

Adverse Neonatal Outcomes and Its Associated Factors Among Mothers with Short and Recommended Interpregnancy Interval, in Awi Zone Public Hospitals, 2020.

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Abstract

Background: Short interpregnancy interval is among modifiable risk factors for maternal and neonatal adverse outcomes for planned pregnancies. It is potentially associated with adverse neonatal outcomes which are known to have considerable public health significance. In Ethiopia neonatal mortality was found to be high according to recent mini Ethiopian Demographic Health Survey Report. More importantly information about adverse neonatal outcomes in relation to interpregnancy interval is poorly described yet in Ethiopia.

Methods: Institution based comparative cross-sectional study was conducted in Awi zone public hospitals. A total of 482 mothers (241 with short and 241 with recommended IPI) were selected. The data was collected by using systematic random sampling technique through pretested structured questionnaire and entered in to Epi data version 3.1 then exported to Statistical Package of Social Science version 23.0 for analysis. Chi-square and independent t-test were used to compare means. Bivariable and multivariable logistic regression analyses was employed to estimate the crude and adjusted odds ratio with a confidence interval of 95% and P value of less than 0.05 considered statistically significant.

Result: Among a total of selected mothers with short and recommended Interpregnancy interval (IPI) response rate was 237 (98.3%) and 238 (98.7%) respectively. Proportion of adverse neonatal outcomes were higher among short IPI groups (37.1%). Factors like, rural residence [AOR=6.9, 95%CI (3.32, 14.59)], and Cesarean section delivery [AOR=3.4, 95%CI (1.18, 10.09)] were significantly associated with adverse neonatal outcomes in short IPI groups. Factors like rural residence [AOR=6.1, 95%CI (2.11, 17.7)], unintended pregnancy [AOR=5.3, 95%CI (1.11, 25.00)], rupture of membrane [AOR=6.89, 95%CI (2.54, 18.65)] and induction of labor [AOR=13.4, 95%CI (3.17, 21.77)] were significantly associated in recommended IPI groups.

Conclusion: Urban residency and vaginal mode of delivery were significantly associated with less risk of adverse neonatal outcomes in both IPI groups. Whereas, intended pregnancy status, spontaneous labor initiation and absence of ROM before labor were protective for adverse neonatal outcomes in recommended IPI mothers. Provision of proper health service coverage at rural area and minimizing C/S rate to reduce adverse neonatal outcome is recommended.

Background

Inter pregnancy period is an opportunity to address complications occurred during pregnancy, to assess a woman's mental and physical wellbeing and to optimize her health along her life time(1). Short Interpregnancy interval (IPI) is among modifiable risk factors for adverse neonatal outcomes for planned pregnancies(2). IPI is defined as the time elapsed between the woman's last delivery and the date of the last menstrual period for the index pregnancy(1, 3).

There are existing recommendations that target optimization of women or couples health before conception. The CDC in 2006 and WHO in 2012 had recommended the need to implement highly recommended for good maternal and perinatal outcomes(4). Prevention of short interpregnancy intervals is a public health priority in the United States. Specifically the American Healthy People objectives call for a 10% reduction of pregnancies that occur within 18 months of a previous birth by 2020(5).

The health status of the couples, particularly of the woman, prior to pregnancy or conception and during the pregnancy period can adversely affect the outcome of the pregnancy(6). Short interpregnancy interval was found to be potentially associated with adverse neonatal outcomes including stillbirth, early neonatal mortality, preterm birth, Neonatal Intensive Care Unit (NICU) admission, low Apgar score and low birthweight (LBW) which are known to have considerable public health significance(7). Globally LBW occurs in > 20 million newborns worldwide, which is a major contributor to perinatal mortality and up to 80% of neonatal mortality(8). Preterm birth complications are also the leading cause of deaths in the neonatal period(9).

Studies from developed countries showed that the risk of developing adverse neonatal outcomes to be higher in pregnancies with short IPI (10–12). Other reports from developed countries showed an increased risk of developing preterm birth and LBW eventhough they show insignificant association for other adverse neonatal outcomes(13). Similarly the effect of short IPI on adverse neonatal outcomes among developing countries was also supported by many literatures(14, 15).

