A ONE-YEAR CROSS SECTIONAL ANALYSIS OF EMERGENCY MEDICAL SERVICES UTILIZATION AND ITS ASSOCIATION WITH HYPERTENSION IN PREGNANCY

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ABSTRACT

Objective: To evaluate the prehospital obstetric population that utilizes emergency medical services (EMS) and their association with hypertensive disorders of pregnancy. Methods: We conducted a retrospective evaluation of one year of all medical calls from a large, municipal, midwestern fire department. Inclusion criteria included all pregnant patients transported to a hospital by EMS. Descriptive statistics were calculated to evaluate prehospital event information (e.g., zip code, time, and duration of call), patient characteristics, and clinical management data regarding blood pressure. Census data were used to compare neighborhood information with poverty rates. Results: Of the 1,575 identified patients, 64.4% (1015/1575) presented with obstetric complaints, 57.4% (700/1220) were in their third trimester and 72.7% (686/944) were multiparous. The median call duration was 17 (interquartile range 12–22) minutes. In the areas where EMS usage was highest, one quarter of individuals lived below the poverty level. Of the studied population, 32.0% (504/1575) were found to be hypertensive; 14.9% (75/504) of hypertensive patients were found to have severe hypertension. Only one patient (1/1575, 0.06%) presented with a chief complaint of hypertension; the rest were discovered by EMS. The highest rates of hypertension were noted in wealthier areas of the city. Patients with severe hypertension were more likely to present with seizures, consistent with eclampsia. Conclusion: Hypertension is common in the obstetric population using EMS. Prehospital management of hypertensive disorders of pregnancy may focus on identification and treatment of severe pre-eclampsia or eclampsia. Areas with longer call times may consider treatment of severe hypertension. Prehospital treatment of hypertensive disorders of pregnancy could be optimized. Key words: pregnancy; obstetrics; hypertension; emergency medical services; pre-eclampsia; prehospital care

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INTRODUCTION

Emergency medical services (EMS) may be the first level of contact for many pregnant patients arriving to the hospital. It is unclear how many pregnant women utilize EMS as this has not been thoroughly studied. Furthermore, little is known regarding prehospital management of women with common obstetric complications, including hypertensive disorders of pregnancy.

The prevalence of hypertensive disorders of pregnancy, which includes chronic hypertension, gestational hypertension, pre-eclampsia, and eclampsia, has doubled over the past twenty years (1) and is the result of advancing maternal age and the obesity epidemic (2, 3). Although hypertensive disorders of pregnancy are decreasingly responsible for maternal deaths in the United States (US) (4), the high prevalence of hypertension remains concerning due to the strong association between detrimental maternal and fetal outcomes and inadequate hypertension control. Because of the high risk of maternal stroke, acute-onset severe hypertension that persists for at least fifteen minutes is considered an obstetric emergency and warrants immediate treatment (5, 6). Further, as hypertension persists, other maternal sequelae include pulmonary edema, renal failure, myocardial infarction, seizures, hemorrhage, and

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death. Severe hypertension is also associated with placental abruption and fetal demise (7, 8).

To our knowledge, no research has systematically evaluated the role EMS plays in evaluating US pregnant patients with hypertension. Given the risks associated with acute severe hypertension in pregnancy, EMS may play a critical role in identifying and treating severe hypertension in this population prior to hospital arrival. The primary goal of this study was to evaluate the obstetric population that utilizes EMS and their association with hypertension in pregnancy.

**METHODS**

This was a retrospective, cross-sectional evaluation of pregnant women transported by Columbus Division of Fire EMS in Columbus, Ohio over the course of one calendar year (January through December 2016). Approval to conduct this study was obtained from the Institutional Review Board at The Ohio State University Wexner Medical Center and the City of Columbus, Ohio. The setting of this study is a large, midwestern city with a 2019 population of 898,553 covering 217 square miles with 12,452 live births in the year 2016 (9). Census data approximates that 20.8% of all individuals in Columbus, Ohio lived below the poverty level (10) in the year of this study. The City of Columbus Division of Fire runs approximately 150,000 emergency medical calls annually. All medical calls are attended by an advanced life support provider and an advanced life support ambulance transports all patients.

