



Birth before Arrival at Faculty of Medicine Vajira Hospital

Kasemsis Kaewkiattikun M.D., Dip. Thai Board of Obstet & Gynecol., MBA., MPA., DM.^{1*}

¹ Department of Obstetrics and Gynecology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand

* Corresponding author, e-mail address: kasem38@hotmail.com

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Abstract

Objective: To discover the prevalence of BBA and to compare maternal and neonatal complications of birth before arrival (BBA) with birth in hospital (BIH). Moreover, to analyze risk factors and predictive factors of BBA in an urban setting.

Method: A retrospective cohort study was conducted by reviewing medical records of postpartum BBA mother-infant dyads compare with BIH mother-infant dyads.

Result: Prevalence of BBA was 1.14%. BBA was significantly associated with neonatal morbidities. A significant maternal morbidity in BBA was birth canal tear. Risk factors for BBA included teenager, low education, multiparity, ANC less than or equal to 4, preterm birth and precipitated labor. Transportation barriers (home-hospital distance, transportation time and timing of transportation) were not significantly different between groups, but delayed transportation was a significant risk in BBA. Significant predictors for BBA were multiparity, ANC less than or equal to 4, preterm birth, precipitate labor and delayed transportation > 60 minutes.

Conclusion: BBA was significant associated with maternal and neonatal morbidity. Transportation barriers (distance, time and timing) were not risk factor of BBA in urban area; but delayed transportation from home was a significant risk. Significant predictors of BBA in an urban setting were multiparity, poor ANC, preterm labor, precipitate labor and delayed transportation.

Keywords: Birth before arrival; BBA; neonatal morbidity; neonatal mortality; maternal morbidity.



การคลอดก่อนมาถึงโรงพยาบาลในคณะแพทยศาสตร์เวชพยาบาล

เกษมสิทธิ์ แก้วเกียรติคุณ พ.บ. วว. สูตินรีเวช^{1*}

¹ ภาควิชาสูติศาสตร์รีเวชวิทยา คณะแพทยศาสตร์เวชพยาบาล มหาวิทยาลัยอัสสัมชัญ กรุงเทพมหานคร ประเทศไทย

* ผู้ติดต่อ, อีเมลล์: kasem38@hotmail.com

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บทคัดย่อ

วัตถุประสงค์: เพื่อศึกษาความชุกและเปรียบเทียบภาวะแทรกซ้อนของมารดาและทารกที่คลอดก่อนมาถึงโรงพยาบาลกับมารดาและทารกที่คลอดในโรงพยาบาล และเพื่อวิเคราะห์ปัจจัยเสี่ยงและปัจจัยทำนายของการคลอดก่อนมาถึงโรงพยาบาลในเขตเมือง

วิธีดำเนินการวิจัย: การศึกษาจากเหตุไปหาผลแบบย้อนหลังโดยการทบทวนเวชระเบียนของคู่แม่-ลูกหลังคลอดที่คลอดก่อนมาถึงโรงพยาบาลเปรียบเทียบกับคู่แม่-ลูกหลังคลอดที่คลอดในโรงพยาบาล

ผลการวิจัย: ความชุกของการคลอดก่อนมาถึงโรงพยาบาลร้อยละ 1.14 การคลอดก่อนมาถึงโรงพยาบาลมีความสัมพันธ์กับการเจ็บป่วยและการตายของทารกแรกเกิด การเจ็บป่วยของมารดาที่มีนัยสำคัญคือการฉีกขาดของช่องทางคลอด ปัจจัยเสี่ยงต่อการคลอดก่อนมาถึงโรงพยาบาลได้แก่ มารดาวัยรุ่น การศึกษาสั้นๆ ตั้งครรภ์หลัง ผ่าครรภ์น้อยกว่า 4 ครั้ง เจ็บครรภ์คลอดก่อนกำหนด และการคลอดเร็วผิดปกติ อุปสรรคการเดินทาง(ระยะทางจากบ้านถึงโรงพยาบาล ระยะเวลาการเดินทาง และช่วงเวลาเดินทาง)ไม่มีความแตกต่างอย่างมีนัยสำคัญระหว่างกลุ่ม แต่การออกเดินทางจากบ้านล่าช้าเป็นปัจจัยเสี่ยงต่อการคลอดก่อนมาถึงโรงพยาบาล ปัจจัยทำนายการคลอดก่อนมาถึงโรงพยาบาลได้แก่ การตั้งครรภ์หลัง การผ่าครรภ์น้อยกว่าหรือเท่ากับ 4 ครั้ง การเจ็บครรภ์คลอดก่อนกำหนด การคลอดเร็วผิดปกติ และการออกเดินทางจากบ้านล่าช้ามากกว่า 60 นาที

