

## Epidemiological description of the risk factors for obstetric emergencies in cross-referral cases at Dr. Soetomo Regional Public Hospital during the COVID-19 pandemic from 2020 to 2021



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### ABSTRACT

**Introduction:** Emergency obstetric referrals are crucial for preventing pregnancy complications that may escalate into severe, life-threatening conditions, ultimately resulting in fatalities. The pandemic influenced the obstetric referral system of healthcare services. Specifically, Dr. Soetomo Regional Public Hospital recorded 107 cross-referral cases in 2020 and 58 in 2021 with obstetric risk factors. In this study, we analyze these obstetric emergency cross-referral cases during the pandemic at the hospital. This study aims to provide an epidemiological description of cross-referral cases with risk factors for obstetric emergencies at Dr. Soetomo Regional Public Hospital during the COVID-19 pandemic from 2020 to 2021.

**Methods:** An analytical descriptive research design, employing a case study approach, was used to analyze cross-referral cases with risk factors for obstetric emergencies over the pandemic period. The research subjects encompassed all obstetric emergency cross-referral cases at Dr. Soetomo Regional Public Hospital during the pandemic, with a total sampling technique applied to select cases that met specific inclusion and exclusion criteria.

**Results:** The analysis of emergency obstetric referrals revealed a significant relationship between the patient's age and their risk factor categories for obstetric emergencies ( $p < 0.001$ ). Furthermore, a significant correlation was found between the delayed referral phases and the risk factors for obstetric emergencies ( $p < 0.001$ ). A significant correlation was observed concerning the need for Intensive Care Unit (ICU) care. The analysis also demonstrated a significant relationship between obstetric emergencies and birth weight as well as APGAR score ( $p < 0.05$ ).

**Conclusion:** This study reveals a compelling relationship between the risk factors for obstetric emergencies and the variables such as age, methods of vaginal delivery, delayed referral phases, birth weights, and APGAR scores during the COVID-19 pandemic.

**Keywords:** COVID-19 pandemic, obstetric emergencies, risk factors, delayed referral phases, obstetric and neonatal outcomes.

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### INTRODUCTION

Emergency obstetric referrals play a critical role in averting pregnancy complications that carry the potential to escalate into severe, life-threatening conditions, often culminating in a fatality. For instance, antepartum hemorrhage can swiftly lead to the demise of both the mother and the unborn fetus within a matter of minutes or hours. Establishing an effective obstetric health service referral system is imperative to prevent such dire outcomes. Ideally, patients with obstetric emergencies should undergo stabilization before being transferred to a more advanced healthcare facility.<sup>1,2,3</sup> Obstetric emergencies are categorized

into three risk groups: There is a Potential Obstetric Emergency (POE) Exists, There is an Obstetric Emergency (OE) Exists, and There is an Obstetric Emergency in Progress or AGDO (Obstetric Emergency and Urgency Exists). Factors such as organizational management, medical personnel, resources and ward equipment, environmental conditions, and family-related barriers are subject to analysis. Organizational management factors have revealed instances of deficient information-sharing systems at referral hospitals, with 17 documented cases.<sup>2,4</sup> Achieving a reduction in maternal mortality is deemed unattainable without an efficient referral system, particularly for cases involving complications. A fundamental tenet of

primary healthcare involves fostering close interrelations between hierarchical levels. Dr. Soetomo Regional Public Hospital recorded 414 referrals with COVID-19 cases in 2020, followed by 315 in 2021. While the COVID-19 service referral system is stipulated in the Ministry of Health guidelines and the Decree of the East Java Governor designating certain hospitals as COVID-19 referrals, the initial stages of the pandemic exposed unpreparedness among regional hospitals in terms of negative pressure isolation rooms and personal protective equipment.