The research team queried one year of EMS run reports from this large municipal midwestern fire department using SafetyPAD (OPEN, Minneapolis, MN, USA), a database focused on quality review and improvement. Pregnant patients who were transported to a hospital were retrospectively identified. Exclusion criteria included patients under age 18, inter-hospital transfers, duplicate run reports, incomplete prehospital medical records, and patients who were not actually found to be pregnant based on author review of the narrative.

Clinical information, including chief complaint, past medical history, gestational age, all blood pressure measurements, gravidity, parity, and EMS interventions, was abstracted from the run report. Demographic information, including age and race/ethnicity was also obtained from the run report. Race/ethnicity information in run reports was documented by EMS providers and based on their interpretation of the patient’s appearance. Standard obstetric definitions of hypertension (≥140/≥90), including mild hypertension (140–159/90–109) and severe hypertension (≥160/≥110), were used (11, 12). We classified patients’ hypertensive status based on the highest blood pressure reported if multiple blood pressures were recorded during the call. Call-related information, including scene zip code, call time of day, and call duration was also obtained. Scene zip code, rather than zip code of patient residence, was reported as scene zip code was available for all calls and missingness was high for zip code of patient residence. Duration of call was measured in minutes by subtracting the time of scene arrival from the time of hospital arrival.

Descriptive statistical analysis was performed with SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). Categorical comparisons were made using Fisher’s exact test, while continuous variables were compared using Wilcoxon rank-sum tests. A significance level of \( p = 0.05 \) was used and \( p \)-values were not adjusted for multiplicity due to the exploratory nature of this study. Zip codes were used to compose heat maps of the neighborhoods with the highest prevalence of EMS runs, hypertension, and severe hypertension. Zip codes that contained fewer than five total calls were merged with other proximal and socioeconomically similar zip codes for heat map depiction. Specific zip codes that were merged are detailed on Figures 2–4. Census data was then used to compare this neighborhood information with poverty rates.

**RESULTS**

In 2016, the Columbus Division of Fire attended 149,207 emergency medical calls; 1,575 cases were identified as pregnant patients who were transported to a hospital (Figure 1). Demographic and call related information of all patients are detailed in Table 1. The median age was 25 (first-third quartile \((Q_1\cdots Q_3)\) 21–30) years. Most patients with completely recorded obstetrical histories were in their third trimester (700/1220, 57.4%) and were multiparous (686/944, 72.7%). The race of most patients was reported as Black (737/1205, 61.2%); however, racial information should be interpreted with caution as race and ethnicity are routinely described using the EMS provider’s interpretation of the patient’s appearance and missingness was high.

The median EMS call duration was 17 \((Q_1\cdots Q_3)\) 12–22 minutes, and slightly more than half (877/1575, 55.7%) of the calls occurred during evening hours (5:00 PM – 8:00 AM). EMS usage was highest in the central, low-income areas of the city (Figure 2). On average, one quarter of individuals lived
Approximately two thirds (1015/1575, 64.4%) of all pregnant patients transported by EMS called for obstetric-related complaints, which included labor, abdominal/pelvic pain, vaginal bleeding, or fetal concerns (Table 2). The remainder called EMS with a variety of other complaints which are detailed in Table 2. Some of the obstetric and non-obstetric complaints overlapped. Seven patients had more than one chief complaint.

Although patients rarely presented with complaints of hypertension (1/1575, 0.06%), nearly one third (504/1575, 32%) of all patients were hypertensive on EMS examination. Few (28/504, 5.6%) hypertensive patients reported a history of chronic hypertension. Compared to their normotensive counterparts, hypertensive patients were more likely to be older (median age 26, Q1-Q3 22–31 years vs median age 25, Q1-Q3 21–29 years, p < 0.001) and have a history of chronic hypertension (28/504, 5.6% vs 12/1071, 1.1% p < 0.001) and diabetes (20/504, 4.0% vs 15/1071, 1.4%, p = 0.003) (Table 3). The geographic distribution of hypertensive calls was noted to be in wealthier areas of the city (Figure 3), with an average of 6% of living below the poverty level (10, 13).