สรุป: การคลอดก่อนมาถึงโรงพยาบาลมีความสัมพันธ์กับการเจ็บป่วยของมารดาและทารกแรกเกิด อุปสรรคของการเดินทาง (ระยะทาง ระยะเวลา และช่วงเวลาเดินทาง)ไม่เป็นปัจจัยเสี่ยงต่อการคลอดก่อนมาถึงโรงพยาบาลสำหรับเขตเมือง แต่การออกเดินทางจากบ้านล่าช้าเป็นปัจจัยเสี่ยงที่มีนัยสำคัญ ปัจจัยทำนายการคลอดก่อนมาถึงโรงพยาบาลในเขตเมืองได้แก่ การตั้งครรภ์หลัง การผ่าครรภ์น้อยกว่า การเจ็บครรภ์คลอดก่อนกำหนด การคลอดเร็วผิดปกติ และการออกเดินทางจากบ้านล่าช้า

Introduction

'Birth before arrival (BBA)' – also called accidental, unplanned or out-of-hospital births or deliveries – is defined as delivery of a baby that takes place outside healthcare facilities, either at home or en route to a delivery center or hospital (in an ambulance, private car or on hospital grounds) or in hostel accommodation for women living remotely from maternity services.¹⁻³ BBA is an emergency condition and serious public health problem which is still common even in modern obstetric practice. This condition happens in both developing and developed countries, and in both urban and rural areas. The prevalence of BBA varies worldwide. In general, the prevalence of BBA in developed countries is less than in developing countries, except for an increasing trend for home births in the USA and Europe. It is 0.1 – 0.44% in Europe⁴, 1.36 – 1.8 % in USA⁵, 1.8 – 4.6% in South Africa^{6,7}, 0.78% in Nepal⁸, 0.28% in Japan and 0.8 – 3.6 % in Thailand.¹⁰⁻¹¹

Most previous published papers focused on neonatal complications, which demonstrated that BBA is associated with increased neonatal morbidity and mortality.^{1,2,12,13} There have been a few reports of maternal morbidity and results are controversial.^{10,12} Risk factors for BBA are also multifactorial and inconclusive.^{7,8,12} Moreover, there are few studies of BBA in Asia and Thailand. A lot of research on BBAs has been conducted in rural and peri-urban areas as well; there are few studies in urban settings where traffic congestion may be a major problem for hospital accessibility. Additionally, urbanization has spread more and more in every country. Therefore, it is necessary to study BBA in the urban environment, where healthcare facilities and resources are more available than in rural settings. This study aimed to find out the prevalence, maternal and neonatal morbidity and mortality, risk factors and predictive factors for BBA in the urban setting of Bangkok.

Methods

Study design

A retrospective cohort study was conducted by reviewing medical records of postpartum mother-infant dyads admitted to the Faculty of Medicine Vajira Hospital, Navamindradhiraj University, Bangkok, Thailand, between January 2011 and August 2016. The research protocol was reviewed and approved by the Vajira Institutional Review Board and Research Ethical Committee of Faculty of Medicine Vajira Hospital in August 2016. Due to the retrospective design of the study, the committee approved the review of patient's medical records without their consent. Confidentiality was kept for all patient data.

Setting

Faculty of Medicine Vajira Hospital is a research-oriented medical school and tertiary care hospital in Bangkok, the capital of Thailand. Most of pregnant women in Bangkok deliver in the hospital assisted by skilled birth attendants. About 2,500 – 3,000 women give birth each year. Road-based transport is the primary mode of transportation in Bangkok which cause severe traffic congestion and difficult hospital access.

Sample

The studied population consisted of postpartum mother-infant dyads admitted to the Department of Obstetrics & Gynecology, Faculty of Medicine Vajira Hospital, Navamindradhiraj University. The population was divided into two groups: birth before arrival (BBA: study group) and birth in hospital (BIH: control group). The ratio between each group was 1:1. The BBA group in this study referred to childbirth which occurs without a skilled birth attendant (an accredited health professional such as a midwife, doctor or nurse who has been educated and trained to proficiency in the skills needed to manage uncomplicated pregnancies, childbirth

and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns) and that occurs either at home or en route before arrival to the labor ward of the Department of Obstetrics & Gynecology, Faculty of Medicine Vajira Hospital, including on the roadside, in a car, in an ambulance, in the emergency room, or on the way outside the labor ward. The BIH group consisted of consecutive mother-infant dyads who fulfilled the inclusion/exclusion criteria and gave birth by trained specialist health professionals in the labor ward of Department of Obstetrics & Gynecology, Faculty of Medicine Vajira Hospital. The BIH group was retrospectively recruited until reaching the desired sample size.

Inclusion criteria for the BBA group were mothers who had planned a hospital delivery and mother-infant dyads admitted within 24 hours after birth at Department of Obstetrics & Gynecology, Faculty of Medicine Vajira Hospital, singleton pregnancy, gestational age 24 – 42 weeks, and neonatal birth weight \geq 500 grams. Inclusion criteria of the BIH group were singleton pregnancy with spontaneous labor and normal vaginal delivery, gestational age 24 – 42 weeks, and neonatal birth weight \geq 500 grams. Exclusion criteria included mother-infant dyads referred from other health care facilities, maternal obstetric complications which might affected the outcomes (chronic hypertension, pre-eclampsia, gestational diabetes, cardiac/renal disease, HIV infection, severe anemia), and neonatal anomalies.