Consequently, East Java's referral hospitals became concentrated primarily in the provincial capital and select urban districts, posing challenges in transferring

mothers from various hospital catchment areas. Further compounding the situation, the closure of district hospital operating rooms due to COVID-19 contraction among healthcare workers disrupted health services. The COVID-19 pandemic has exerted profound effects on healthcare systems, societal structures, and the global economy.<sup>5,6</sup> This study aims to provide an epidemiological description of cross-referral cases with risk factors for obstetric emergencies at Dr. Soetomo Regional Public Hospital during the COVID-19 pandemic from 2020 to 2021.

## METHODS

This research employed a descriptive-analytic approach with a case study design, focusing on analyzing casual referrals that transpired throughout the pandemic period spanning from April to September 2022 at Dr. Soetomo Regional Public Hospital, Surabaya. The research sample encompassed all obstetric emergency referral cases at Dr. Soetomo Regional Public Hospital from 2020 to 2021. Inclusion criteria for this study entail cross-referrals transpiring from April 2020 to April 2021 involving pregnant and postpartum women. Conversely, incomplete medical record data constituted the exclusion criterion.

The research spanned approximately six months, encompassing the collection of data pertaining to referred patients. This encompassed their address, age, diagnosis, parity, history of prior cesarean delivery, adherence to Antenatal Care (ANC), identification of risk factors based on diagnosis upon admission, method of delivery during treatment, records of the referring healthcare facilities, classification of delayed referral phases, and examination of obstetric and neonatal outcomes in casual referrals during the pandemic.

Subsequently, the recorded data underwent analysis utilizing the Statistical Package for the Social Sciences (SPSS), employing descriptive analysis techniques in alignment with the findings.

## RESULTS

A comprehensive review of medical records encompassing patients with cross-

referrals to Dr. Soetomo Regional Public Hospital from April 2020 to 2021 yielded a total of 165 cases. Subsequently, from this population, a subset of 144 patients satisfying the inclusion criteria with complete medical record data during the 2020-2021 period was identified. Notably, the highest proportion of referred patients hailed from domiciles within Surabaya (Table 1).

During the COVID-19 pandemic, referral cases highlighted a prevailing trend of delays primarily occurring in phase 3. The measures instituted at Dr. Soetomo Regional Public Hospital for addressing each delayed referral phase and obstetric emergency risk factor, in conjunction with the corresponding delayed referral phase, are elucidated in Table 2. The maternal and neonatal outcomes associated with each phase of delayed referral are presented in Table 3.

An analysis conducted on the age characteristics of the cross-referred patients is presented in Table 4. Among these patients, the age range of 20-24 years exhibited the highest prevalence, comprising 5 cases with APGO, 52 cases with AGO, and 23 cases with AGDO. For patients aged  $\geq 35$  years, there were 3 cases with APGO, 15 cases with AGO, and 21 cases with AGDO.

Spearman's correlation analysis demonstrated a relationship between the patient's age and their risk factor categories for obstetric emergencies, albeit with a weak correlation strength ( $p < 0.005$ ).

Considering the characteristics of Antenatal Care (ANC) compliance, Table 5 highlights that the group with  $\geq 6x +$  consultation with Obstetrics and Gynecology Specialist showed a predominance, encompassing 23 cases with APGO, 53 cases with AGO, and 28 cases with AGDO. Meanwhile, within the  $< 6x +$  consultation with the Obstetrics and Gynecology Specialist group, there were 5 cases with APGO, 10 cases with AGO, and 13 cases with AGDO.

However, no correlation between the frequency of ANC and the obstetric emergency status was observed in the ANC compliance variable ( $p > 0.05$ ).

Furthermore, analysis of the delivery methods in Table 6 highlights a dominance in the abdominal delivery group,

accounting for 8 cases with APGO, 43 cases with AGO, and 33 cases with AGDO. This was followed by spontaneous delivery with 20 cases of APGO, 27 cases of AGO, and 6 cases of AGDO.

The correlation analysis revealed a noteworthy connection between the categories of the risk factors for obstetric emergencies and the abdominal delivery method, signifying statistical significance ( $p < 0.05$ ). The contingency coefficient value of 0.398 further indicates a positive direction in this relationship (Table 6).