Of the hypertensive patients, 14.9% (75/504) had severe hypertension. These patients were older (median age 28, Q1-Q3 24–33 years) and presented more often in their third trimester (37/57, 64.9%) but were otherwise similar to the remainder of the

### Table 1. Demographic and call-related information from all calls and by blood pressure status.

| Variable                      | All patients n (%) | Severely Hypertensive n (%) | Normotensive n (%) | Hypertensive n (%) | p       |
|-------------------------------|--------------------|-----------------------------|-------------------|-------------------|---------|
| No. patients                  | 1575               | 75                          | 1071              | 504               | <0.001  |
| Age (years)                   |                    |                             |                   |                   |         |
| Trimester*                    |                    |                             |                   |                   |         |
| First                         | 240 (19.7%)        | 7 (12.3%)                   | 162 (19.5%)       | 78 (20.1%)        | 0.14    |
| Second                        | 280 (23.0%)        | 13 (22.8%)                  | 204 (24.5%)       | 76 (19.5%)        |         |
| Third                         | 700 (57.4%)        | 37 (64.9%)                  | 465 (56.0%)       | 235 (60.4%)       |         |
| Parity†                       |                    |                             |                   |                   |         |
| Nullipara                     | 258 (27.3%)        | 14 (29.2%)                  | 168 (25.8%)       | 90 (30.6%)        | 0.13    |
| Multipara                     | 686 (72.7%)        | 34 (70.8%)                  | 482 (74.2%)       | 204 (69.4%)       |         |
| Race / ethnicity‡             |                    |                             |                   |                   |         |
| Black                         | 737 (61.2%)        | 39 (62.9%)                  | 513 (62.0%)       | 224 (59.4%)       | <0.001  |
| Hispanic                      | 348 (28.9%)        | 19 (30.6%)                  | 235 (28.4%)       | 113 (30.0%)       |         |
| Asian                         | 28 (2.3%)          | 1 (1.6%)                    | 18 (2.2%)         | 10 (2.7%)         |         |
| Other                          | 79 (6.6%)          | 2 (3.2%)                    | 55 (6.6%)         | 24 (6.4%)         |         |
| Call time of day              |                    |                             |                   |                   |         |
| 0800-1700                     | 698 (44.3%)        | 32 (42.7%)                  | 471 (44.0%)       | 227 (45.0%)       | 0.70    |
| 1700-0800                     | 877 (55.7%)        | 43 (57.3%)                  | 600 (56.0%)       | 277 (55.0%)       |         |
| Call length (minutes)         |                    |                             |                   |                   |         |
| Median (IQR)                  | 17 (12-22)         | 18 (13-25)                  | 17 (12-23)        | 17 (12.5-22)      | 0.17    |

Normotensive is <140/<90, hypertensive is ≥140/<90, and severely hypertensive is ≥160/<110. Significant results are bolded.

Abbreviations: IQR: interquartile range; No. Number.

*Trimester was missing for 355 patients.

†Parity was missing for 631 patients.

‡Racial and ethnic information should be interpreted with caution as race is described as the EMS provider’s interpretation of the patient’s appearance. “Other” race/ethnicity includes patients described as “other” in the EMS run report. Race/ethnicity information was missing for 370 patients.
hypertensive cohort (Table 1). Severely hypertensive patients were more likely to present with seizures, when compared to those without severe hypertension (4/75, 5.3% vs 17/1500, 1.1%, \( p = 0.015 \)), consistent with eclampsia. Though our statistical power is limited by a small sample size, proportionally more patients with severe hypertension reported a chief complaint of headache than patients without severe hypertension (3/75, 4.0% vs 18/1500, 1.2%, \( p = 0.075 \)), which may suggest a diagnosis of pre-eclampsia with severe features. No patients who complained of hypertension had severe hypertension. Severely hypertensive patients were more likely than those without severe hypertension to have received an electrocardiogram (12/75, 16.0% vs 107/1500, 7.1%, \( p = 0.011 \)), nitroglycerin (3/75, 4.0% vs 2/1500, 0.1%, \( p = 0.001 \)), and/or midazolam (2/75, 2.7% vs 2/1500, 0.1%, \( p = 0.013 \)) (Table 4) by EMS providers. Furthermore, the geographic distribution of patients with severe hypertension had the lowest poverty rates in the city with an average of 5.6% living below the poverty level (Figure 4) (10, 13).