The sample size was calculated based on a previous study by Beeram, et al². There were significantly more NICU admissions in newborns who were delivered out of hospital than in newborns who were delivered in hospital (29% vs. 15%, $p < 0.001$). The powers of 80% and a level of confidence of 95% were applied to determine the difference between groups. The sample size of each group was 134. The researcher added 20% for incomplete medical record and medical record loss; the total number of mother-infant dyads was

322 (161 in each group). BBA cases were recruited sequentially and retrospectively from August 2016 until the desired number of cases was reached.

Data collection

Maternal data obtained from the obstetric record included age, height, weight, BMI, marital status, education level, occupation, parity, number of antenatal care (ANC) visits, gestational age at first ANC, gestational age at delivery (delivery at 24 – 37 weeks was defined as preterm birth, delivery at 38 – 42 weeks was defined as term birth), labor progression (precipitate labor was defined as expulsion of the fetus within less than 3 h of commencement of regular contractions, labor with normal progression was defined as expulsion of the fetus within 3 - 30 h after commencement of regular contractions in nulliparous women and 3 - 15 h after commencement of regular contractions in parous women), time of labor commencement, time of delivery, home to hospital distance, time spent from home to hospital (transportation time) and length of hospital stay. Maternal morbidities data included prolonged third stage of labor (defined as third stage $>$ 30 minutes), retained placenta, postpartum hemorrhage (defined as postpartum blood loss \geq 500 ml), birth canal tear, and puerperal sepsis.¹⁴

Neonatal data were obtained from the pediatric record. All neonatal conditions and diagnoses were assessed by the attending pediatrician. Neonatal data and morbidities included birth weight, length of hospital stay, low birth weight (defined as birth weight $<$ 2,500 grams), preterm birth (defined as gestational age 24 – 37 completed weeks), NICU admission, neonatal asphyxia, neonatal hypothermia (defined as rectal temperature $<$ 36.5 c), neonatal hypoglycemia (defined as admission glucose reagent strip reading $<$ 2.2 mmol/L or $<$ 40 mg/dl), neonatal tachypnea, neonatal infection (culture-proven sepsis or clinical sepsis), neonatal death (defined as death during the first 28 days after birth), and meconium stain.¹⁴

Statistical analysis

The data were analyzed by statistician using SPSS version 22 (IBM SPSS, Armonk, NY, USA). Data are presented as mean \pm standard deviation and frequencies/percentages. *P*-values were two-sided analysis and less than 0.05 was considered statistically significant. Chi-square test and Fisher's exact test were used for categorical data and Student's *t*-test was used for continuous data. Univariate and multivariate analyses were further entered into logistic regression analysis to determine independent predictors of BBA and presented as OR and 95% CI. *p*-value of <0.05 was considered statistically significant.

Results

Three hundred and eleven mother-infant dyads were recruited. Four from the BBA group and seven from the BIH group were excluded due to incomplete medical records and medical record loss. Therefore, a total of 311 mother-infant dyads were finally eligible for analysis in this study, 157 in BBA group and 154 in BIH group.

The prevalence of BBA during the study period was 1.14%. Most BBA occurred in the emergency room (52.87%) with others occurring at home (24.84%) and en route to hospital (19.75% in the car and 2.54% on the roadside). All of them had no skilled birth attendant including births in the emergency room.

Table 1 shows baseline characteristics of mothers and newborns comparing the BBA and BIH groups. Of all 311 participants, the majority of mothers were adult (76.2%), married (87.1%), had a primary/elementary school education (65.3%), and had an occupation as an employee or merchant (53.7%). They were mostly multipara (70.4%), attended their first ANC at ≤ 12 weeks gestational age (54.0%), with number of ANC was ≤ 4 (55.6%), delivered at full term (63.3%) and had normal labor progression (66.2%). A comparison of mothers in the BBA group ($n=157$) with the BIH group ($n=154$) revealed that BBA mothers were statistically more likely than BIH mothers to be teenager (OR 2.01,

95%CI 1.17-3.44, *p*-value <0.001), have only a primary/elementary school education (OR 2.05, 95%CI 1.06-3.32, *p*-value = 0.003), be multipara (OR 1.80, 95%CI 1.10-2.95, *p*-value = 0.019), with number of ANC ≤ 4 (OR 18.73, 95%CI 10.48-33.48, *p*-value <0.001), experience preterm birth (OR 2.86, 95%CI 1.77-4.64, *p*-value <0.001) and have precipitated labor (OR 11.29, 95%CI 6.16-20.70, *p*-value <0.001)

The only significant maternal morbidity that occurred more in BBA than BIH was birth canal tear (OR 21.49, 95%CI 10.50-43.97, *p*-value <0.001); other variables were not significantly different. Most birth canal tears occurred in mothers who gave birth in the emergency room (47.9%). In contrast to maternal morbidity, several neonatal morbidities occurred more significantly in BBA than BIH, including NICU admission (OR 5.12, 95%CI 1.89-13.83, *p*-value <0.001), hypothermia (OR 89.72, 95%CI 21.47-374.88, *p*-value <0.001), hypoglycemia (OR 12.38, 95%CI 3.70-41.46, *p*-value <0.001), tachypnea (OR 13.81, 95%CI 1.78-106.93, *p*-value = 0.001), infection (OR 9.60, 95%CI 3.31-27.88, *p*-value <0.001), birth asphyxia (OR 21.07, 95%CI 2.78-159.43, *p*-value <0.001), low birth weight (OR 10.37, 95%CI 3.58-30.01, *p*-value <0.001), preterm infant (OR 2.86, 95%CI 1.77- 4.64, *p*-value <0.001) and neonatal death (OR 12.66, 95%CI 1.63-98.61, *p*-value = 0.002). It was only meconium stain which did not differ between the two groups (Table 2).