In Ethiopia the perinatal mortality rate is relatively high among women with a pregnancy interval of less than 15 months (45 deaths per 1,000 pregnancies)(16). Despite; the availability of health facilities and improved health services, recent report from Ethiopian Demographic Health Survey (EDHS) determined that stagnant prevalence in neonatal mortality as compared to the previous 2016 EDHS report(17). Therefore this study aimed to compare pregnancy outcomes between short and recommended IPI and identify associated factors among women delivering at Awi zone public hospitals.

Methods

Study area and period

The study was conducted from February 15 to April 15, 2020, at public hospitals in Awi zone, Amhara region, North West Ethiopia, 2020. Awi zone is one of the 15 Zones in Amhara Region of Ethiopia. It is bordered on the west by Benishangul-Gumuz Region, on the north by Semien Gondar Zone and on the east by Mirab Gojjam. The administrative centre of Awi zone is Injibara; other towns include Chagni, and Dangila. Injibara is found 297 Km from Adis ababa, Ethiopia. It has 11 woredas and a total of 5 public hospitals (dangla primary hospital, Injibara general hospital, Jawi primary hospital, and Gmjabet primary hospital and Chagni primary hospitals) and 447 health centers.

Study Design And Population

Institution based comparative cross-sectional study was conducted among all mothers who had at least one previous live birth and who gave their current birth in Awi zone public hospitals during the study period. Mothers whose charts were incomplete and whose current delivery was other than singleton were excluded from the study.

Sample Size Determination

Sample size was calculated using a double population proportion formula; assuming 22.2% proportion (p_1) for the exposed and proportion (p_2) for unexposed 11.3% based on a previous study which tried to show interpregnancy interval as a risk factor for preterm birth, with 95% level of confidence (z) and power of 80%. By applying 10% of non-response rate the final sample size became 200.

Sample size calculated using values from different previous literatures was determined by using Epi info version 7 by considering the following assumptions: confidence interval (CI) 95%, power 80%, ratio 1:1 and non-response rate 10%. The factors were taken from previous study conducted in Suhul Shire hospital, Gamo Gofa zone, North Wollo zone and Nigst Eleni hospital hosanna town[18–21](Table1).

Table 1
sample size calculation based on significant independent variables identified on literatures.

Authors	Factor	Prevalence of neonatal adverse outcome P_1 (in exposed), p_2 (in unexposed)	Power	AOR	Sample size with 10% non-response rate
Adhena et al.	residence	$P_1 = 27.7\%$ $P_2 = 16.2\%$	80%	1.643(0.93–2.8)	482
Feleke et al.	Occupational status	$P_1 = 16.6\%$, $p_2 = 1.4\%$	80%	0.074 (0.017, 0.324)	147
Kasahun et al.	Age	$P_1 = 32.8\%$ $P_2 = 20.5\%$	80%	0.5 (0.20, 1.20)	480
Abdo et al.	Marital status	$P_1 = 36\%$ $P_2 = 20.6\%$	80%	0.47(0.25, 0.91)	321

Since the sample size calculated from the factors gives the larger sample size, the sample size for this study was 482.

Data Collection Tools And Procedures

Questionnaire was designed to meet the objective of this study and the study was based on interviewer administered questionnaire and chart review. The questionnaire was pretested on 5% (25) of the calculated sample size in durbete hospital. First, the English version of the questionnaire was prepared. Then it was translated to Amharic and Avingi version (local languages) and then translated back to English to check its consistency.

The questionnaire has three parts. The first include socio-demographic information such as age, educational level, and occupation, place of residence (urban and rural), the second part deal with maternal characteristics and the third neonatal outcome. By reviewing their chart sex of their infant, duration of their labor pain, mode of delivery, obstetric U/S estimate of their GA, APGAR score, birth weight of the newborn, were taken from their chart. Then in the postnatal ward just before their discharge mothers were interviewed.

Measurement

The outcome variable was measured as presence or absence of adverse neonatal outcomes.

Adverse neonatal outcome implies the presence of at least one or more of the following conditions in the current pregnancy. These include APGAR score less than 7, still birth, NICU admission, low birth weight, congenital anomaly, and preterm birth.

