peahl, MD, MS, University of Michigan; Katherine Tucker, PhD, University of Oxford), and 3 federal partners (Centers for Disease Control and Prevention; the National Heart, Lung, and Blood Institute; and the National Institutes of Health Office of Research on Women's Health). Comments were presented to the USPSTF during its deliberation of the evidence and were considered in preparing the final evidence review.

Editorial Disclaimer: This evidence report is presented as a document in support of the accompanying USPSTF recommendation statement. It did not undergo additional peer review after submission to *JAMA*.

REFERENCES

1. American College of Obstetrician and Gynecologists. Gestational hypertension and preeclampsia: ACOG Practice Bulletin Summary, number 222. *Obstet Gynecol*. 2020;135(6):1492-1495. doi:10.1097/AOG.0000000000003892

2. Hutcheon JA, Lisonkova S, Joseph KS. Epidemiology of pre-eclampsia and the other hypertensive disorders of pregnancy. *Best Pract Res Clin Obstet Gynaecol*. 2011;25(4):391-403. doi:10.1016/j.bpobgyn.2011.01.006

3. DeSisto CL, Robbins CL, Ritchey MD, Ewing AC, Ko JY, Kuklina EV. Hypertension at delivery hospitalization—United States, 2016-2017. *Pregnancy Hypertens*. 2021;26:65-68. doi:10.1016/j.preghy.2021.09.002

4. Petersen EE, Davis NL, Goodman D, et al. Vital signs: pregnancy-related deaths, United States, 2011–2015, and strategies for prevention, 13 states, 2013–2017. *MMWR Morb Mortal Wkly Rep*. 2019;68(18):423-429. doi:10.15585/mmwr.mm6818e1

5. Pregnancy Mortality Surveillance System. Centers for Disease Control and Prevention. Accessed January 17, 2023. https://www.cdc.gov/reproductivehealth/maternal-mortality/pregnancy-mortality-surveillance-system.htm

6. Chew LC, Verma RP. Fetal Growth Restriction. National Center for Biotechnology Information. Published 2020. Accessed April 19, 2023. https://www.ncbi.nlm.nih.gov/books/NBK562268/

7. Hitti J, Sienas L, Walker S, Benedetti TJ, Easterling T. Contribution of hypertension to severe maternal morbidity. *Am J Obstet Gynecol*. 2018;219(4):405.e1-405.e7. doi:10.1016/j.ajog.2018.07.002

8. Admon LK, Winkelman TNA, Zivin K, Terplan M, Mhyre JM, Dalton VK. Racial and ethnic disparities

in the incidence of severe maternal morbidity in the United States, 2012-2015. *Obstet Gynecol*. 2018; 132(5):1158-1166. doi:10.1097/AOG.0000000000002937

9. Liese KL, Mogos M, Abboud S, Decocker K, Koch AR, Geller SE. Racial and ethnic disparities in severe maternal morbidity in the United States. *J Racial Ethn Health Disparities*. 2019;6(4):790-798. doi:10.1007/s40615-019-00577-w

10. Palatnik A, McGee P, Bailit JL, et al; Eunice Kennedy Shriver National Institute of Child Health Human Development Maternal-Fetal Medicine Units (MFMU) Network. The association of race and ethnicity with severe maternal morbidity among individuals diagnosed with hypertensive disorders of pregnancy. *Am J Perinatol*. 2023;40(5):453-460. doi:10.1055/a-1886-5404

11. Petersen EE, Davis NL, Goodman D, et al. Racial/ethnic disparities in pregnancy-related deaths—United States, 2007-2016. *MMWR Morb Mortal Wkly Rep*. 2019;68(35):762-765. doi:10.15585/mmwr.mm6835a3

12. Grobman WA, Parker CB, Willinger M, et al; Eunice Kennedy Shriver National Institute of Child Health and Human Development Nulliparous Pregnancy Outcomes Study: Monitoring Mothers-to-Be (nuMoM2b) Network. Racial disparities in adverse pregnancy outcomes and psychosocial stress. *Obstet Gynecol*. 2018;131(2):328-335. doi:10.1097/AOG.0000000000002441

13. Gyamfi-Bannerman C, Pandita A, Miller EC, et al. Preeclampsia outcomes at delivery and race. *J Matern Fetal Neonatal Med*. 2020;33(21):3619-3626. doi:10.1080/14767058.2019.1581522

14. Fingar KR, Mabry-Hernandez I, Ngo-Metzger Q, Wolff T, Steiner CA, Elixhauser A. Healthcare Cost and Utilization Project (HCUP) Statistical Briefs: statistical brief #222: delivery hospitalizations involving preeclampsia and eclampsia, 2005-2014. National Center for Biotechnology Information. Published 2017. Accessed January 17, 2023. https://www.ncbi.nlm.nih.gov/books/NBK442039/

15. Esakoff TF, Rad S, Burwick RM, Caughey AB. Predictors of eclampsia in California. *J Matern Fetal Neonatal Med*. 2016;29(10):1531-1535.