Neonatal birth weight and body temperature in BBA group were significantly lower than BIH group (2594.40 ± 642.39 vs. 3052 ± 383.15 grams and 35.29 ± 5.79 vs. 37.06 ± 0.46 Celsius, respectively). Moreover, length of hospital stay was significantly longer in BBA neonates (7.29 ± 8.59 vs. 4.35 ± 2.01 day) whereas maternal length of hospital stay was not statistically different between groups (Table 2).

When transportation to hospital was analyzed, this study found that most pregnant women left home after beginning of labor > 60 minutes (55.3%), home to hospital distance was < 10 kilometers (65.6%), with transportation time > 30 minutes (79.1%) and were transported during non-rush hour period (59.2%).

Table 1:

Baseline maternal characteristics comparing BBA with BIH

Characteristics	Total (n = 311)	BBA (n = 157)	BIH (n = 154)	Odds ratio (95% CI)	P-value*
Age group					
- < 20 years	74 (23.8)	47 (63.5)	27 (36.5)	2.01	0.010
- ≥ 20 years	237 (76.2)	110 (46.4)	127 (53.6)	(1.17-3.44)	
BMI		23.53 ± 3.67	22.78 ± 3.95	NA	0.084
Marital status					
- Single	4 (1.3)	2 (0.5)	2 (0.5)	NA	0.543
- Married	271 (87.1)	135 (49.8)	136 (50.2)		
- Divorced	36 (11.6)	20 (55.6)	16 (44.4)		
Education					
- Primary/ elementary school	203 (65.3)	115 (56.7)	88 (43.3)	2.05	0.003
- Secondary school and higher	108 (34.7)	42 (38.9)	66 (61.1)	(1.26-3.32)	
Occupation					
- None and studying	144 (46.3)	78 (54.2)	66 (45.8)	1.32	0.228
- Yes	167 (53.7)	79 (47.3)	88 (52.7)	(0.84-2.06)	
Parity					
- Multipara	219 (70.4)	120 (54.8)	99 (45.2)	1.80	0.019
- Primipara	92 (29.6)	37 (40.2)	55 (59.8)	(1.10-2.95)	
Number of ANC					
- ≤ 4	173 (55.6)	135 (78.0)	38 (22.0)	18.73	<0.001
- > 4	138 (44.4)	22 (15.9)	116 (84.1)	(10.48-33.48)	
GA at delivery					
- < 38 weeks	114 (36.7)	76 (66.7)	38 (33.3)	2.86	<0.001
- ≥ 38 weeks	197 (63.3)	81 (41.1)	116 (58.9)	(1.77-4.64)	
Labor progression (minutes)		207.19 ± 175.37	516.78 ± 304.64	NA	<0.001
- Precipitate labor	105 (33.8)	89 (84.8)	16 (15.2)	11.29	<0.001
- Normal labor progression	206 (66.2)	68 (33.0)	138 (67.0)	(6.16-20.70)	

Note: Data are presented as number (%), mean ± standard deviation, *chi-square test Abbreviation: GA, gestational age; ANC, antenatal care; NA, not applicable

Table 2:

Maternal and neonatal morbidities comparing BBA with BIH

Outcomes	Total (n = 311)	BBA (n = 157)	BIH (n = 154)	Odds ratio (95% CI)	P-value
Maternal morbidities					
Birth canal tears					
- Yes	104 (33.4)	94 (90.4)	10 (9.6)	21.49	<0.001
- No	207 (66.6)	63 (30.4)	144 (69.6)	(10.50 - 43.97)	
Postpartum hemorrhage					
- Yes	11 (3.5)	7 (63.6)	4 (36.4)	1.75	0.374
- No	300 (96.5)	150 (50.0)	150 (50.0)	(0.50-6.10)	
Retained placenta					
- Yes	2 (0.6)	2 (100.0)	0 (0.0)	0.99	0.097*
- No	309 (99.4)	155 (50.2)	154 (49.8)	(0.97 - 1.01)	
Prolonged third stage of labor					
- Yes	9 (2.9)	4 (44.4)	5 (55.6)	0.78	0.713*
- No	302 (97.1)	153 (50.7)	149 (49.3)	(0.21 - 2.96)	
Puerperal infection					
- Yes	7 (2.3)	5 (71.4)	2 (28.6)	2.50	0.254*
- No	304 (97.7)	152 (50.0)	152 (50.0)	(0.48 - 13.08)	
Length of hospital stay (days)					
		3.91 ± 0.91	4.00 ± 1.56	NA	0.449
Neonatal morbidities					
NICU admission					
- Yes	28 (9.0)	23 (82.1)	5 (17.9)	5.12	<0.001
- No	283 (91.0)	134 (47.3)	149 (52.7)	(1.89 - 13.83)	
Neonatal hypothermia					
- Yes	87 (28.0)	85 (97.7)	2 (2.3)	89.72	<0.001
- No	224 (72.0)	72 (32.1)	152 (67.9)	(21.47 - 374.88)	
Neonatal hypoglycemia					
- Yes	34 (10.9)	31 (91.2)	3 (8.8)	12.38	<0.001
- No	277 (89.1)	126 (45.5)	151 (54.5)	(3.70 - 41.46)	
Neonatal tachypnea					
- Yes	14 (4.5)	13 (92.9)	1 (8.1)	13.81	0.001
- No	297 (95.5)	144 (48.5)	153 (51.5)	(1.78 - 106.94)	