Data Processing, Analysis And Interpretation

The collected data were entered and cleaned using Epi data version 3.1, then exported to SPSS version 23 for analysis. Descriptive analysis, chi-square and independent t-test were conducted to summarize the data and the final result of the study was interpreted in the form of text, figures and tables. Binary logistic regression analysis was executed to see the association between independent and dependent variables.

All explanatory variables with $p < 0.2$ in bivariable logistic regression were entered into multivariable logistic regression analysis and significant association was identified based on $p < 0.05$ and odds ratio with 95% CI in multivariable logistic regression. The final model fitness was checked using Hosmer-Lemeshow Goodness of Fit test ($p = 0.519$). Separate analysis was also done for mothers with both short and recommended IPI.

Ethical Consideration

After approval, ethical clearance was obtained from Institutional Review Board (IRB) of College of Medicine and Health sciences, Bahir Dar University. Then, official letter was written from College of Medicine and Health Sciences to each Awi zone public hospitals. The aim of the study was informed for each study participant, and the study participants had a right to refuse or discontinue participating in the

research without any restriction. Finally informed written consent was obtained from each participant before data collection and confidentiality was assured.

Results

Socio-demographic characteristics of participants

Among the total of 482 mothers, 475 mothers were participated in the study which makes response rate of 98.5%. Regarding IPI, 237 (49.9%) were mothers with short IPI and 238 (50.1%) were mothers with recommended IPI. The highest proportion, 88(37.1%) short IPI mothers and 100 (42%) recommended IPI mothers were in the age group of 25–29 years. The mean age of the mother was 30.95(SD \pm 5.46) among mothers with short IPI and 30.75 (SD \pm 4.6) among those mothers with recommended IPI. Almost all 227(95.8%) of mothers with short IPI and 237(99.6%) mothers with recommended IPI were married. More than half 133(56.1%) of mothers with short IPI and 129(54.2%) recommended IPI mothers were urban residents. Regarding the educational status of mothers, 84(35.4%) of mothers with short IPI and 103(43.3%) of mothers with recommended IPI didn't attended formal education. Concerning educational status of the husbands, 84(36.8%) husbands of mothers with short IPI and 94(39.5%) husbands of mothers with recommended IPI didn't attend formal education (Table 2).

Table 2
sociodemographic characteristics of mothers with short and recommended IPI in Awi zone public hospitals, Northwest Ethiopia, 2020

Variables	Adverse neonatal outcome		p- value
	Yes (%)	No (%)	
Age			
20–24	22 (9.3%)	10 (4.2%)	0.045
25–29	88 (37.2%)	100 (42%)	
30–34	64 (27%)	71 (29.8%)	
35 and above	63 (26.6%)	57 (24%)	
Marital status			
Married	135 (28.4%)	329 (69.3%)	0.430
Unmarried*	2 (0.4%)	9 (1.9%)	
Religion			
Orthodox	116 (24.4%)	276 (58.1%)	0.508
Muslim	19 (4%)	51 (10.7%)	
Protestant	2 (0.4%)	11 (2.3%)	
Educational status of the mother			
No formal education	56 (11.7%)	131 (27.6%)	0.874
Primary	45 (9.5%)	111(23.4%)	
Secondary and above	36 (7.6%)	96 (20.2%)	
Occupation of the mother			
Farmer	54 (11.4%)	118 (24.8%)	0.590
House wife	52 (10.9%)	151 (31.7%)	
Governmental employee	23 (4.8%)	49 (10.3%)	
Merchant	10 (1.7%)	20 (4.2%)	
Husbands educational status			
No formal education	77 (32.4%)	91 (38.2%)	0.256
Primary	58 (24.5%)	62 (26.1%)	
Secondary and above	96 (40.1%)	74 (31.1%)	

Variables	Adverse neonatal outcome		p- value
	Yes (%)	No (%)	
Residence			
Rural	94 (19.9%)	120 (25.3%)	< 0.001
Urban	43 (9.1%)	218 (45.9%)	
Husbands occupational status			
Farmer	11 (2.3%)	27 (5.7%)	0.942
Daily labourer	60 (12.6%)	144 (30.3%)	
Government employee	30 (6.3%)	69 (14.5%)	
Merchant	36 (7.6%)	98 (20.6%)	
*single, widowed, divorced			

