Adverse Birth Outcomes and Associated Factors among Iron-Folic Acid Supplements User and Non-user Women in Public Hospitals, Harari Region, Eastern, Ethiopia: A Comparative Cross-Sectional Study

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Abstract

Background: Iron folic acid supplementation is a routine component of prenatal care that is an effective strategy for preventing adverse birth outcomes. However, its relationship with adverse birth outcomes is poorly understood, particularly in developing countries such as Ethiopia. Therefore, this study aimed to determine adverse birth outcomes and associated factors among iron-folic acid supplement users and non-user women in public hospitals in Eastern Ethiopia.

Methods: A comparative cross-sectional study was conducted on 512 (341 iron folic acid users and 171 non-users) consecutively selected women who gave birth in two public hospitals in Harari region. Data were collected by using interviews and complemented by reviewing medical records. Data was analyzed using the Statistic package for Social Science version 24. Factors associated with adverse birth outcomes were identified using the multivariable binary logistic regression model. A P-value less than 0.05 is taken as a cut-off to determine statistical significance.

Results: The adverse birth outcomes among non-iron folic acid users and users were 53% (95% CI: 45.0, 61.0) and 16% (95% CI: 12.0 20.0), respectively. Oligohydramnios (AOR=5.76; 95%CI: 1.56, 21.25), spontaneous onset of labor (AOR=0.06; 95%CI: 0.04,0.68), and induction of labor (AOR=0.20, 95%CI 0.05-0.90) were adverse birth outcomes among iron folic acid users, whereas anemia (AOR=3.38; 95%CI: 1.43, 7.98), pregnancy-induced hypertension (AOR=4.50; 95%CI: 1.61,12.58), and maternal long working hours (AOR=1.27; 95%CI: 1.07,1.50) were associated with adverse birth outcomes among non- iron folic acid users.

Conclusions: In this study adverse birth outcomes are higher among non-iron folic acid users. Anemia, pregnancy-induced hypertension, and long working hours were significant associations with adverse birth outcomes among non-iron folic acid users. Early screening and treatment of pregnancy-related complications, and health education regarding iron-folic acid supplements during antenatal care should be strengthened.

Keywords: Anemia; Usear: Non user: Folate, Iron, Adverse outcome; Pregnant women

Introduction

Adverse birth outcomes, such as low birth weight, preterm birth, and stillbirth, coupled with neonatal mortality, continue to be major public health issues, particularly in developing countries, like Ethiopia (Ariff *et al*., 2016; Eshete *et al*., 2019). About 2.3 million newborns die worldwide in 2021 (UNICEF, 2023). According to the 2019 Ethiopian Demographic Health Survey (EDHS) in Ethiopia, the neonatal mortality rate in Ethiopia was reported to be 30 per 1000 live births. In the Harari region specifically, the neonatal mortality rate was slightly higher at 37 per 1000 live births. (EDHS, 2019). Pregnancy and birth outcomes are closely related to the mother's nutritional status both before and throughout pregnancy (Lowensohn *et al*., 2016). Iron folic acid (IFA) is a standard component of antenatal care that plays an important role in predicting feto-maternal outcomes (EDHS, 2019). Women who use IFA during pregnancy have a lower risk of medical complications like anemia and adverse birth outcomes. IFA supplementation reduced the incidence of low birth weight by 16% (Christian *et al*., 2003), premature birth by 50%, (Zeng *et al*., 2008) and congenital anomalies by 42%, and neonatal mortality by 70% (Mulatu *et al*., 2017; Malik *et al.,* 2018; Tulu *et al.,* 2019; Iqbal & Ekmekcioglu, 2019; Gedefaw *et al.,*

2020). Preterm birth and low birth weight are the primary causes of neonatal mortality in Ethiopia (Seid *et al*., 2019, Thomas *et al*., 2022, Mengesha *et al*., 2017).

The World Health Organization (WHO) recommended 30-60 mg of iron and 0.4mg of folic acid day during pregnancy to fulfill the increased nutritional requirements of both the fetus and the mother to minimize adverse birth outcomes (WHO, 2016). However, only 41.4% of women adhered to IFA supplementation in Ethiopia (Sendeku *et al.,* 2020) which can increase the risk of adverse birth outcomes (Caniglia *et al*., 2022). Maternal hypertension disorder during the last pregnancy, being anemic, maternal age, the premature rupture of membrane (PROM), and birth interval of less than two years were found to be the main factors associated with adverse outcomes among both iron-folic acid users and non-users (Habib *et al*., 2018, Abadiga *et al*., 2021).