When examining the referring healthcare facilities (Table 7), it becomes evident that the majority of cases were conducted by hospitals designated in a Governor's Decree to provide COVID-19 services. Specifically, there were 14 cases of APGO, 34 cases of AGO, and 23 cases of AGDO. Conversely, hospitals undesignated in a Governor Decree to provide COVID-19 services followed by 13 cases of APGO, 28 cases of AGO, and 15 cases of AGDO.

The test yielded an insignificant correlation between the patient's initial hospital and the risk factor categories for obstetric emergencies.

Demographically, a majority of the subjects were from Surabaya, with 22 patients referred in phase 1 and 110 patients referred in phase 3. In the group of patients referred from outside Surabaya, 1 patient was referred in phase 1, and 11 patients were referred in phase 3 (Table 8).

The test yielded an insignificant correlation between the delayed referral phases and the patient's demographics.

Based on the phases of delayed referral (Table 9), phase 3 exhibited a notable predominance. In phase 3, 19 cases of APGO, 61 cases of AGO, and 42 cases of AGDO were identified. Conversely, phase 1 presented 10 cases of APGO, 10 cases of AGO, and 2 cases of AGDO.

In the correlation analysis between the variables (Table 9), a significant relationship emerged with a p-value of 0.001 ( $p < 0.05$ ). The correlation coefficient of 0.278 indicates a positive, relatively weak relationship between these two variables.

According to the obstetric outcomes (Table 10), it was observed that 1 patient with APGO died, 4 patients with AGO died, and 2 patients with AGDO died.

The correlation analysis between the patients' obstetric outcomes and their risk factor categories for obstetric emergencies did not yield a significant relationship across all three categories ( $p > 0.05$ ). It implies that the risk factor categories do

not correlate with the patients' outcomes in the cross-referral cases (Table 10).

In terms of obstetric outcomes, the study revealed that among surviving patients, 20 patients were referred in phase 1, 1 patient was referred in phase 2,

and 116 patients were referred in phase 3. Among the patients who died, 2 patients were referred in phase 1 delay, and 5 patients were referred in phase 3 delay (Table 11).

The correlation analysis between the patients' obstetric outcomes and the phases of delayed referrals resulted in a p-value of 0.594 ( $p > 0.05$ ), indicating an insignificant relationship. Thus, it can be concluded that the mother's outcome is not correlated with the type of late referral (Table 11).

When considering the patients' COVID-19 infection status, it was observed that among the group of patients who survived, 42 patients were not tested for COVID-19, 42 patients tested negative for COVID-19, and 53 patients tested positive for COVID-19. In contrast, among the patients who did not survive, 1 patient was not tested for COVID-19, and 6 patients were confirmed to have COVID-19 (Table 12).

Furthermore, when analyzing the correlation between the patients' obstetric outcomes and their COVID-19 infection status, a non-significant p-value of 0.056 ( $p > 0.05$ ) was obtained. The result indicates that the patients' obstetric outcomes are not correlated with their COVID-19 infection status (Table 12).

An additional obstetric outcome considered was the need for ICU care. Among patients who were not admitted to the ICU, there were 27 patients with APGO, 65 with AGO, and 30 with AGDO. In the group that required treatment in the ICU care, 2 patients had APGO, 6 patients had AGO, and 14 patients had