Obstetric Characteristics Of Women With Short And Recommended Ipi

The current pregnancy was planned wanted and supported in 196(82.7%) and 217(91.2%) of mothers with short and recommended IPI respectively. In more than three fourth 202(85.2%) and 186(78.2%) of mothers with short and recommended IPI respectively the presentation of the fetus was vertex. In almost all, 225(94.9%) and 225(94.9%) of mothers with short and recommended IPI respectively, the current pregnancy was completed at term GA. Labor started spontaneously in 231(97.1%) of mothers with short IPI and 220(92.4%) of mothers with recommended IPI. Nearly all, 236(99.6%) and 234(98.3%) of mothers with short and recommended IPI respectively had ANC follow up and 29(12.2%) of mothers from short IPI group and 33(13.9%) of those mothers from recommended IPI group started ANC late.

During their current pregnancy 6(2.5%) mothers with short IPI and 14(5.9%) of those mothers with recommended IPI faced obstetric complication. It was hypertensive disorder which accounts more 5(83.3%) and 12(85.7%) among short and recommended IPI mothers respectively. The overall proportion of ROM was 67(14.1%) and was prolonged in 26(38.8%) of cases. The mean duration of ROM was 7.66 (SD \pm 5.09). In 31(6.5%) of cases duration of labor took 12hr and above, while the mean duration of labor was 6.48(SD \pm 2.48) (Table 3).

Table 3
 obstetric characteristics of mothers with short and recommended
 IPI in Awi zone public hospitals, Northwest Ethiopia, 2020.

Variable	Adverse neonatal outcome		p- value (χ^2)
	Yes (%)	No (%)	
Gravidity			
2–5	54 (22.8%)	38 (16%)	0.613
5 and above	34 (14.3%)	11 (4.6%)	
Parity			
2–5	55 (23.2%)	37 (15.5%)	0.76
5 and above	33 (13.9%)	12 (5%)	
Pregnancy status			
Intended	108 (22.7%)	313 (65.9%)	< 0.001
Unintended	29 (6.1%)	25 (5.26%)	
ANC			
Four and above	98 (20.6%)	245 (51.6%)	0.834
Less than four	39 (8.2%)	93 (19.1%)	
Tetanus toxoid (TT) vaccinated			
Yes	133 (28%)	333 (70.1%)	0.297
No	4 (0.8%)	5 (1.1%)	
Complication during pregnancy			
No	124 (26.1%)	331 (69.7%)	< 0.001
Yes	13 (2.7%)	7 (1.5%)	
ROM			
Yes	39 (8.2%)	28 (5.9%)	< 0.001
No	98 (20.6%)	310 (65.3%)	
IPI			
Short	88	149	< 0.001
Recommended	49	189	
Duration of ROM			

Variable	Adverse neonatal outcome		p- value (χ^2)
	Yes (%)	No (%)	
Less than 8hr	1 (3%)	10 (29.4%)	0.312
8hr and above	2 (6%)	5 (14.7%)	
Mode of delivery			
Vaginal	116 (24.4)	316 (66.5)	0.002
C/S	21 (4.4%)	22 (4.6%)	

3.3. Factors associated with adverse neonatal outcomes among mothers with short IPI

Three models were fitted to assess factors in relation to adverse neonatal outcomes. The first model was fitted to identify factors associated with adverse neonatal outcomes among mothers with short IPI. Variables such as residence, mode of delivery and time of initiation of ANC follow-up were found to have significant association with adverse neonatal outcomes. The odds of Mothers from rural area to develop adverse neonatal outcomes were 6.9 times (AOR = 6.9, 95%CI = 3.32, 14.59) higher than those mothers from urban area. Mothers who deliver through C/S were 3.21 times (AOR = 3.21, 95%CI = 1.08, 9.50) more likely to have babies with adverse neonatal outcomes than their counterparts (Table 4).