Several studies looked into the association between IFA supplementation during pregnancy and adverse birth outcomes, such as low birth weight or preterm birth (Shi *et al*., 2021; Zenebe *et al*., 2021). Although such studies are valuable for determining targeted interventions, more comprehensive studies addressing multiple adverse outcomes are required, particularly in low-resource settings for targeting specific interventions for each adverse birth outcome. In Ethiopia, only a few studies (Gebregzabiherher *et al*., 2017; Girma *et al*., 2019; Zenebe *et al*., 2021) have been conducted. This study, Therefore, this study aimed to determine the magnitude of adverse birth outcomes and associated factors among IFA users and non-users Women in Public Hospitals, Harari Region, Eastern, Ethiopia: A Comparative Cross-Sectional Study.

Materials and Methods
Study Setting, Design, and Period
An institutional-based comparative cross-sectional study was conducted at two public hospitals in Harari region; Hiwot Fana Specialized Compressive university Hospital (HSCUH) and Jugal General Hospital

from July 19 to September 3, 2021. Harar is found in the eastern part of Ethiopia, 526km from the capital city, Addis Ababa. Hiwot Fana University Specialized Hospital was established in 1928, providing services to Harari regional state and the surrounding population while serving as a teaching hospital for Haramaya University (HFUSH-HR, 2020). Jugal General Hospital was established in 1902 and has inpatient and outpatient services (JUGAL-HMIS, 2020).

Population, Inclusion/ Exclusion Criteria
The source populations were all pregnant women who gave birth in Hiwot Fana Specialized University Hospital and Jugal Hospital during the data collection period. The study population included both IFA supplement users and those who did not use IFA supplements during their current pregnancy. Women who were physically and mentally capable of responding to the questions and singleton deliveries were included in the study. On the other hand, women who took additional micronutrient supplements and who received iron folate as a therapeutic intervention for anemia during pregnancy were excluded.

Sample Size and Sampling Technique
The sample size was calculated with a double population formula using Epi info 7.2 version, considering power 80%, 95% Confidence interval and the ratio of non-users to users 1:2. The proportion of low birth weight from a previous study was 8.3 among IFA users and 1.9 among IFA non users (Gebregzabiherher *et al*., 2017), resulting in a sample size of 512 for this study. The total sample size was proportionally allocated to each hospital based on the expected monthly deliveries. According to the annual report of Hiwot Fana Specialized University Hospital and Jugal Hospital, the average number of births per month in the previous year was 350 and 240, respectively (HFUSH-HR, 2020, JUGAL-HMIS, 2020). Non-users and users were selected based on a 1:2 ratio in each hospital. Finally, a consecutive sampling technique was used to select the study participants (Fig1).
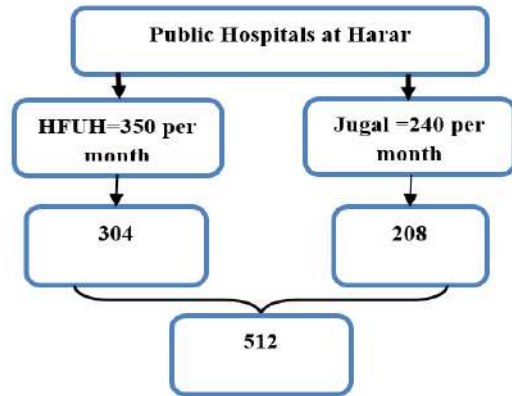
Figure-1: Schematic representation of sampling procedure.