Table 2:

Maternal and neonatal morbidities comparing BBA with BIH (Con.)

Outcomes	Total (n = 311)	BBA (n = 157)	BIH (n = 154)	Odds ratio (95% CI)	P-value
Neonatal infection					
- Yes	36 (11.6)	32 (88.9)	4 (11.1)	9.60	<0.001
- No	275 (88.4)	125 (45.5)	150 (54.5)	(3.31 - 27.88)	
Birth asphyxia					
- Yes	20 (6.4)	19 (95.0)	1 (5.0)	21.07	<0.001
- No	291 (93.6)	138 (47.4)	153 (52.6)	(2.78 - 159.43)	
Low birth weight					
- Yes	38 (12.2)	34 (89.5)	4 (10.5)	10.37	<0.001
- No	273 (87.8)	123 (45.1)	150 (54.9)	(3.58 - 30.07)	
Preterm infant					
- Yes	114 (36.7)	76 (66.7)	38 (33.3)	2.86	<0.001
- No	197 (63.3)	81 (41.1)	116 (58.9)	(1.77 - 4.64)	
Meconium stain					
- Yes	16 (5.1)	6 (37.5)	10 (62.5)	0.57	0.286
- No	295 (94.9)	151 (51.2)	144 (48.8)	(0.20 - 1.62)	
Neonatal death					
- Yes	13 (4.2)	12 (92.3)	1 (7.7)	12.66	0.002
- No	298 (94.9)	145 (48.7)	153 (51.3)	(1.63 - 98.61)	
Neonatal birth weight (gram)		2594.40 ± 642.39	3052.61 ± 383.15	NA	<0.001
Neonatal body temperature (C)		35.29 ± 5.79	37.06 ± 0.46	NA	<0.001
Length of hospital stay (days)		7.29 ± 8.59	4.35 ± 2.01	NA	<0.001

Note: Data are presented as number (%), mean ± standard deviation, * Fisher's exact test, Abbreviation: NICU, neonatal intensive care unit

Comparing transportation to hospital between groups revealed that the BBA group had a significantly greater duration from labor to transportation than the BIH group (176.82 ± 85.34 vs. 127 ± 75.37 minutes, p=0.016). Mothers who delayed transportation after commencement of labor by more than 60 minutes

were significantly more likely to experience BBA than those transported within 60 minutes. However, home-hospital distance, transportation time and timing of transportation were not significantly different between BBA and BIH (Table 3).

Table 3:

Transportation to hospital comparing BBA with BIH

	Total (n = 306)	BBA (n = 157)	BIH (n = 154)	Odds ratio (95% CI)	P-value
Duration from labor to transportation (minutes)		176.82 ± 85.34	127.19 ± 75.37	NA	0.016
- < 30 minutes	60 (19.3)	20 (33.3)	40 (66.7)	NA	<0.001
- 31 - 60 minutes	79 (25.4)	29 (36.7)	50 (63.3)		
- > 60 min.	172 (55.3)	108 (62.8)	64 (37.2)		
Home- hospital distance (km)		9.78 ± 9.67	11.66 ± 10.69	NA	0.104
- 1 - 10 km	204 (65.6)	112 (54.9)	92 (45.1)	NA	0.071
- 10.1 – 20 km	72 (23.2)	30 (41.7)	42 (58.3)		
- 20.1 – 30 km	17 (5.5)	5 (29.4)	12 (70.6)		
- > 30.1 km	18 (5.8)	10 (55.6)	8 (44.4)		
Transportation time (minutes)		50.76 ± 23.57	53.36 ± 24.94	NA	0.346
- < 30 minutes	65 (20.9)	31 (47.7)	34 (52.3)	NA	0.090
- 30 - 60 minutes	148 (47.6)	84 (56.8)	64 (43.2)		
- > 60 min.	98 (31.5)	42 (42.9)	56 (57.1)		
Timing of transportation					
- Rush hour	127 (40.8)	62 (48.8)	65 (51.2)	0.89	0.626
- Non-rush hour	184 (59.2)	95 (51.6)	89 (48.4)	(0.56 - 1.40)	

Note: Data are presented as number (%), mean ± standard deviation, Rush hour: 5 – 9 am and 4 – 8 pm, Transportation time: time spent from home to hospital Abbreviation: NA, not applicable; km, kilometers

To analyze factors predicting BBA, univariate regression analysis found that parity, number of ANC, labor progression and duration from labor to transportation were significant factors ($p < 0.1$). After adjusting OR estimated by multiple logistic regression were analyzed, this study found that significant predictive factors for BBA were multiparity (OR 2.57, 95%CI 1.01-6.54, p -value = 0.048), ANC ≤ 4 (OR 2.80, 95%CI 1.26-6.24, p -value = 0.012), preterm birth (OR 2.24, 95%CI 1.04-4.83, p -value = 0.040), precipitate labor (OR 10.74, 95%CI 4.76-24.21, p -value <0.001) and duration from labor to transportation > 60

minutes (OR 3.38, 95%CI 1.82-6.27, p -value <0.001) (Table 4).