**DISCUSSION**

Consistent with the limited existing literature (14, 15), most of our study patients contacted EMS for pregnancy-related complaints, though nearly a third

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**FIGURE 2.** Geographic density of emergency medical services calls for pregnant patients in Columbus in 2016 by zip code. Abbreviations: EMS: Emergency medical services
of patients were found to be hypertensive upon physical examination. There are many potential complications that patients may face during pregnancy that require emergent treatment. Early stabilization of acutely ill patients prior to hospital arrival by EMS personnel is critically important for optimal patient outcomes (16–18). Acute episodes of sustained severe hypertension (≥160/≥110) in pregnancy is a medical emergency (5, 6). Blood pressures that remain over this threshold for at least fifteen minutes should be treated as early as possible to decrease the risk of maternal stroke (5, 6).

Although there have been numerous efforts to set standards around EMS practice including the 2019 EMS Scope of Practice Model (19) and the 2017 Clinical Practice Guidelines (20), EMS protocols still vary widely by region (21–23). There are little data regarding the optimal approach to care of the hypertensive obstetric patient in the prehospital setting; one study evaluating inter-facility transportation of pregnant women noted the most common clinically significant event that occurred during transport was worsening of hypertensive disease requiring intervention (24).

The high prevalence of hypertension demonstrated in our study suggests that pregnant women using EMS may carry an overall greater risk of hypertensive disorders of pregnancy than the 1–17% seen in the general obstetric population (1, 7, 25, 26). Although hypertension in pregnant patients utilizing EMS is not well described in the literature, our results are consistent with the higher prevalence of hypertension on physical exam (13.0%) compared to patient-reported medical history (3.5%) or chief complaint (<1.0%) in Australian pregnant women using EMS (14). Although the retrospective nature of our study and lack of information on care after arrival to the hospital challenges us to identify the true risk for these patients, it is concerning that so many EMS-treated pregnant patients were hypertensive. EMS providers should have a high index of suspicion for hypertensive disorders of pregnancy as they may play a critical role in identifying pregnant patients with severe hypertension in the prehospital setting.

Consistent with known risk factors and the pathophysiology of pre-eclampsia, hypertensive patients in our sample frequently presented in the third trimester, were nulliparous, were more likely to have a personal history of chronic hypertension and diabetes (25, 26). These patients were also older and more likely to live in higher income areas, representing the positive association between advancing maternal age and increased socioeconomic status (27). The significant proportion of patients with severe hypertension supports the concept that