Table 4
 multivariable analysis of adverse neonatal outcomes among mothers with short IPI in Awi zone public hospitals, Northwest Ethiopia, 2020

Variables	Adverse neonatal outcomes				
	Yes	No	COR95%CI	AOR95%CI	p-value
Age group					
20–24	8 (3.4%)	14 (5.9%)	0.7 (0.27, 2.02)	1.53 (0.41,5.71)	0.525
25–29	31 (13.1%)	56 (23.6)	0.72 (0.37,1.39)	2.02 (0.8,5.07)	0.132
30–34	20 (8.4%)	41 (17.3%)	0.64 (0.3,1.31)	1.0 (0.41,2.44)	0.988
35 and above	29 (12.2%)	38 (16.0%)	1	1	
Residence					
Rural	61 (25.7%)	45 (19%)	5.22 (3.01,13.6)	6.9 (3.32,14.59)	< 0.001
Urban	27 (11.4%)	104 (43.9%)	1	1	
Educational status of the mother					
No formal education	42 (17.7%)	42 (17.7%)	1.01 (0.53,1.73)		0.348
Primary	29 (12.2%)	52 (21.9%)	0.87 (0.45, 1.70)		0.293
Secondary and above	32 (12.7%)	40 (16.5%)	1		0.323
Sex of new born					
Male	64 (13.5%)	138 (29.1%)	1.27 (0.5, 1.18)	1.18 (0.62,1.26)	0.598
Female	73 (15.4%)	200 (42.1%)	1	1	
ANC					
Less than 4	20 (8.4%)	44 (18.6%)	0.8 (0.63,2.13)	1.2 (0.55,2.90)	0.563
4 and above	68 (28.7%)	105 (44.3%)	1	1	
RH status of the mother					
negative	11 (4.6%)	11 (4.6%)	1.7 (0.7, 4.3)	2.84 (0.94,8.58)	0.064
Positive	77 (32.5%)	138 (58.2%)	1	1	

Variables	Adverse neonatal outcomes				
	Yes	No	COR95%CI	AOR95%CI	p-value
Complication during pregnancy					
Yes	5 (1.1%)	15 (3.2%)	4.2 (0.51,33.9)	1.98 (0.24,16.01)	0.520
No	139 (29.3%)	316 (66.5%)	1		
ROM					
Yes	21 (8.9%)	12 (5.1%)	3.5 (1.61,7.70)	2.22 (0.89,5.56)	0.087
No	67 (28.35)	137 (57.8%)	1		
Mode of delivery					
C/S	9 (3.8%)	13 (5.5%)	2.4 (1.13,5.42)	3.21 (1.08,9.50)	0.035
Vaginal delivery	75 (31.6%)	140 (59.1%)	1		
Pregnancy status					
Un intended	21 (8.9%)	20 (8.4%)	1	1.68 (0.75,3.78)	0.206
Intended	67 (28.3%)	129 (54.4%)	2.25 (1.13,4.48)		
ANC initiation					
Late	5 (2.1%)	23 (9.7%)	0.33 (0.12,0.91)	0.61 (0.22,1.21)	0.008
Early	83 (35%)	126 (53.2%)	1		

Factors associated with adverse neonatal outcomes among mothers with recommended IPI

The second model was fitted to assess factors associated with adverse neonatal outcomes among mothers with recommended IPI. Variables like residence, pregnancy status, presence of ROM before labor and labor status were found to have a significant association with adverse neonatal outcomes among mothers with recommended IPI. The odds of delivering babies with adverse neonatal outcome among rural mothers was 6.1 times (AOR = 6.1, 95%CI = 2.11, 17.7) higher than their counterparts. The odds of delivering babies with adverse outcome among mothers whose pregnancy was unintended was found to be 5.3 times (AOR = 5.3, 95%CI = 1.11, 25.00) higher than their counterparts. Similarly mothers who had induction of labor were 13.4 times (AOR = 13.4, 95%CI = 3.17, 21.77) more likely to deliver babies with adverse neonatal outcomes than those whose labor start spontaneously. The odds of having babies with

adverse neonatal outcomes in mothers who had ROM before labor was 6.89 times (AOR = 6.89, 95%CI = 2.54) higher than their counterparts (Table 5)

Table 5
distribution of adverse neonatal outcomes among women with recommended IPI in Awi zone public hospitals, Northwest Ethiopia, 2020.