**Table 1. Characteristics of the cross-referred patients**

Characteristic	n	%
<b>Age</b>		
< 20	6	4.2
20–34	99	68.8
≥ 35	39	27.1
<b>Gestational Age</b>		
24–34 mgg	30	20.8
35–36 mgg	11	7.6
37–40 mgg	81	56.3
> 40 mgg	21	14.6
<b>Parity</b>		
Nullipara	36	25
Multipara	105	72.9
Grandmultipara	3	2.1
<b>History of previous cesarean delivery</b>		
Never	106	73.6
1x cesarean delivery	31	21.5
2x cesarean delivery	7	4.9
<b>Antenatal Examination</b>		
≥ 6x + consultation with Obstetrics and Gynecology Specialist	104	72.2
< 6x + consultation with Obstetrics and Gynecology Specialist	28	28
< 6x + no consultation with Obstetrics and Gynecology Specialist	2	1.4
< 6x + no consultation with Obstetrics and Gynecology Specialist	7	4.9
Never	3	2.1
<b>Delivery method</b>		
Spontaneous Delivery	53	36.8
Assisted Vaginal Delivery	7	4.9
Abdominal Delivery	84	58.3
<b>Referring to hospitals' locations</b>		
Undesignated hospital	56	38.9
Designated hospital	71	49.3
Primary Healthcare Facility	17	11.8
<b>Demographics</b>		
Surabaya	132	91.7
Outside Surabaya	12	8.3

**Table 2. Actions taken for the patients cross-referred to Dr. Soetomo Regional Public Hospital**

Delayed Referral Phase	Action Taken in Dr. Soetomo Regional Public Hospital		
<b>Delay Phase 1</b>	Vaginal Delivery	Assisted Vaginal Delivery	Cesarean Delivery
10 cases of APGO (6.94%)	5 patients (50%)	-	5 patients (50%)
10 cases of AGO (6.94%)	1 patient (10%)	-	9 patients (90%)
2 cases of AGDO (1.39%)	-	-	2 patients (100%)
<b>Delay Phase 3</b>			
19 cases of AGDO (13.19%)	16 patients (84.21%)	-	3 patients (15.79%)
61 cases of AGO (42.36%)	27 patients (44.26%)	-	34 patients (55.73%)
42 cases of AGDO (29.17%)	6 patients (14.29%)	5 patients (11.90%)	31 patients (73.81%)

AGDO (Table 13).

The correlation analysis demonstrated a significant relationship between the patients' obstetric outcomes and their needs for ICU care, with a p-value of less

than 0.05. The correlation coefficient value of 0.292 indicates a weak relationship (Table 13).

Regarding the correlation between the delayed referral phases and the maternal

outcomes (Table 14), there was a delayed referral in phase I, resulting in one mother with APGO dying. Similarly, one mother with AGO died in a delayed referral. In the delayed referrals in phase III, 3 mothers

**Table 3. Maternal and neonatal outcomes in the cross-referral cases in Dr. Soetomo Regional Public Hospital**

Delayed Referral Phase	Neonatal Outcome					Maternal Mortality	
<b>Delay Phase 1</b>	Normal APGAR Score	Moderate APGAR Score	Low APGAR Score	Premature	IUGR	Neonatal Mortality	-
10 cases of AGDO xxx (6.94%)	9 patients (90%)	1 patient (10%)	-	2 patients (20%)	-	-	1 Mother (10%)
10 cases of AGO (6.94%)	9 patients (90%)	-	1 patient (10%)	2 patients (20%)	-	1 Neonate (10%)	1 Mother (10%)
2 cases of AGDO (1.39%)	1 patient (50%)	1 patient (50%)	-	-	-	-	-
<b>Delay Phase 3</b>							
19 cases of AGDO xxx (13.19%)	19 patients (100%)	-	-	16 patients (84.21%)	-	1 Neonates (5.26%)	-
61 cases of AGO (42.36%)	-	1 patient (1.64%)	3 patients (4.92%)	51 patients (83.61%)	5 patients (8.19%)	3 Neonates (4.91%)	3 Mothers (4.91%)
42 cases of AGDO xxx (29.17%)	-	7 patients (16.67%)	3 patients (7.14%)	26 patients (61.90%)	10 patients (23.81%)	5 Neonates (11.90%)	2 Mothers (4.76%)

**Table 4. Correlation analysis of the cross-referred patients' age with their risk factor categories for obstetrics emergencies**

Age	APGO	AGO	AGDO	$r_s$ (p-Value)
< 20 years	3 (50%)	3 (50%)	0	0.359
20–34 years	24 (24.2%)	52 (52.5%)	23 (23.2%)	(P < 0.001)
≥ 35 years	2 (5.1%)	16 (41%)	21 (53.8%)	