Discussion

BBA is an emergency condition that always occurs despite planned hospital birth. This study found that the prevalence of BBA was 1.14 %. This prevalence is comparable to global figures in other developing countries.⁵⁻¹¹ Although the incidence of BBA is low, the literature demonstrates that BBA is associated with high neonatal morbidity and mortality.^{1,2,12,13,15}

Table 4:

Univariate and multivariate regression analysis of factors predicting BBA

Factors	Univariate analysis			Multivariate analysis		
	OR ¹	95%CI	p-value	OR _{adj} ²	95%CI	p-value
Age group						
< 20 years	1.00	Reference				
≥ 20 years	0.59	(0.23-1.51)	0.269	NA	NA	NA
Education						
Primary school	1.00	Reference				
Secondary school and higher	1.21	(0.57-2.55)	0.616	NA	NA	NA
Occupation						
No	1.00	Reference				
Yes	1.15	(0.58-2.26)	1.145	NA	NA	NA
Parity						
Primipara	1.00	Reference		1.00	Reference	
Multipara	4.12	(1.65 - 10.29)	0.002	2.57	(1.01-6.54)	0.048
Number of ANC						
> 4	1.00	Reference		1.00	Reference	
≤ 4	4.48	(2.26-8.87)	<0.001	2.80	(1.26-6.24)	0.012
GA at delivery						
38 – 42 weeks (term)	1.00	Reference		1.00	Reference	
24 – 37weeks (preterm)	1.96	(0.99-3.88)	0.052	2.24	(1.04-4.83)	0.040
Labor progression						
Normal labor progression	1.00	Reference		1.00	Reference	
Precipitate labor	11.29	(6.16-20.70)	<0.001	10.74	(4.76-24.21)	<0.001
Duration from labor to transportation						
< 30 minutes	1.00	Reference		1.00	Reference	
31 - 60 minutes	1.24	(0.60-2.56)	0.554	1.16	(0.57-2.35)	0.680
> 60 min.	3.415	(1.81-6.45)	<0.001	3.38	(1.82-6.27)	<0.001

Abbreviation: GA, gestational age; ANC, antenatal care; OR, odds ratio; OR_{adj}, adjusted odds ratio; CI, confidence interval. ¹Crude OR estimated by Binary logistic regression. ²Adjusted OR estimated by multiple logistic regression adjusting for parity, number of ANC, GA at first ANC, GA at delivery, labor progression and duration from labor pain to transportation.

This study demonstrates several more significant neonatal morbidities in BBA neonates than earlier reports.^{1,2,12,13} This finding is probably due to most neonates in BBA group being significantly more preterm and low birth weight than in the BIH group. Moreover, most neonates were transported more than 30 minutes, which affected proper intervention, well-prepared equipment, and immediate resuscitation by neonatologist to reduce neonatal morbidities, especially in case of poor Apgar score or preterm birth. There is evidence that prolonged transportation times are significant predictors of neonatal mortality among transported neonates.¹⁵ Moreover, neonatal intervention before and during transportation significantly decreases neonatal morbidities and mortality.¹⁶

Additionally, all BBA newborns in this study were delivered without skilled birth attendants, which could result in more neonatal morbidities and mortality. Delivery that is assisted by skilled birth attendants will increase the chances of emergency obstetric care, safe delivery and also life-saving neonatal intervention to abate potential morbidity and mortality among mothers and newborns, even in cases of home birth. There is clear evidence that the presence of skilled birth attendants is associated with a significant reduction in maternal and neonatal morbidities, even in cases of home birth.¹⁶⁻¹⁸

For maternal morbidity, there are fewer reports and fewer maternal morbidities than neonatal morbidities.^{19,20} According to the result of this study, the only significant maternal morbidity that was higher in BBA than BIH was birth canal tear (59.5% vs. 6.5%, $p < 0.001$). This might be because there was no proper intervention, a lack of well-prepared equipment and no skilled birth attendant.

Characteristics of BBA mothers were significantly more teenage, low education, multipara, attended ANC ≤ 4 , preterm birth and rapid labor progression. These findings are consistent with most earlier studies.^{7,9,21,22} The possible explanations might be that younger women are less likely to take care and aware of labor compared to adult. Low education also affects their attitude, beliefs and proper

decision making towards health care. Inadequate antenatal visits might affect the women's concern for her pregnancy status, obstetric complications and preparedness for birth. Furthermore, preterm labor, multiparity and short labor duration are likely to lead to quicker childbirth and to unexpected BBA.