Variables	Adverse neonatal outcomes				
	Yes	No	COR 95%CI	AOR 95%CI	p-value
Age group					
20–24	4 (1.7%)	6 (2.5%)	1.76 (0.44,7.03)	1.02 (0.13,8.09)	0.980
25–29	21 (8.8%)	77 (32.4%)	0.72 (0.34,1.51)	0.61 (0.18,1.99)	0.607
30–34	7 (2.9%)	61 (18.9%)	0.3 (0.11,0.99)	0.32 (0.08,1.20)	0.093
35 and above	17 (7.1%)	45 (18.9%)	1	1	
Residence					
Rural	33 (13.9%)	75 (31.5%)	3.13 (1.68,16.2)	6.1 (2.11,17.7)	< 0.001
Urban	16 (6.7%)	114 (47.9%)	1	1	
Educational status of the mother					
No formal education	23 (9.7%)	78 (32.8%)	1.25 (0.73,3.93)		0.217
Primary	17 (7.1%)	59 (24.8%)	0.69 (0.18,4.05)		0.262
Secondary and above	9 (3.8%)	52 (21.8%)	1		
Occupational status of participant					
House wife	33 (13.9%)	80 (33.8%)	1		
Farmer	32 (13.5%)	45 (19%)	1.12 (0.56,2.25)		0.738
Governmental employee	17 (7.2%)	20 (8.4%)	0.77 (0.28,2.13)		0.619
Merchant	6 (2.5%)	4 (1.7%)	0.46 (0.09,2.21)		0.337
Sex of new born					
Male	24 (10.1%)	83 (34.9%)	1.22 (0.43,2.39)	1.14 (0.50,2.57)	0.75
Female					

Variables	Adverse neonatal outcomes				
	Yes	No	COR 95%CI	AOR 95%CI	p-value
	25 (10.5%)	106 (44.5%)	1	1	
ANC					
Less than 4	19 (8.0%)	49 (20.6%)	1.81 (0.71,4.2)	1.53 (0.63,3.70)	0.592
4 and above	30 (12.6%)	140 (58.8%)	1	1	
RH status of the mother					
Negative	9 (3.8%)	20 (8.4%)	1.8 (0.81,4.48)	1.43 (0.47,4.39)	0.904
Positive	40 (16.8%)	169 (71%)	1	1	
ROM					
Yes	18 (7.6%)	16 (6.7%)	6.27 (2.3,17.8)	6.89 (2.54,18.6)	< 0.001
No	31 (13.0%)	173 (72.7%)	1	1	
Labor status					
Induced	12 (5%)	6 (2.5%)	10 (3.4,22.0)	13.4 (3.17,21.77)	< 0.001
Spontaneous	37 (15.5%)	183 (76.9%)	1	1	
Mode of delivery					
C/S	8 (3.4%)	13 (5.5%)	2.6 (0.78,8.89)	2.96 (0.917,9.56)	0.070
Vaginal delivery	41 (17.2%)	176 (73.9%)	1	1	
Pregnancy status					
Un intended	8 (3.4%)	5 (2.1%)	7.1 (1.02,24.1)	5.3 (1.11,25.00)	0.032
Intended	41 (17.2%)	184 (77.3%)	1	1	

Factors associated with adverse neonatal outcomes among mothers with short and recommended IPI

A full model was developed to assess factors associated with adverse neonatal outcomes among mothers with short and recommended IPI. In this model variables like residence, IPI, presence of ROM,

labor status and mode of delivery were found to be significantly associated with adverse neonatal outcomes regardless of the IPI. Mothers with IPI of less than 24 month were 3.39 times (AOR = 3.39, 95%CI = 2.02, 5.7) more likely to develop adverse neonatal outcome than their counter parts. Rural resident mothers were 6.3 times (AOR = 6.3, 95%CI = 3.52) more likely to give birth of newborn with adverse neonatal outcome compared to mothers from the urban residency. Similarly mothers with ROM were also found to be 6.2 times (AOR = 6.2, 95%CI = 3.01, 12.8) more likely to deliver newborn with adverse neonatal outcomes than their counterparts. In this study, Mothers who had induction of labor were 3.88 times (AOR = 3.88, 95%CI = 1.14, 10.71) more likely to deliver newborn with adverse neonatal outcome as compared to their counterparts. Mothers who gave birth through C/S were 2.4 times (AOR = 2.4, 95%CI = 1.17, 5.2) more likely to have adverse neonatal outcomes than those with vaginal deliveries (Table 6).