| Complaint                      | All Patients n (%) | Normotensive or mildly hypertensive *n (%) | Severely hypertensive n (%) | p     |
|-------------------------------|-------------------|------------------------------------------|----------------------------|-------|
| Number of Patients            | 1575              | 1500                                     | 75                         | 0.46  |
| Any Obstetric                 | 1014 (64.4%)      | 970 (64.7%)                              | 45 (60.0%)                 | 1.0   |
| Labor                         | 514 (32.6%)       | 489 (32.6%)                              | 25 (33.3%)                 | 0.90  |
| Pelvic/Abdominal pain         | 335 (22.5%)       | 338 (22.5%)                              | 17 (22.7%)                 | 0.058 |
| Vaginal Bleeding              | 136 (8.6%)        | 134 (8.9%)                               | 2 (2.7%)                   | 0.39  |
| Fetal Concern                 | 10 (0.6%)         | 9 (0.6%)                                 | 1 (1.3%)                   | 0.46  |
| Any Non-Obstetric             | 566 (35.9%)       | 538 (35.9%)                              | 30 (40.0%)                 | 1.0   |
| Gastrointestinal Complaint    | 112 (7.1%)        | 107 (7.1%)                               | 5 (6.7%)                   | 0.77  |
| Altered Mental Status         | 86 (5.5%)         | 82 (5.5%)                                | 4 (5.3%)                   | 0.53  |
| Musculoskeletal Complaint     | 79 (5.0%)         | 78 (5.2%)                                | 1 (1.3%)                   | 0.52  |
| Trauma, Major                 | 64 (4.1%)         | 62 (4.1%)                                | 2 (2.7%)                   | 0.77  |
| Trauma, Minor                 | 60 (3.8%)         | 56 (3.7%)                                | 4 (5.3%)                   | 0.53  |
| Mental Health Complaint       | 15 (1.0%)         | 14 (0.9%)                                | 1 (1.3%)                   | 1.0   |
| Malaise                       | 29 (1.8%)         | 28 (1.9%)                                | 1 (1.3%)                   | 0.056 |
| Shortness of Breath           | 31 (2.0%)         | 30 (2.0%)                                | 1 (1.3%)                   | 1.0   |
| Assault                       | 30 (1.9%)         | 29 (1.9%)                                | 1 (1.3%)                   | 1.0   |
| Headache                      | 21 (1.3%)         | 18 (1.2%)                                | 3 (4.0%)                   | 0.075 |
| Seizure                       | 21 (1.3%)         | 17 (1.1%)                                | 4 (5.3%)                   | 0.015 |
| Other                         | 19 (1.2%)         | 16 (1.1%)                                | 3 (4.0%)                   | 0.056 |
| Hypertension                  | 1 (0.1%)          | 1 (0.1%)                                 | 0 (0.0%)                   | 1.0   |
| Total complaints**            | 1583 (100%)       | 1508 (95.3%)                             | 75 (4.7%)                  |       |

Normotensive is <140/<90, hypertensive is ≥140/≥90, and severely hypertensive is ≥160/≥110. Significant results are bolded.

*Mildly hypertensive includes blood pressures 140-159/90-109.

1Labor includes complaints of contractions and rupture of membranes.

3Pelvic pain includes abdominal pain and vaginal irritation or discharge.

3Altered mental status includes syncope and intoxication with alcohol and other substances.

3Other includes chest pain, palpitations, urinary complaint, requested a ride to the hospital, allergic reaction, dehydration, and dermatologic complaint.

** Seven patients indicated more than one complaint.
TABLE 3. Past medical history of pregnant patients using emergency medical services stratified by blood pressure.

| History                                      | Normotensive n (%) | Hypertensive n (%) | p       | Severely hypertensive n (%) |
|----------------------------------------------|--------------------|--------------------|---------|-----------------------------|
| Number of patients                           | 1071               | 504                | 0.78    | 75                          |
| Pulmonary disorder                           | 93 (8.7%)          | 46 (9.1%)          |         | 7 (9.3%)                    |
| Mental health disorder                       | 59 (5.5%)          | 39 (7.7%)          | 0.093   | 11 (14.7%)                  |
| Hematologic disorder                         | 28 (2.6%)          | 6 (1.2%)           | 0.093   | 1 (1.3%)                    |
| Seizures                                     | 25 (2.3%)          | 20 (4.0%)          | 0.076   | 2 (2.7%)                    |
| Urologic/gastrointestinal condition          | 21 (2.0%)          | 10 (2.0%)          | 1.0     | 4 (5.3%)                    |
| Drug abuse                                   | 16 (1.5%)          | 10 (2.0%)          | 0.53    | 3 (4.0%)                    |
| Diabetes                                     | 15 (1.4%)          | 20 (4.0%)          | 0.003   | 4 (5.3%)                    |
| Hypertension                                 | 12 (1.1%)          | 28 (5.6%)          | <0.001  | 11 (14.7%)                  |
| Musculoskeletal condition                    | 10 (0.9%)          | 5 (1.0%)           | 1.0     | 1 (1.3%)                    |
| Headaches                                    | 10 (0.9%)          | 2 (0.4%)           | 0.36    | 1 (1.3%)                    |
| Other*                                       | 31 (2.9%)          | 24 (4.8%)          | 0.076   | (0.0%)                      |

Normotensive is <140/<90, hypertensive is ≥140/≥90, and severely hypertensive is ≥160/≥110. Significant results are bolded.