**Table 5. Correlation analysis of ANC compliance with the risk factor categories for obstetric emergencies in the cross-referral cases**

ANC compliance	APGO	AGO	AGDO	$r_s$ (p-Value)
≥ 6x and consultation with Obstetrics and Gynecology Specialist	23 (22.1%)	53 (51%)	28 (26.9%)	0.121 (0.148)
< 6x and consultation with Obstetrics and Gynecology Specialist	5 (17.9%)	10 (35.7%)	13 (46.4%)	
≥ 6x and no consultation with Obstetrics and Gynecology Specialist	0	2 (100%)	0	
< 6x and no consultation with Obstetrics and Gynecology Specialist	0	5 (71.4%)	2 (28.6%)	
Never	1 (33.3%)	1 (33.3%)	1 (33.3%)	

**Table 6. Correlation analysis of the delivery methods with the risk factor categories for obstetric emergencies in the cross-referral cases**

Delivery method	APGO	AGO	AGDO	p-value in Fisher's exact test
Vaginal Delivery	20 (37.7%)	27 (50.9%)	6 (11.3%)	C = 0.398
Assisted Vaginal Delivery	1 (14.3%)	1 (14.3%)	5 (71.4%)	p < 0.001
Abdominal Delivery	8 (9.5%)	43 (51.2%)	33 (39.3%)	

with AGO and 2 mothers with AGDO died, totaling 7 out of 144 cross-referred patients.

From the analysis of birth weight distribution (Table 15), patients with AGDO had the highest prevalence

with birth weights below 2,500 g in 22 deliveries, followed by those with AGO with 14 deliveries and those with APGO

**Table 7. Correlation analysis of the referring healthcare facilities' locations with the risk factor categories for obstetric emergencies during the COVID-19 pandemic from 2020 to 2021**

Referring healthcare facility	APGO	AGO	AGDO	p-value in Fisher's exact test
Undesignated hospital	13 (23.2%)	28 (50%)	15 (26.8%)	0.826
Designated hospital	14 (19.7%)	34 (47.2%)	23 (31.9%)	
Primary healthcare facility	2 (11.8%)	9 (52.9%)	6 (35.3%)	

**Table 8. Correlation analysis of the delayed referral phases with the patients'**

Domicile	Phase 1	Phase 2	Phase 3	p-value in Fisher's exact test
Surabaya	22 (16.7%)	0	110 (83.3%)	0.253
Outside Surabaya	1 (8.3%)	0	11 (91.7%)	

**Table 9. Correlation analysis of the delayed referral phases with the risk factor categories**

Delayed referral phase	APGO	AGO	AGDO	$r_s$ (p-Value)
Phase 1	10 (45.5%)	10 (45.5%)	2 (9.1%)	0.278
Phase 2	0	0	0	(p < 0.001)
Phase 3	19 (15.6%)	61 (50%)	42 (34.4%)	

**Table 10. Correlation analysis of the patient's obstetric outcomes with the risk factor categories for obstetric emergencies**

Obstetric outcomes	APGO	AGO	AGDO	p-value in Fisher's exact test
Live birth	28 (20.4%)	67 (48.9%)	42 (30.7%)	1.000
Stillbirth	1 (14.3%)	4 (57.1%)	2 (28.6%)	

**Table 11. Correlation analysis of the patient's obstetric outcomes with the delayed referral phases**

Obstetric outcomes	Phase 1	Phase 2	Phase 3	p-value in Fisher's exact test
Live birth	20 (90.9%)	1 (100%)	116 (95.9%)	0.594
Stillbirth	2 (9.1%)	0	5 (4.1%)	

**Table 12. Correlation analysis of the patient's obstetric outcomes with their COVID-19 infection status**

Obstetric outcomes	Not undergoing testing for COVID-19	Not detected as infected with COVID-19	Detected as infected with COVID-19	p-value in Fisher's exact test
Live birth	42 (30.7%)	42 (30.7%)	53 (38.7%)	0.056
Stillbirth	1 (14.3%)	0	6 (85.7%)	