Table 6

multivariable analysis of adverse neonatal outcomes for mothers with both short and recommended IPI, in Awi zone public hospitals, Northwest Ethiopia, 2020.

Variables	Adverse neonatal outcomes				
	Yes	No	COR95%CI	AOR95%CI	p-value
Age group					
20–24	12 (2.5%)	20 (4.2%)	1.08 (0.2,3.02)	1.1 (0.37,3.2)	0.324
25–29	52 (10.9%)	133 (28.0)	0.7 (0.30,2.18)	1.05 (0.52,2.13)	0.89
30–34	27 (5.7%)	102 (21.3%)	0.47 (0.15,1.13)	0.6 (0.29,1.21)	0.399
35 and above	46 (9.7%)	83 (17.5%)	1	1	
Residence					
Rural	94 (25.3%)	120 (25.3%)	4 (3.3,10.72)	6.3 (3.52,11.6)	< 0.001
Urban	43 (9.1%)	218 (45.9%)	1	1	
IPI					
Short IPI	88 (18.5%)	149 (31.4%)	2.27 (1.8,4.01)	3.39 (2.02,5.7)	< 0.001
Recommended IPI	49 (10.3%)	189 (39.8%)	1	1	
Sex of new born					
Male	64 (13.5%)	138 (29.1%)	1.27 (0.15,1.88)	1.01 (0.59,1.53)	0.948
Female	73 (15.4%)	200 (42.1%)	1	1	
Parity					
5 and above	45 (20.6%)	84 (17.7%)	3.2 (0.59,5.8)	2.1 (0.75,6.06)	0.74
2–5	92 (19.4%)	254 (53.5%)	1	1	
ANC					
Less than 4	39 (8.2%)	93 (19.6%)	1.04 (0.37,1.36)		0.968
4 and above	98 (20.6%)	245 (51.6%)	1		
ROM					
Yes	45 (9.5%)	22 (4.6%)	5.60 (3.22,9.77)	6.2(3.01, 12.8)	< 0.001
No	109 (22.9%)	299 (62.9%)	1	1	
Mode of delivery					
C/S	21 (4.4%)	22 (4.6%)	2.6 (1.13,5.42)	2.4 (1.17,5.2)	0.025

Vaginal delivery Variables	Adverse neonatal outcomes				
	Yes	No	COR95%CI	AOR95%CI	p-value
	116 (24.4%)	316 (66.5%)	1	1	
Labor status					
Induced	14 (2.9%)	10 (2.1%)	3.72 (1.61,8.62)	3.88 (1.14,10.71)	0.009
Spontaneous	123 (25.9%)	328 (69.1%)	1	1	
Pregnancy status					
Un intended	29 (6.1%)	25 (5.3%)	3.3 (1.8,5.58)	1.93(0.93,3.89)	0.078
Intended	108 (22.7%)	313 (65.9%)	1	1	
RH status of the mother					
Positive	20 (4.2%)	31 (6.5%)	1.69 (0.92,3.088)	1.86 (0.88,3.95)	0.103
Negative	117 (24.6%)	307 (64.6%)	1	1	

Discussion

The overall proportion of adverse neonatal outcome in this study was 28.8%. This result was found to be consistent with studies done in East Gojjam(22) and north Wollo(23), 31.7% and 31.8% respectively. Whereas the overall prevalence in this study was found to be higher than a study from Gondar specialized teaching hospital, 23%(24). This might be because the study of Gondar specialized teaching hospital estimate proportions only for stillbirth, preterm birth and LBW, they didn't include other adverse outcomes like APGAR score < 7, NICU admission nor major congenital anomalies.

Waiting at least 24 months before trying to become pregnant after a live birth is highly recommended as it helps to avoid the risk of developing poor neonatal and infant health outcome (25). The finding of this study also supports this recommendation, rates of adverse neonatal outcomes were found to have a significant association with short IPI. This result is also supported by a case-control study from northwest Ethiopia(26) and another cohort study from southern Ethiopia(27). It was also consistent with studies from Sudan and Qatar(14, 28).