*Other medical problems include human immunodeficiency virus, hepatitis, heart condition, cancer, stroke, arthritic disorder, and endocrine condition other than diabetes.

FIGURE 3. Geographic density of hypertension in pregnant patients using emergency medical services in Columbus in 2016 by zip code. Abbreviations: EMS: Emergency medical services
Obstetric patients utilizing EMS are at a high risk to carry hypertensive disorders of pregnancy. Furthermore, many of these patients had findings suggestive of pre-eclampsia with severe features; 38.1% (8/21) of patients complaining of headache also had elevated blood pressures (12, 25).

Despite similar rates of a reported past medical history of seizures (2/75, 2.7% vs 43/1500, 2.9%), severely hypertensive patients were more likely to present with seizures (4/75, 5.3%) than normotensive or mildly hypertensive (17/1500, 1.1%) patients ($p = 0.015$). Most eclamptic patients have severe hypertension in the antepartum setting (28) and three patients in our sample (0.2%, 3/1575) met diagnostic criteria for eclampsia. Although the prevalence of eclampsia in the western world is less than 0.05% (28), our higher than expected prevalence of eclampsia was consistent with a cohort of Australian obstetric patients using EMS (1%) (14). This information supports the hypothesis that pregnant women using EMS are inherently at high risk for hypertensive disorders of pregnancy and their sequelae.

Exploratory analyses of EMS interventions demonstrated differences in treatment patterns between the severely hypertensive and normotensive/mildly hypertensive cohorts. Our system protocol for treatment of hypertensive diseases of pregnancy at the time of this study is available in Appendix 1. Although a small sample size of severely hypertensive patients prohibits a comprehensive understanding of practice variability, midazolam was administered to two of the three patients with eclampsia. Benzodiazepine administration may be due to event specific characteristics and may be considered in the acute convulsive setting; however, magnesium remains the most effective therapy for eclampsia (12, 28, 29). Many EMS protocols permit paramedic administered benzodiazepine for status epilepticus or prolonged convulsions in a seizing patient (30, 31); however, use of magnesium sulfate by EMS is less common. Some regional protocols permit the use of magnesium for treatment of hypertension in pregnancy, suspected pre-eclampsia, or eclampsia (30), but national protocols vary (32). Several large clinical trials have investigated the role of magnesium for various obstetric pathologies; the data at this time do not support the use of magnesium for the purpose of blood pressure reduction (6, 33–35) or for pre-eclampsia without severe features (12, 28, 29). Although several EMS protocols permit the use of magnesium for a wide variety of obstetric indications, including hypertension and pre-eclampsia without severe features (29), this treatment should not be administered by EMS for these indications. On the contrary, magnesium sulfate decreases the risk of eclamptic seizures in women with pre-eclampsia with severe features and decreases the risk of additional eclamptic seizures in patients with eclampsia (12, 27, 28). Magnesium administration by EMS to patients with suspected pre-eclampsia with severe features or those with eclamptic seizures may be feasible as magnesium is often carried by EMS personnel for other conditions, including its use in advanced cardiac life support (36).