16. MacDorman MF, Thoma M, Declcerq E, Howell EA. Racial and ethnic disparities in maternal mortality in the United States using enhanced vital records, 2016-2017. *Am J Public Health*. 2021;111(9):1673-1681. doi:10.2105/AJPH.2021.306375

17. Howell EA. Reducing disparities in severe maternal morbidity and mortality. *Clin Obstet Gynecol*. 2018;61(2):387-399. doi:10.1097/GRF.0000000000000349

18. Minehart RD, Bryant AS, Jackson J, Daly JL. Racial/ethnic inequities in pregnancy-related morbidity and mortality. *Obstet Gynecol Clin North Am*. 2021;48(1):31-51. doi:10.1016/j.ogc.2020.11.005

19. Heck JL, Jones EJ, Bohn D, et al. Maternal mortality among American Indian/Alaska Native women: a scoping review. *J Womens Health (Larchmt)*. 2021;30(2):220-229. doi:10.1089/jwh.2020.8890

20. US Preventive Services Task Force. Screening for preeclampsia: US Preventive Services Task Force recommendation statement. *JAMA*. 2017;317(16):1661-1667. doi:10.1001/jama.2017.3439

21. American College of Obstetricians and Gynecologists (ACOG). Hypertension in pregnancy: report of the American College of Obstetricians and Gynecologists' Task Force on Hypertension in Pregnancy. *Obstet Gynecol*. 2013;122(5):1122-1131. doi:10.1097/01.AOG.0000437382.03963.88

22. US Preventive Services Task Force Procedure Manual. US Preventive Services Task Force. Updated May 2021. Accessed April 27, 2023. https://uspreventiveservicestaskforce.org/uspstf/about-uspstf/methods-and-processes/procedure-manual

23. Henderson JT, Webber EM, Vesco KK, Thomas RG. *Screening for Hypertensive Disorders of Pregnancy: An Evidence Update for the US Preventive Services Task Force. Evidence Synthesis No. 227*. Agency for Healthcare Research and Quality; 2023. AHRQ publication 22-05299-EF-1.

24. Atkins D, Eccles M, Flottorp S, et al; GRADE Working Group. Systems for grading the quality of evidence and the strength of recommendations, I: critical appraisal of existing approaches. *BMC Health Serv Res*. 2004;4(1):38. doi:10.1186/1472-6963-4-38

25. Berkman ND, Lohr KN, Ansari M, et al. *Grading the Strength of a Body of Evidence When Assessing Health Care Interventions for the Effective Health Care Program of the Agency for Healthcare Research and Quality: An Update*. Agency for Healthcare Research and Quality; 2014. AHRQ publication 10(14)-EHC063-EF.

26. McDuffie RS Jr, Beck A, Bischoff K, Cross J, Orleans M. Effect of frequency of prenatal care visits on perinatal outcome among low-risk women: a randomized controlled trial. *JAMA*. 1996;275(11):847-851. doi:10.1001/jama.1996.03530350029030

27. Ross-McGill H, Hewison J, Hirst J, et al. Antenatal home blood pressure monitoring: a pilot randomised controlled trial. *BJOG*. 2000;107(2):217-221. doi:10.1111/j.1471-0528.2000.tb11692.x

28. Sikorski J, Wilson J, Clement S, Das S, Smeeton N. A randomised controlled trial comparing two schedules of antenatal visits: the antenatal care project. *BMJ*. 1996;312(7030):546-553. doi:10.1136/bmj.312.7030.546

29. Tucker KL, Mort S, Yu L-M, et al; BUMP Investigators. Effect of self-monitoring of blood pressure on diagnosis of hypertension during higher-risk pregnancy: the BUMP 1 randomized clinical trial. *JAMA*. 2022;327(17):1656-1665. doi:10.1001/jama.2022.4712

30. Walker DS, Koniak-Griffin D. Evaluation of a reduced-frequency prenatal visit schedule for low-risk women at a free-standing birthing center. *J Nurse Midwifery*. 1997;42(4):295-303. doi:10.1016/S0091-2182(97)00027-X

31. Rhode MA, Shapiro H, Jones OW, III. Indicated vs. routine prenatal urine chemical reagent strip testing. *J Reprod Med*. 2007;52(3):214-219.

