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"What Is Normal? A Call for Standardizing Approaches In Postpartum Blood Pressure Monitoring to Combat Maternal Mortality"

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Abstract

Introduction: Most maternal deaths occur during the postpartum period, either within 24 hours of birth (approximately 17% in the United States) or within the first 6 weeks postpartum (approximately 40% in the United States). 4 in 5 of these deaths are preventable, with leading causes during the postpartum period such as venous thromboembolism (VTE), sepsis, and postpartum hemorrhage (PPH). A commonality in these diagnoses is abnormal vital signs. And yet, normal vital sign reference ranges during the postpartum period, a time of natural hemodynamic changes, have not been adequately defined in the US populations. An objective, accessible screening for these hemodynamic changes is blood pressure.

Methods: This study followed the Joanna Briggs Institute (JBI) guidelines for evidence synthesis, utilizing a rapid review approach to systematically identify, screen, and analyze research on postpartum vital signs and reference ranges. The process adhered to JBI's stages of identification, screening, eligibility assessment, and data extraction, synthesizing findings from 70 studies examining postpartum blood pressure (BP) norms, hypertension classification, and clinical management protocols.

Results: There is a lack of a standardized definition for "normal" postpartum BP (PBP), with existing thresholds varying across studies. Moreover, approximately 60% of delayed-onset postpartum preeclampsia (PE) cases occur in women without prior hypertensive diagnoses, emphasizing the need for improved screening.

Conclusions: While PBP monitoring practices remain inconsistent, emerging strategies, such as home BP monitoring and quality improvement initiatives during newborn visits, show promise for earlier detection and intervention. These findings underscore the need for standardized PBP reference ranges, enhanced postpartum monitoring protocols, and interdisciplinary provider education to improve hypertension management in the postpartum period.

Keywords: intrapartum; postpartum period; fourth trimester; venous thromboembolism; postpartum hemorrhage; Pulmonary hypertension; American Heart Association; blood pressure; hypertensive disorders; maternal morbidity; socioeconomic factors; national health policies; maternal deaths; postpartum hypertension

Introduction

The intrapartum and postpartum period are naturally marked with a high rate of hemodynamic changes, where increases in cardiac output, blood pressure, heart rate, and plasma volume, occur during birth, the hour immediately after, and during the postpartum, or "fourth trimester" period [1]. In fact, it is believed that the postpartum body only returns to pre-pregnancy hemodynamic levels 3 to 6 months postpartum. In parallel, when examining maternal mortality data, most maternal deaths occur during the postpartum period, either within 24 hours of birth (approximately 17% in the United States) or within the first 6 weeks postpartum (approximately 40% in the United States) [2]. The leading causes of these deaths diagnosed as venous thromboembolism (VTE), sepsis, and postpartum hemorrhage (PPH) during the postpartum period overwhelmingly exhibit abnormal vital signs [2]. Improving detection of such physiological deterioration during the postpartum period has been grossly under researched.

Pulmonary hypertension, and other hypertensive disorders, are one of the highest risk disorders during pregnancy [1]. Both a rising cause of pregnancy-related mortality and morbidity,

(with associated rates of mortality ranging from 25% to 56%), hypertension-related hospitalizations have risen substantially in pregnant women; delays often occur in diagnostics, due to unspecified thresholds for vitals during pregnancy [1]. Despite a much higher prevalence, only 24% of cases are diagnosed during pregnancy due to their congenital nature [1]. Maternal deaths due to hypertensive disorders and other such complications are largely preventable. With rising maternal deaths occurring in the United States, it is imperative that interventions to prevent them are put in place.The maternal cardiovascular system is drastically changed by pregnancy, due to the increased cardiac burden [3]. These changes impact blood volume, with a 60 to 80% increase in cardiac output immediately after delivery, yet it is unclear how these ranges vary later into the postpartum period [3]. Change in postpartum vital signs influenced by pregnancy physiology can be a utilized for early detection and thus prevention; and yet, normal ranges for vital signs in the postpartum period have been inadequately defined and researched. One study even examined how the mean time to return to normotensive values was 5.7 ± 3.7 weeks after delivery for women in preeclampsia or diagnosed hypertension during pregnancy [4]. Moreover, there remains debate around thresholds for concern [5]. Currently, only two studies, a prospective longitudinal cohort study in the UK and in Nigeria, respectively, have attempted to characterize these postpartum vital ranges with any sense of granularity [2,6]. Looking at blood pressure, heart rate, oxygen saturation, temperature, and respiratory rate, for two weeks postpartum, [2] found that there were day-specific changes in the reference ranges for these vital signs, suggesting that more specificity will help obtain earlier diagnoses of abnormal or elevated blood pressure. [6] was focused on preventing postpartum hemorrhage by redefining these metrics in a low-resource setting; they collected data on BP, HR, mean arterial pressure (MAP) to redefine the obstetric shock index (SI). Both cohorts, while they moved the needle forward on more comprehensive reference ranges during the postpartum period, looked at it in a limited capacity. [6], only examined vital signs one hour after delivery, whereas [2], only collected data for two weeks postpartum. Both cohorts are not representative of the diversity present in the United States population. With differences over vital thresholds continuing between the American Heart Association (AHA) and the American College of Obstetricians and Gynecologists (ACOG), more clearly defined clinical guidelines for these vital signs during the postpartum period are necessary [7]. Thus, this scoping review attempts utilize a wider net to identify all pertinent studies globally that have examined the role of postpartum vitals, in specific relation to blood pressure, as well as overall postpartum health.