**Table 13. Correlation analysis of the patient's obstetric outcomes with their needs for ICU care**

Requiring ICU care	APGO	AGO	AGDO	p-value in Fisher's exact test
Not requiring ICU care	27 (22.1%)	65 (53.3%)	30 (24.4%)	0.001
Requiring ICU care	2 (9.1%)	6 (27.3%)	14 (63.6%)	C = 0.292 (p = 0.004)

**Table 14. Correlation analysis of the patients' delayed referral phases and their risk factor categories with their outcomes**

Delayed Referral Phase	Risk factor category	Live birth	Stillbirth
Phase I	APGO	9 (90%)	1 (10%)
	AGO	9 (90%)	1 (10%)
	AGDO	2 (100%)	0
Phase II	APGO	0	0
	AGO	1 (100%)	0
	AGDO	0	0
Phase III	APGO	19 (100%)	0
	AGO	57 (95%)	3 (5%)
	AGDO	40 (95.2%)	2 (4.8%)

**Table 15.** Correlation analysis of the neonates' birth weights with their mothers' risk factor categories for obstetric emergencies

Risk factor category	< 2,500 g	2,500–3,999 g	≥ 4,000 g	$r_s$ (p-Value)
APGO	2 (7.1%)	24 (85.7%)	2 (7.1%)	0.388
AGO	14 (20%)	53 (75.7%)	3 (4.3%)	(p < 0.001)
AGDO	22 (52.4%)	20 (47.6%)	0	

**Table 16.** Correlation analysis of the neonates' birth weights with their mothers' risk factor categories for obstetric emergencies

Risk factor category	Normal-Mild Asphyxia	Moderate Asphyxia	Severe Asphyxia	$r_s$ (p-Value)
APGO	27 (96.45%)	1 (3.6%)	0	0.257
AGO	63 (91.3%)	3 (4.3%)	3 (4.3%)	(0.002)
AGDO	30 (73.2%)	8 (19.5%)	3 (7.3%)	

**Table 17.** Correlation analysis of the patients' delayed referral phases and their risk factor categories with the neonates' outcomes

Delayed Referral Phase	Risk factor category	Live birth	Stillbirth
Phase I	APGO	10 (100%)	0
	AGO	9 (90%)	1 (10%)
	AGDO	2 (100%)	0
Phase II	APGO	0	0
	AGO	1 (100%)	0
	AGDO	0	0
Phase III	APGO	17 (94.4%)	1 (5.6%)
	AGO	56 (94.9%)	3 (5.1%)
	AGDO	35 (87.5%)	5 (12.5%)

with two deliveries. There were 3 and 2 deliveries weights  $\geq 4,000$  g in patients with AGO and APGO, respectively. Patients with AGO had the most frequent distribution observed in the 2,500–3,999 g weight range, accounting for 53 deliveries.

The results of the correlation analysis indicated a relationship between the neonates' birth weights and their mothers' risk factor categories for obstetric emergencies ( $p < 0.05$ ). With a correlation coefficient value of 0.388, this relationship is characterized as weak (Table 15).

When examining the neonates' APGAR Scores (AS), it was evident that the highest occurrence of moderate asphyxia was observed in 8 patients with AGDO, while severe asphyxia cases were identified in 3 patients with AGO and 3 patients AGDO (Table 16).

The correlation analysis exhibited a significant association between the neonates' birth weights and their mothers' risk factor categories for obstetric emergencies ( $p < 0.05$ ). A correlation coefficient value of 0.257 indicates a weak relationship (Table 16).

Examining the patients' delayed referral phases and their risk factor categories, it was observed that in patients with AGO referred in phase 1, there was 1 neonatal death. Out of 144 cross-referred patients, in 10 patients referred in phase III, there were 1 neonatal death in patients with APGO, 3 neonatal death in patients with AGO, and 5 neonatal death in patients with AGDO (Table 17).