This study also revealed that, unintended pregnancy status was significantly associated with adverse neonatal outcomes among mothers with short IPI. This result was consistent with a study done in southern Ethiopia that showed unintended pregnancy status to be associated with risk of adverse neonatal outcomes(29). This is because those mothers with unintended pregnancy status are less likely to seek care from health institutions(30, 31) which might alter maternal use of antenatal care services, subsequent poor labor and delivery care and in adequate neonatal care.

Maternal residence was found significantly associated with adverse neonatal outcomes. In this study rural residents were found more likely to have adverse neonatal outcome than urban residents. This finding was consistent with a report from Nigst Eleni hospital in hosanna(18), North Wollo(23), Gamo Gofa(20) and Mekelle(32) which also showed rural residents to have significantly higher risk of developing adverse neonatal outcomes. This might be due to distance naturally prevents mothers from doing so even if they are knowledgeable of the benefits of antenatal care services but deprives them the opportunity for early identification and management of pregnancy related problems and may further influence their choice of place of delivery and also lack some health services on time. According to this study, presence of premature ROM was also significantly associated with risk of having babies with adverse neonatal outcome. This study was found to be consistent with a study from Gambia, which reported higher risk of developing adverse neonatal outcomes among women who had premature ROM(33) Similarly this result was also consistent with a study from southern Ethiopia, which reported premature ROM to have a significant effect on adverse neonatal outcomes(29) This may be because of the risk of developing infection when the duration of rupture prolongs and a subsequent neonatal sepsis that may alter neonates APGAR score and may also need NICU admission.

Induction of labor was found to have a statistically significant effect on adverse neonatal outcomes in both short and recommended IPI mothers. This result was consistent with a study from suhul shire(21) This might be due to the risk of subsequent fetal distress after labor establishment through induction.

This study also showed that, C/S delivery was associated with higher risk of having adverse neonatal outcomes than vaginal delivery. This result was consistent with study from low and middle income countries(34) that showed delivery through C/S to be associated with adverse neonatal outcomes. This might be due to the fact that mothers for whom C/S done would have fetal distress during labor as an indication for C/S and this subsequently affects the neonatal condition.

Limitation Of The Study

Cross-sectional nature of this study limits to set a causal-effect relationship between dependent and independent variables. Selection bias might be also the limitation of the study.

Mothers who deliver in health centers in Awi zone were not included, due to the lack of some relevant activities such as obstetric ultrasound, to estimate the GA and absence of NICU.

Conclusion

There was significant difference in proportion of adverse neonatal outcomes among short and recommended IPI mothers, 37.1% and 20.6% respectively. Urban residency and vaginal delivery were significantly associated with less risk of adverse neonatal outcomes among mothers in the short IPI groups. Whereas urban residency, intended pregnancy status, spontaneous labor initiation and absence of ROM before labor were reported as a protective for adverse neonatal outcomes in recommended IPI

mothers. Provision of proper health service coverage at rural area and minimizing C/S rate to reduce adverse neonatal outcome is highly recommended.

Abbreviations

ACOG American College of Obstetrics and Gynecology

ANC Antenatal Care

APGAR Appearance Pulse Grimace Activity Respiration

C/S Cesarean Section

CI Confidence Interval

EDHS Ethiopian Demographic Health Survey

GA Gestational Age

IPI Interpregnancy Interval

LBW Low Birth Weight

NICU Neonatal Intensive Care Unit

ROM Rupture of Membrane

USAID United States Agency for International Development

WHO World Health Organization

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the institutional review board of Bahir Dar University.

Formal letter of cooperation was written for public hospitals in Awi Zone, dangla primary hospital, Injibara general hospital, Jawi, Gimjabet and Chagni primary hospitals and permission was obtained. Written consent was obtained from each study participants. Confidentiality of information and privacy was maintained.

Consent for publication: Not applicable

Availability of data and materials: The datasets used and/or analyzed during the current study is available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests.

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Authors' Contribution

JCF conceived and designed the protocol, performed the data collection, contributed for data analysis, wrote the paper and revised the manuscript.

AM, KGW and **TW** participate on the editorial and data entry and analysis. All authors read and approved the final paper.

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 35. Annex I. English version questionnaire.

Supplementary Files

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- [Englishversionquestionnaire.docx](#)