Data Collection Techniques

Data were collected by the following method;

Face-to-face interview; was conducted by four trained midwives using a pretested structured questionnaire. The data collection tools were adapted from EDHS and previous studies (Adane *et al.*, 2014; Abdo *et al*., 2016; Kassahun *et al*., 2019; EDHS, 2019). The questionnaire contained Socio-demographic factors (age, monthly household income, residence, working hours, family size, and educational status), obstetrics history, and pregnancy complication-related factors (parity, gravidity, antenatal care follow-ups, birth interval, on-set of labor, mode of birth, anemia, antepartum hemorrhage, pregnancy-induced hypertension, premature rupture of membrane, polyhydramnios and oligohydramnios), health behavior factors (chat chewing, alcohol and coffee drinking), and nutritional and dietary-related factors (dietary counseling, extra meal)

Maternal chart review; was performed using a checklist containing questions used to assess pregnancy-related complications, neonatal birth outcome, mode of delivery, and labor-related complications.

Operational Definition

Adverse birth outcomes: was reported as "yes" if one or more of the following events was present: macrosomia is newborn birth weight greater than 4kg(ACOG, 2020); low birth weight is birth weight less than 2.5kg and preterm birth is born before 37 completed weeks of gestation(WHO, 2022). Congenital anomaly is an abnormality of body structure and function present at birth (having recorded or vis-

ible defects) (CDC, 2020) and stillbirth is the death of a newborn after 28 weeks of gestation or during labor (CDC, 2022)

Iron folic acid users: women who took greater than or equal to 180 tablets or for a minimum of 6 months plus those who took ≥4 tablets per week and started taking in the early first trimester during index pregnancy (WHO, 2016).

Iron folic acid non-users: Women who did not obtain the minimum needed dose of IFA or did not take iron folic acid at the time of the index pregnancy (WHO, 2016).

Maternal daily work hours were considered as the overall time spent in income-generating activities (Garti *et al.*, 2018).

Long working hours: working for greater than eight hours per day (Stylianou-Riga *et al.,* 2018).

Data Quality Control

The questionnaire was translated into local languages Afaan Oromo and Amharic then translated back to English to confirm consistency before actual data collection. The instruments were developed and modified according to the cultural context after reviewing similar studies; content validity was checked by 6 experts for factors associated with adverse birth outcomes with a content validity index assessed at 86.1% and a minimum requirement cut point of content validity index that assessed by expert is 83%(Polit *et al.,* 2006). Data collectors and supervisors received training on study objectives, appropriate data collection methods, and procedures. The questionnaire was pre-tested on five percent of the total sample size at Haramaya General Hospital and necessary adjustments were made before actual data collection.

Data Processing and Analysis

The collected data were checked manually for completeness, and consistency and then coded using a template prepared for this study. Data were entered using EPI data version 3.1 and exported to Statistical Package for Social Sciences (SPSS) 24.0 for further analysis. Chi-square and Fisher's exact tests were used for categorical variables. Data were presented with mean and standard deviation. Binary logistic regression analysis was carried out to find the association between each independent variable and adverse birth outcomes; then the variables with a p-value less

than 0.25 were considered for multivariable logistic regressions. In multivariable logistic regression analysis the variables with P-value <0.05 at a 95% confidence interval (CI) were declared statistical significance factors.

Ethical Consideration
Ethical clearance was obtained from Haramaya University College of Health and Medical Sciences Institutional Health Research Ethical Review Committee, with reference number (IHRERC/106/2021) and official support and permission letters were obtained from the two hospitals. Data were collected after getting voluntary consent for both interview and medical records review from each study participant; for those aged less than 18 years, oral and formal consent was obtained from their respective family or husband.

Information from women and medical records was kept confidential, and data were collected anonymously.

Results
Socio-Demographic Characteristics of Participants
A total of 512 women (341 IFA- users versus 171 non-users) were included in the study. The mean age among IFA users and non-users was 26.75±4.92 and 26.23± 4.78 years, respectively. Most of the IFA-users were urban dwellers compared to non-users (55 versus 37 %). The mean reported income among users was 4743.84 birr (SD+3476.4) and 3810.41 birr Ethiopian Birr (ETB) (SD+3392.2) among non-users. Approximately half of the non-IFA users had no formal education compared to IFA users (48 versus 23%) (Table 1).