Methods

Literature Review

The Joanna Briggs Institute (JBI) guidelines for evidence synthesis was utilized in the design of this study, employing a rapid review approach to systematically identify, screen, and analyze relevant research related to postpartum vital signs and reference ranges. The review process included the following phases: identification, screening, eligibility assessment, and data extraction.

To ensure a comprehensive identification of relevant literature, searches were conducted in two major databases: PubMed and Web of Science. The search strategy was designed to capture research specifically addressing postpartum vital signs, associated reference ranges, and physiological parameters during pregnancy. The search terms included:

a) “postpartum”

b) “fourth trimester”

c) “postpartum reference ranges”

d) “postpartum vital signs”

e) “vital signs during pregnancy”

f) “hypertensive disorders of pregnancy”

g) “pregnancy cardiovascular changes”

h) “blood pressure during pregnancy”

i) “postpartum blood pressure”

Boolean operators (e.g., AND, OR) and database-specific filters were applied to refine the search and minimize irrelevant results. No publication date restrictions were imposed, ensuring the inclusion of both foundational and recent studies, and studies could be of any design-type or methodology, so long as they were published in English originally (or a suitable translation was readily accessible). The initial search yielded **330 abstracts**, which were imported into a reference management tool to remove duplicates. Abstracts were screened based on predefined inclusion and exclusion criteria:

Table 1: Inclusion and Exclusion Criteria for Study Participation
This table outlines the specific criteria used to determine participant eligibility, including the conditions for inclusion and exclusion in the study.

Inclusion Criteria	Exclusion Criteria
Studies reporting on reference ranges for postpartum or pregnancy- related vital signs.	Studies not focused on the postpartum period or unrelated to vital signs.
Research addressing physiological changes or hypertensive disorders relevant to postpartum health.	Non-human studies or those lacking original data.
Original studies with sufficient methodological rigor (e.g., cohort, cross-sectional, or case-control studies).	Reviews, commentaries and editorials without new empirical evidence
Literature or systematic reviews, as they were viewed as a way to map the breadth of knowledge and identify knowledge gaps.	

Abstracts meeting the inclusion criteria advanced to the full-text

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review stage. Following abstract screening, 84 articles were identified as relevant for further analysis. The full-text review stage involved a detailed assessment of the 84 selected articles. Key considerations included: study design and methodology, population characteristics and demographics, vital signs data, and were required to explicitly address the postpartum period, with a particular focus on the fourth trimester. Following this stage, 14 articles were excluded due to issues such as insufficient relevance to the postpartum period, a focus on exclusively prenatal or intrapartum women, lack of original data, or lack of methodological rigor. The final selection consisted of studies that met all inclusion criteria, resulting in a total of 70 articles.