32. Balk EM, Konnyu KJ, Cao W, et al. *Schedule of Visits and Televisits for Routine Antenatal Care: A Systematic Review: Comparative Effectiveness Review No. 257*. Agency for Healthcare Research and Quality; June 2022. AHRQ publication 22-EHC031.

33. Palmer KR, Tanner M, Davies-Tuck M, et al. Widespread implementation of a low-cost telehealth service in the delivery of antenatal care during the COVID-19 pandemic: an interrupted time-series analysis. *Lancet*. 2021;398(10294):41-52. doi:10.1016/S0140-6736(21)00668-1

34. Duryea EL, Adhikari EH, Ambia A, Spong C, McIntire D, Nelson DB. Comparison between in-person and audio-only virtual prenatal visits and perinatal outcomes. *JAMA Netw Open*. 2021;4(4):e215854. doi:10.1001/jamanetworkopen.2021.5854

35. Bryant AS, Worjoloh A, Caughey AB, Washington AE. Racial/ethnic disparities in obstetric outcomes and care: prevalence and determinants. *Am J Obstet Gynecol*. 2010;202(4):335-343. doi:10.1016/j.ajog.2009.10.864

36. Pregnancy-related deaths: data from 14 US maternal mortality review committees, 2008-2017. Centers for Disease Control and Prevention. Published 2021. Accessed April 27, 2023. https://www.cdc.gov/reproductivehealth/maternal-mortality/erase-mm/mmr-data-brief.html

37. Alvidrez J, Castille D, Laude-Sharp M, Rosario A, Tabor D. The National Institute on Minority Health and Health Disparities research framework. *Am J Public Health*. 2019;109(S1):S16-S20. doi:10.2105/AJPH.2018.304883

38. Williams DR, Priest N, Anderson NB. Understanding associations among race, socioeconomic status, and health: patterns and prospects. *Health Psychol*. 2016;35(4):407-411. doi:10.1037/hea0000242

39. Bailey ZD, Krieger N, Agénor M, Graves J, Linos N, Bassett MT. Structural racism and health inequities in the USA: evidence and interventions. *Lancet*. 2017;389(10077):1453-1463. doi:10.1016/S0140-6736(17)30569-X

40. NIMHD research framework. National Institute on Minority Health and Health Disparities. Accessed November 19, 2021. http://www.nimhd.nih.gov/about/overview/research-framework/

41. Hauspurg A, Jeyabalan A. Postpartum preeclampsia or eclampsia: defining its place and management among the hypertensive disorders of pregnancy. *Am J Obstet Gynecol*. 2022;226(2S):S1211-S1221. doi:10.1016/j.ajog.2020.10.027

42. Jones EJ, Hernandez TL, Edmonds JK, Ferranti EP. Continued disparities in postpartum follow-up and screening among women with gestational diabetes and hypertensive disorders of pregnancy: a systematic review. *J Perinat Neonatal Nurs*. 2019;33(2):136-148. doi:10.1097/JPN.0000000000000399

43. American College of Obstetrician and Gynecologists. ACOG committee opinion No. 736 summary: optimizing postpartum care. *Obstet Gynecol*. 2018;131(5):949-951. doi:10.1097/AOG.0000000000002628

44. Essien UR, Molina RL, Lasser KE. Strengthening the postpartum transition of care to address racial disparities in maternal health. *J Natl Med Assoc*. 2019;111(4):349-351. doi:10.1016/j.jnma.2018.10.016

45. Redman EK, Hauspurg A, Hubel CA, Roberts JM, Jeyabalan A. Clinical course, associated factors, and blood pressure profile of delayed-onset postpartum preeclampsia. *Obstet Gynecol*. 2019;134(5):995-1001. doi:10.1097/AOG.0000000000003508

46. Peahl AF, Howell JD. The evolution of prenatal care delivery guidelines in the United States. *Am J Obstet Gynecol*. 2021;224(4):339-347. doi:10.1016/j.ajog.2020.12.016