## DISCUSSION

During the data analysis of the cross-referral cases, a significant association was observed between the patient's age and their risk factor categories for obstetric emergencies, with the highest prevalence occurring among those aged 20–34 years. The distribution was 24.2% for those with APGO, 52.5% for those with AGO, and 23.2% for those with AGDO. This finding is in line with existing studies that indicate an increased risk of pregnancy complications with advancing maternal age. For instance, research has demonstrated an exponential rise in preeclampsia risk with increasing

maternal age.<sup>7</sup> Another study investigating the correlation between maternal age and the prevalence of maternal morbidity during labor and delivery complications found that age played a significant role. The study highlighted that women aged 11–18 years had a higher likelihood of complications compared to those aged 25–29 years, including conditions such as premature birth, chorioamnionitis, endometritis, and mild preeclampsia.<sup>8</sup>

Regarding the patients' Antenatal Care (ANC) compliance and the risk factors for obstetric emergencies, the data analysis did not reveal a significant relationship between the two. However, it is worth noting that among the description provided, 28 patients with risk factors for obstetric emergencies exhibited strong ANC compliance, attending six or more visits and meeting with an obstetrician. Interestingly, emergency cases were largely dominated by preeclampsia.<sup>9</sup> A similar study conducted on 300 postpartum women employed a structured questionnaire and face-to-face interviews. The results demonstrated that 67% of

patients received quality antenatal care based on antenatal book records. Notably, those who did not receive adequate care experienced complications such as premature birth, the need for induction and augmentation of labor, dystocia, stillbirth, low APGAR scores, and low birth weight.<sup>10</sup>

COVID-19 in pregnancy is also commonly found together with previously undiagnosed preeclampsia (PE), giving rise to the term preeclampsia-like syndrome in pregnant women infected with COVID-19.<sup>11,12</sup> Preeclampsia is defined as a pregnancy complication with a new onset of proteinuria and hypertension, occurring after 20 weeks of gestation, in which organ damage may occur.<sup>13</sup>

The relationship between PE and COVID-19 infection must be evaluated holistically. First, COVID-19 infection can present signs and symptoms similar to PE. On the other hand, COVID-19 can facilitate the occurrence of PE through its own pathogenesis. Besides that PE can also form a similar conducive environment which increases the susceptibility to COVID-19 infection.<sup>14,15</sup> The potential overlap between risk factors for PE and severe COVID-19 should be assessed as a confounding variable.<sup>12,16,17</sup>

The data analysis on compliance with ANC visits in referred cases regarding obstetric emergency risk factors did not show a significant relationship. An interesting finding from this overview was observed among 28 patients with obstetric emergency risk factors, where the best compliance with ANC was achieved with six or more visits and consultations with a specialist obstetrician. The distribution of emergency cases was predominantly related to preeclampsia.<sup>18</sup> The study was conducted on 300 postpartum women, and data were collected through a structured questionnaire using a two-step face-to-face interview approach and from patients' antenatal record books. 67% of the participants received quality antenatal care. Among those who did not receive quality care, outcomes included premature birth, and post-term birth, resulting in induction and augmentation of labor, dystocia, stillbirth, low APGAR scores, and low birth weight.<sup>19</sup>

Regarding the relationship between the risk factor categories for obstetric emergencies and the delivery methods, a significant connection was observed between the categories of obstetric emergencies and the patients' abdominal delivery method. In making abdominal delivery decisions for patients with obstetric emergencies, considerations are based on obstetric indications and the urgency of maternal and fetal well-being.<sup>20</sup> Notably, only one case did not conform to obstetric considerations, as a cesarean section was performed because this particular patient was suspected of having a COVID-19 infection. This finding aligns with a previous study, which found that women with a history of previous cesarean delivery exhibited a significant association with elective cesarean decisions.<sup>21</sup>