Results

Geographic Variations in Postpartum Blood Pressure Monitoring and Management

Analysis of included studies reveals significant geographic disparities in postpartum blood pressure (BP) monitoring and management. Studies conducted in high-resource settings, such as the United States and the United Kingdom, implement structured follow-up protocols for high-risk patients [8], whereas low-resource settings often lack standardized postpartum monitoring, likely due to a confluence of factors such as staffing, resources, and patient follow-up [4]. For instance, a study conducted at Erasmus Medical Center in the Netherlands [9] highlights reliance on home BP monitoring due to healthcare accessibility constraints, while research from Newark, New Jersey [10] emphasizes hospital-based postpartum BP assessments. These variations underscore the role of healthcare infrastructure and resource availability in shaping postpartum hypertension care. It, however, also highlighted how, when available, these resources were directed almost exclusively to high-risk patients. Those deemed 'low-risk' and lacked an official diagnosis at any point during pregnancy were unlikely to be closely monitored. Further evidence from studies in Canada and Australia [11] suggests that nationalized healthcare systems facilitate more consistent postpartum BP follow-up compared to fragmented care models in the U.S. Canadian studies highlight structured postpartum hypertension screening integrated within maternal health clinics, ensuring more timely detection of postpartum preeclampsia. Conversely, research from rural settings in sub-Saharan Africa [12] and South Asia [13] reveals that limited access to postpartum care leads to higher rates of undiagnosed and unmanagedhypertensive disorders, contributing to increased maternal morbidity. In Latin America, studies from Brazil and Mexico [14,15] emphasize the role of community health workers in postpartum monitoring, leveraging local outreach programs to improve hypertension screening. However, these programs often struggle with inconsistent funding and lack of standardized BP thresholds, creating disparities in patient outcomes. Similarly, research from India [16] highlights significant regional variation, with urban tertiary hospitals implementing postpartum BP protocols, whereas rural districts rely primarily on home-based self-monitoring, leading to delayed recognition of hypertensive complications.

Influence of Study Design on Reported Outcomes

A variety of study designs were included, each contributing unique insights. Prospective cohort and feasibility studies [17,4] provide longitudinal data on postpartum BP trends, identifying a delayed onset of hypertension up to 3 months postpartum. These studies highlight how the postpartum period is severely neglected when it comes to clinical oversight. Retrospective cohort studies [10] reveal gaps in follow-up care and disparities in patient outcomes based on race and socioeconomic status, which is in line with national data on maternal morbidity and mortality. Randomized control trials [8] evaluate the effectiveness of self-management strategies, demonstrating that home BP monitoring is a viable intervention to improve and enhance early detection. However, literature reviews [18] highlight inconsistencies in defining normal postpartum BP, suggesting that thresholds for intervention vary widely across studies, and thus, lead to fragmented and inconsistent levels of care being provided.

Population Characteristics and Risk Stratification

Postpartum hypertension is inherently influenced by multiple patient-level factors, including age, comorbidities, and prior hypertensive disorders. But, studies also indicated that approximately 60% of delayed-onset postpartum preeclampsia (PE) cases occur in women *without* a prior hypertensive diagnosis [4]. This once again suggests that a large population of women at risk are not included in the 'high-risk' and therefore monitored population, if monitoring is available. Population-based analyses [17] show that younger women and Black patients face higher risks of postpartum hypertension but receive less consistent follow-up care. Studies conducted in East Asia [19] highlight that postpartum hypertension risk is increased among women with a history of gestational diabetes, further complicating follow-up care. In contrast, research in Scandinavian countries [20] suggests that comprehensive maternal health policies contribute to lower rates of undiagnosed postpartum hypertension due to structured, routine postpartum screenings.

Furthermore, socioeconomic factors have been identified as significant determinants in postpartum hypertension disparities. Research in the U.S. [21] and South Africa [22]. points to financial barriers and healthcare access limitations as primary contributors to poor postpartum follow-up, particularly among marginalized communities. Additionally, studies focusing on lactation and postpartum BP regulation [9] have been explored, suggesting a possible protective effect of breastfeeding on BP stabilization, though findings remain inconclusive. Studies from Germany and Japan [23,24] indicate that prolonged breastfeeding may have a protective effect in stabilizing BP, though the evidence remains mixed

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Policy Solutions and Interventions

Several studies suggest interventions to improve postpartum hypertension detection and management. Home BP monitoring programs have been shown to facilitate early detection, particularly in settings where hospital-based follow-ups are inconsistent [8]. However, adherence remains a challenge, necessitating integration with telemedicine support systems to ensure timely clinical oversight [4]. Policy recommendations include expanding postpartum BP screening beyond traditional obstetric visits by integrating assessments into pediatric check-ups [10]. This approach ensures that women who might otherwise miss postpartum follow-ups receive BP evaluations. Additionally, some institutions have implemented quality improvement initiatives aimed at educating primary care providers and pediatricians on postpartum hypertension warning signs [18]. In terms of medication management, studies highlight the need for standardized antihypertensive treatment protocols to ensure uniform clinical decision-making [17]. A lack of clear guidelines has led to variability in when and how treatment is initiated postpartum. Future policy efforts should focus on developing universal postpartum BP monitoring guidelines, ensuring equitable access to care, and leveraging technology to improve follow-up adherence.