Unlike the general population, where acute hypertension is not routinely treated in the prehospital (30) or emergency department setting unless there are signs of end organ damage (37), treatment of acute hypertension in pregnancy is indicated (6, 34). First line pharmacotherapy for acute severe hypertension in pregnancy includes the use of oral nifedipine, intravenous labetalol, or intravenous hydralazine (6, 34). None of the patients in our study received these medications as they are not

| Treatment                  | Normotensive or mildly hypertensive (% | Severely hypertensive n (%) | $p$  |
|----------------------------|----------------------------------------|-----------------------------|------|
| Number of patients         | 1500                                   | 75                          |      |
| IV access                  | 500 (33.3%)                            | 32 (42.7%)                  | 0.10 |
| Oxygen                     | 294 (19.6%)                            | 20 (26.7%)                  | 0.14 |
| Electrocardiogram          | 107 (7.1%)                             | 12 (16.0%)                  | 0.011|
| Position                   | 370 (24.7%)                            | 8 (10.7%)                   | 0.005|
| Nitroglycerin              | 2 (0.1%)                               | 3 (4.0%)                    | 0.001|
| Midazolam                  | 2 (0.1%)                               | 2 (2.7%)                    | 0.013|
| Naloxone                   | 5 (0.3%)                               | 1 (1.3%)                    | 0.25 |
| Aspirin                    | 1 (0.1%)                               | 1 (1.3%)                    | 0.093|
| Airway management          | 3 (0.2%)                               | 0 (0.0%)                    | 1.0  |
| Fentanyl                   | 3 (0.2%)                               | 0 (0.0%)                    | 1.0  |

Normotensive is $<140/90$, hypertensive is $\geq140/\geq90$, and severely hypertensive is $\geq160/\geq110$. Significant results are bolded.

*Mildly hypertensive includes blood pressures 140-159/90-109.
available for administration by prehospital personnel in our jurisdiction and prehospital providers do not routinely treat hypertension in the non-obstetric population. Three severely hypertensive patients in our cohort did receive nitroglycerin, which may also decrease blood pressure; however, all reported chest pain, which was the indication for its administration.

EMS is also a means of access to medical care for low income and vulnerable populations (38–40). Our study suggests the demographics of pregnant women using EMS are similar to the general population using EMS. Our findings are consistent with previous research noting pregnant Australian women using EMS similarly resided in low-income areas (14), however, population-level research is necessary to evaluate these patterns.

As a retrospective study, there are inherent limitations that must be acknowledged. Every effort was made to include all eligible patients; however, selection and sample bias may be present. The exclusion of patients with incomplete run reports may affect the results of the study although this number is low. Similarly, the call data pulled includes the total number of calls and does not reflect the possibility that one individual might have made multiple calls to EMS during the course of her pregnancy. Patients were transported to many different hospitals and
hospital follow-up data were unavailable for analysis. This study was limited to an evaluation of EMS runs from a single department in a large midwestern city as a result and may not be nationally representative. Despite these potential limitations, this study adds to the existing literature regarding the demographics of patients who contact EMS during their pregnancies, reasons why they utilize EMS, a more thorough understanding of hypertension in this population, and recommendations for the prehospital treatment of hypertensive disorders of pregnancy.

Current guidelines for the management of acute hypertension in pregnancy recommend repeating the blood pressure measurement in fifteen minutes following the first severe range reading prior to initiating antihypertensive treatment (5, 6). In our study, median call duration was seventeen minutes overall and eighteen minutes in patients with severe hypertension. It would be impractical to consider EMS treatment of severe acute hypertension in urban or suburban settings where response and transport times are short (41, 42); however, treatment of acute severe hypertension in pregnancy could be considered in rural or more remote settings with longer transit times (41, 42). Future research evaluating the prevalence of severe hypertension in communities with longer EMS transport times may help define the need for prehospital treatment of acute severe hypertension in pregnancy. The utilization of magnesium for pre-eclampsia with severe features or eclampsia in the prehospital setting may be considered but warrants additional research. Finally, involving obstetric care providers in the development of national and regional EMS protocols may optimize prehospital treatment of pregnant women.

**CONCLUSION**

Hypertension is common in the obstetric population using EMS. Prehospital management of hypertensive disorders of pregnancy may focus on identification and treatment of severe pre-eclampsia or eclampsia. Areas with longer call times may consider treatment of severe hypertension. Prehospital treatment of hypertensive disorders of pregnancy could be optimized.

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