From the perspective of the referring health facilities, while a significant relationship was not observed overall, an intriguing observation emerged. The data revealed that 23 cases involving patients with emergency risk factors were referred by hospitals designated in a Governor Decree to provide COVID-19 services. This dynamic underscores the challenge of accommodating casual patient referrals during a surge in hospitalizations, leading to resource scarcity and heightened utilization of limited medical equipment. This circumstance is further exacerbated by the inadequacy of Indonesia's existing health infrastructure to meet the escalating demand for healthcare services. Data from the Ministry of Health's website, accessed on March 7, 2021, indicated that Indonesia possesses 2,925 hospitals with a collective bed capacity of 388,106.<sup>22</sup> Another study conveyed that the relationship between travel time to referral facilities and maternal mortality cases, with a travel time of four hours or more, is significantly associated with maternal deaths in hospitals. Ideally, for obstetric emergency cases, achieving care access within two hours is recommended.<sup>23</sup>

Turning to the relationship between the delayed referrals and the referring hospitals' locations, no significant association was observed, encompassing delays in making decisions regarding the referrals initiated by the individuals concerned, their families, or both, as

well as delays in reaching the appropriate healthcare facilities. However, a noteworthy finding emerged when relating delays to risk factors for obstetric emergencies.<sup>24</sup> In contrast, an association emerged between the delayed referrals and the risk factor categories for obstetric emergencies, with the highest incidence observed in phase 3, encompassing 19 patients with APGO, 61 patients with AGO, and 42 patients with AGDO. The preeminence of phase 3 delayed referrals corresponds with the context of the COVID-19 pandemic, during which hospitals encountered a surge in patient influx, resulting in constrained special isolation treatment rooms, heightened ICU and NICU demands, and a higher prevalence of COVID-19 infections among healthcare workers. Notably, no phase 2 delayed referral was observed, reflecting the ease of access to healthcare services. In line with these findings, a multicenter study involving 27 referral obstetric facilities across various regions of Brazil investigated delayed phases of obstetric care. This comprehensive study screened 82,144 live births and proactively identified 9,555 cases of potentially life-threatening events, maternal deaths, or near misses.<sup>25</sup>

In Indonesia, the common causes of obstetric mortality are generally associated with emergency issues, which experience four delays: delay in recognizing signs of danger and risks, delay in making decisions, delay in obtaining transportation, and delay in receiving assistance at referral facilities. Respondents appropriately selected adequate healthcare facilities, although during the COVID pandemic, respondents' awareness of seeking care and giving birth in healthcare facilities did not decrease. Thus, there is a relationship between referral types and maternal-neonatal outcome conditions.<sup>26,27</sup>

The condition of hospital facilities and infrastructure at the beginning of the pandemic indicated a lack of readiness in COVID-19 management, particularly regarding the availability of negative-pressure isolation rooms and personal protective equipment (PPE). The ideal hospital conditions include having negative-pressure operating rooms and post-operative negative-pressure isolation

rooms.<sup>28-30</sup> The research is based on data collected during the specific period from April to September 2022 at Dr. Soetomo Regional Public Hospital, Surabaya. This relatively short time frame may not capture the full spectrum of obstetric emergencies that could occur over a longer period.

## CONCLUSION

In conclusion, some significant relationships exist between the risk factors for obstetric emergencies and variables such as age, methods of vaginal delivery, delayed referral phases, as well as birth weights, and Apgar scores, particularly within the context of the COVID-19 pandemic.

## FUNDING

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## ETHICAL CONSIDERATIONS

The ethical approval for this study was obtained from the Ethical Clearance Committee of the Faculty of Medicine, Universitas Airlangga - Dr. Soetomo General Academic Hospital (Reference number: 1180/LOE/301.4.2/1/2023).

## CONFLICT OF INTEREST

The authors declare have no conflict of interest.

## AUTHOR CONTRIBUTIONS

All authors are responsible for the concept, design, intellectual context, data acquisition and preparation of the manuscript. All authors read and approved the final manuscript.

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