Results from multiple logistic regression analysis revealed that significant predictive factors for BBA were 2.57 times more prevalent in multiparity, by 2.8 times in ANC ≤ 4 , by 2.24 times in preterm birth and by 10.74 times more in short labor progression. This finding has implications for healthcare personnel to be aware of these characteristics as BBA risk and provide health education about birth planning and preparing to prevent BBA.

Transportation to hospital is a main task for plan-in-hospital pregnant women when labor starts. Home-to-hospital distance may be an important obstacle to reaching hospital before delivery. Previous studies have shown different association between transportation barrier and BBA risk, depending on setting and context of the studied area. One study in a mixed urban-rural setting in Nepal, in which there was no intermediate level of private or government hospital or maternity homes in the study area, found that home-hospital distance of more than 1 hour was associated with an increased risk of home delivery.²³ Another study in Oman, in which most home deliveries did not have adequate transport facilities available, reported that increasing distance from hospitals was a significant risk factor for BBA.²⁴ Similarly, studies in France and Australia found that long distance and transportation difficulties due to maternity unit closures increased out-of-hospital births rates.^{3,25} In contrast, a study in a peri-urban setting in South Africa did not find any association between distance from a health facility and BBA.²⁶ However, this study found that home-to-hospital distance, transportation time and timing of transportation were not associated with BBA. The finding of this study might be explained by the urban setting of this study, which differs from rural areas. Transportation barriers in rural area include

long distance, transportation difficulties, poor road infrastructure and lack of transport to a maternity unit.^{8,26-28} Whereas for the majority of the population in urban areas living close to hospitals the main transportation barrier is not long distance.¹⁶

Although most studies have shown that transportation was identified as the major barrier to traveling to the hospital resulting in BBA.²³⁻²⁷ This study did not show this effect on BBA, even due to traffic congestion in urban setting. Conversely, delayed transportation from home was the significant risk factor for BBA. Duration from onset of labor to transportation of more than 60 minutes was 3.38 times more predictive of BBA occurring than for BIH. Thus, healthcare personnel should educate all pregnant women to go to hospital immediately when labor begins.

Nevertheless, healthcare personnel should realize that every pregnant woman has a chance to give birth out of hospital. To minimize incidence of BBA, all pregnant women and their husbands should be counseled during antenatal visits about the importance of birth preparedness and transportation plans. Particularly, women who are at high risk of BBA should be encouraged to attend regular ANC. Routine history taking should be targeted to find out history of preterm labor and precipitate labor. Health education during ANC should include signs and symptoms of labor, preparation for delivery, ambulance facilities, important telephone numbers and early transport to hospital when labor begins. Moreover, it is necessary for continuing training of healthcare personnel who are involved in BBA.

There are many limitations of this study. Firstly, this study was a retrospective design for which data were obtained from medical record that might be incomplete or missing. However, there was a low rate of incomplete medical record and medical record loss in this study. Secondly, neonatal co-morbidities such as hypothermia, hypoglycemia, tachypnea, meconium stain, and birth asphyxia were not measured at the same time after delivery, and it was therefore underestimated and difficult

to conclude whether birth before arrival was an independent risk factor for morbidity or instead due to unmeasured confounders. Additionally, no data of cervical dilatation and amniotic fluid leakage were recorded which might affect labor progression. Finally, the transportation time and distance were not accurately measured, but approximated data.

Findings of in this study can be generalized to other healthcare facilities to identify and educate group at risk for giving birth before arrival. However, this study was performed in a single urban area in Thailand. It's generalization to rural area or other countries may be limited. Further studies should be carried out to compare BBA in urban with rural areas to assess whether similar patterns are apparent. Furthermore, future studies should evaluate attempts to limit incidence, morbidity, and mortality of mothers and infants delivered before arrival to hospital.

Conclusion

This study contributes to a better understanding of BBA in the urban setting. The prevalence of BBA was comparable to other developing countries. This study confirmed that BBA was significantly more associated with maternal and neonatal morbidity than BIH. Maternal risks of BBA were similar to several previous reports. In urban settings, transportation barriers (distance, time and timing) were not risk factors for BBA but delayed transportation from home was a significant risk for BBA occurrence. Significant predictors of BBA were multiparity, preterm labor, precipitate labor and delayed transportation. BBA needs multidisciplinary team to abate maternal and neonatal morbidity.