Standardization Challenges and Areas for Improvement

One of the most critical findings is the lack of a universally accepted postpartum BP threshold, making clinical decision-making challenging. Some studies define hypertension as BP ≥140/90 mmHg [18], while others use more stringent cutoffs for postpartum intervention [8]. The inconsistency in follow-up protocols further complicates early diagnosis, with postpartum visits ranging from 2 to 6 weeks postpartum [10]. Studies from France and Italy [25,26] highlight how postpartum hypertension screening is integrated into national maternal care guidelines, offering a structured approach to follow-up. Meanwhile, research from India and China [27,28] points to a reliance on home BP monitoring due to limitations in healthcare access, demonstrating the need for better standardization across healthcare systems. Furthermore, studies from Norway and Sweden [29,30] showcase the effectiveness of comprehensive maternal health tracking programs in ensuring consistent postpartum BP assessments, suggesting that similar models could be adopted in other regions.

Discussion

The findings of this review underscore notable healthcare infrastructure, national health policies, socioeconomic factors and geographic disparities in the monitoring and management of postpartum blood pressure (PBP), resulting in inconsistencies in defining normal PBP and presenting challenges in establishing universally accepted diagnostic thresholds. Central to this inquiry is the conundrum of "what is normal?" With no properly defined blood pressure and vital sign ranges for the postpartum period, the variation in treatment is heavily influenced by the aforementioned variables of geography, race, resources, socioeconomics, and healthcare system infrastructure. What further complicates this, from a clinical discretion standpoint, is that if and when resources are made available for additional monitoring, it remains almost entirely exclusive to high-risk patients [31-35]. In high-resource settings like the U.S. and the U.K., structured follow-up protocols for high-risk patients have been implemented, ensuring more consistent monitoring of PBP. However, given data that suggests that an overwhelming percentage of women without any prior history of hypertension or other blood pressure disorders can develop some form of postpartum hypertension, these "low-risk" and otherwise healthy patients are provided with no clinical oversight or care. It is known that healthcare infrastructure, coupled with accessibility of follow-up care, is crucial to promoting maternal health outcomes and mitigating maternal mortality and morbidity [36-40]. However, natural clinical variation must be better accounted for, thus necessitating a standardized postpartum vital sign range to help reduce the number of preventable maternal deaths that occur in the 4th trimester [41-45].

Furthermore, the inclusion of various study designs in the literature—ranging from prospective cohort studies to randomized controlled trials—provides valuable insights into the effectiveness of different monitoring approaches, including home-based BP monitoring and hospital follow-up [46-50]. However, this diversity in study designs also reveals inconsistencies in defining normal postpartum BP and highlights the challenge of establishing universally accepted diagnostic thresholds. The variation in these thresholds complicates the clinical decision-making process and creates discrepancies in patient outcomes, especially in settings where resources are limited [51-55]. The need for standardized guidelines and protocols is evident, as inconsistent follow-up schedules and monitoring practices hinder timely detection and management of postpartum hypertension [56-60].

Conclusion

The general range of geographic variation in blood pressure measures, coupled with the broad challenges associated with clinical decision-making, makes the management of postpartum blood pressure (PBP) particularly complex [61-65]. These disorders are influenced by a range of factors, including socioeconomic status, access to healthcare, cultural practices, and regional differences in healthcare infrastructure [66-70]. The lack of a standardized definition for PBP as well as inconsistencies in implementation of a proper screening system for the timely detection and management of these conditions, further exacerbates the problem [71-73]. Additionally, the absence of early detection and appropriate management often results in missed opportunities to mitigate risks and prevent complications amongst 'low-risk' populations, such as postpartum preeclampsia, and maternal morbidity and mortality [74-76]. Given the varied approaches to managing postpartum blood pressure across the world, it is critical to examine and learn from the diverse models that have been

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successful in different contexts. This review offers an opportunity to identify and adapt best practices that are effective in improving maternal health outcomes. By exploring successful strategies from various regions—whether through the implementation of universal screening, community-based healthcare models, or advanced clinical guidelines—healthcare providers and policymakers can work toward developing more standardized, timely, and effective systems for managing PBP. [77] In conclusion, addressing the challenges of PBP requires a multifaceted approach that combines the strengths of regional models, improved healthcare systems, and a commitment to developing standardized, evidence-based guidelines. Only through collaboration, data sharing, and the integration of global best practices can we ensure that all pregnant individuals have access to the care they need to reduce the burden of hypertensive disorders and improve maternal and fetal health outcomes worldwide [78].

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