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Reference

- Bassingthwaite MK, Ballot DE. Outcomes of babies born before arrival at a tertiary hospital in Johannesburg, South Africa. *S Afr J CH*. 2013; 7(4): 139 – 45.
- Beeram M, Solarin K, Young M, Abedin M. Morbidity and Mortality of Infants Born Before Arrival at the Hospital. *Clinical Pediatrics*. 1995; 34(6):313 – 6.
- Kildea S, McGhie AC, Gao Y, Rumbold A, Rolfe M. Babies born before arrival to hospital and maternity unit closures in Queensland and Australia. *Women and Birth*. 2015; 28; 236–45.
- Gunnarsson B, Smarason AK, Skogvoll E, Fasting S. Characteristics and outcome of unplanned out-of-institution births in Norway from 1999 to 2013: a cross-sectional study. *Acta Obstet Gynecol Scand*. 2014; 1-8.
- MacDorman MF, Mathews TJ, Declercq E. Trends in Out-of-Hospital Births in the United States, 1990–2012. *NCHS Data Brief*. 2014; 144: 1-8.
- Parag N, Naby F. Profile of babies born before arrival at hospital in a peri-urban setting. *S Afr J CH*. 2014;8(2):45-9.
- Khupakonke S, Beke A, Amoko DHA. Maternal characteristics and birth outcomes resulting from births before arrival at health facilities in Nkangala District, South Africa: a case control study. *BMC Pregnancy and Childbirth*. 2017; 17: 1-10.
- Chaudhary P. Accidental -out of- hospital deliveries: factors influencing delay in arrival to maternity hospital. *Kathmandu University Medical Journal*. 2005; 3(2): 115-22.
- Hiraizumi Y, Suzuki S. Birth before Arrival at a Hospital in Eastern Tokyo, Japan. *J Nippon Med Sch*. 2011; 78 (5): 334 – 5.
- Sibunruang S. Maternal and Newborn Complications of Birth before Admission to Taksin Hospital, Bangkok Metropolitan Administration. *Vaj Medl J*. 2005; 49(3) 153 – 8.
- Wattananurangkowit W. Birth before Arrival (BBA) at Yasothon Hospital, 5 Year Descriptive and Retrospective Analytic Study. *J Health Sc*. 2008; 17 suppl 2: 369 – 78.
- Hadar A, Rabinovich A, Sheiner E, Landau D, Hallak M, Mazor M. Obstetric characteristics and neonatal outcome of unplanned out-of-hospital term deliveries: a prospective, case-control study. *J Reprod Med*. 2005 Nov; 50(11):832-6.
- Snowden JM, Tilden EL, Snyder J, Quigley B, Caughey AB, Cheng YW. Planned Out-of-Hospital Birth and Birth Outcomes. *N Engl J Med*. 2015; 373(27): 2642–53.
- Cunningham FG, Leveno KJ, Bloom SL, Spong CY, Dashe JS, Hoffman BA, et al. *Williams Obstetrics*. 24th ed. New York: McGraw-Hill; 2014.
- Narang M, Kaushik JS, Sharma AK, Faridi MMA. Predictors of Mortality among the Neonates Transported to Referral Centre in Delhi, India. *Indian J Public Health*. 2013; 57(2): 100 – 4.
- Pirneskoski J, Peräjoki K, Nuutila M, Kuisma M. Urgent EMS managed out-of-hospital delivery dispatches in Helsinki. *SJTREM*. 2016; 24(94): 1-6
- Berhan Y, Berhan A. Skilled health personnel attended delivery as a proxy indicator for maternal and perinatal mortality: A systematic review. *Ethiop J Health Sci*. 2014; 24 Suppl: 69–80.
- Janssen PA, Saxell L, Page LA, Klein MC, Liston RM, Lee SK. Outcomes of planned home birth with registered midwife versus planned hospital birth with midwife or physician. *CMAJ*. 2009; 181(6-7) 337-83.
- Unterscheider J, Ma'ayeh M, Geary MP. Born before arrival birth: impact of a changing obstetric population. *J Obstet Gynecol*. 2011; 31(8): 721-3.
- Duvekot E, Wijnen M. A comparison between health centre deliveries and deliveries born before arrival in Aitape district. *P N G Med J*. 1994; 37(3): 173-7.

21. Titapant V, Sirimai K, Roongphornchai S. Risk factors for birth before arrival at Siriraj Hospital. *J Med Assoc Thai.* 2002; 85(12): 1251-7.
22. Lazić Z, Takač I. Outcomes and risk factors for unplanned delivery at home and before arrival to the hospital. *Wien Klin Wochenschr.* 2011; 123(1-2):11-4.
23. Wagle RR, Sabroe S, Nielsen BB. Socioeconomic and physical distance to the maternity hospital as predictors for place of delivery: An observation study from Nepal. *BMC Pregnancy and Childbirth.* 2004; 4:8.
24. Bhat BA, Suri K, Gupta B. A Clinico-Epidemiological Evaluation of Infants Born Before Arrival at Hospital. *Ann Saudi Med.* 2000; 20(5-6): 483-4.
25. Blondel B, Drewniak N, Pilkington H, Zeitlin J. Out-of-hospital births and the supply of maternity units in France. *Health & Place.* 2011; 17:1170-3.
26. Alabi AA, O'Mahony D, Wright G, Ntsaba MJ. Why are babies born before arrival at health facilities in King Sabata Dalindyebo Local Municipality, Eastern Cape, South Africa? A qualitative study. *Afr J Prm Health Care Fam Med.* 2015;7(1): 1 – 9.
27. Gabrysch S, Campbell OMR. Still too far to walk: Literature review of the determinants of delivery service use. *BMC Pregnancy and Childbirth.* 2009, 9(34): 1 – 18.
28. Silal SP, Penn-Kekana L, Harris B, Birch S, McIntyre D. Exploring inequalities in access to and use of maternal health services in South Africa. *BMC Health Serv Res.* 2012; 12: 1 – 12.