Table 1: Socio-demographic characteristics of iron folic acid user and non-user women who gave birth in public hospitals in Harari region, Eastern Ethiopia, 2021 (n=512)

Variables		Iron folic acid	
		User (n=341) No (%)	Non user (n=171) No (%)
Residence	Urban	189 (55.4)	63 (36.8)
	Rural	152 (44.6)	108 (63.2)
Maternal educational status	Unable to read and write	77 (22.6)	82 (48)
	Read and write	5 (1.5)	2 (1.2)
	Primary school	130 (38.1)	57(33.3)
	Secondary school	69 (20.2)	19 (11.1)
	Collage and above	60 (17.6)	11(6.4)
Maternal occupation	Governmental employee	40 (11.7)	3 (1.8)
	Private employee	49 (14.4)	19 (11.1)
	Merchant	45 (13.2)	18 (10.5)
	Housewife	172 (50.4)	93 (54.4)
	Farmer	35 (10.3)	38 (22.2)
Husband educational status	Unable to read and write	71(20.8)	54 (31.6)
	Read and write	4 (1.2)	0 (0)
	Primary school	78 (22.9)	48 (28.1)
	Secondary school	91(26.7)	33 (41.4)
	Collage and above	97 (28.4)	36 (21.1)
Husband occupation	Governmental employee	72 (21.1)	19 (11.1)
	private employee	52 (15.2)	16 (9.4)
	Merchant	63 (18.5)	26 (15.2)
	Daily laborer	25 (7.3)	17 (9.9)
	Farmer	129 (37.8)	93 (54.4)
Daily maternal work hours	≤8hrs	242 (71)	128 (72.3)
	>8hrs	99 (29)	43 (25.1)

Obstetrics history and pregnancy-related complication
ANC was used by 100% of IFA users against 49% of non-users. More than three-quarters (78%) of IFA users reported an intended pregnancy compared to 68% of non-users.

In terms of pregnancy-related complications, almost one-fourth (22%) of non-IFA users reported anemia during pregnancy, compared to 2.3% of IFA users. Non-IFA users reported higher antepartum hemorrhage than le IFA users

reported. Pregnancy-induced hypertension was found in 10.0 and 16% of IFA users and non-users, respectively. The mean gravidity for women who use iron folic acid is 2.92 (SD: 1.95), while for non-users it is 3.37 (SD: 2.22). The mean birth interval in years is 2.72 (SD: 1.76) for women who use iron folic acid, and 2.04 (SD: 1.43) for non-users. Additionally, the mean duration of labor in hours is 10.61 (SD: 5.05) for women who use iron folic acid, and 10.46 (SD: 4.34) for non-users. (Table 2).

Table 2: Obstetrics and pregnancy-related complications among Iron folic acid user and non-user women who gave birth in public hospitals in Harari region, Eastern Ethiopia, 2021(n=512)

Variables		Iron folic acid	
		User (n=341) N (%)	Non user (n=171) N (%)
Pregnancy planned	Yes	267 (78.3)	116 (67.8)
	No	74 (21.7)	55 (32.2)
Parity	Primipara	106 (31.1)	46 (26.9)
	Multipara	235 (68.9)	125 (73.1)
ANC	Yes	341(100)	83 (48.5)
	No	0 (0)	88 (51.5)
MUAC	< 23	114 (33.4)	89 (52)
	≥23	227 (66.6)	82 (48)
Extra rest	Yes	111(32.6)	29 (17)
	No	230 (67.4)	142 (83)
Self-ordered medication During1st trimester	Yes	2 (0.6)	3 (1.8)
	No	339 (99.4)	168 (98.2)
Antepartum hemorrhage	Yes	19 (5.6)	21(12.3)
	No	322 (94.4)	150 (87.7)
Pregnancy induced hypertension	Yes	34 (10)	28 (16.4)
	No	307 (90)	143 (83.6)
Premature rupture of membrane	Yes	53 (15.5)	31(18.1)
	No	288 (84.5)	140 (81.9)
Oligohydramnios	Yes	17 (5)	12 (7)
	No	324 (95)	159 (93)
Polyhydramnios	Yes	8 (2.3)	10 (5.8)
	No	333 (97.7)	161(94.2)
Anemia	Yes	8 (2.3)	38 (22.2)
	No	333 (97.7)	133 (77.8)
Onset of labor	Spontaneous	245 (71.8)	126 (73.7)
	Induced	77 (22.6)	40 (23.4)
Mode of birth	Elective CS	19 (5.6)	5 (2.9)
	SVD	168 (49.3)	96 (56.1)
	Vacuum	22 (6.5)	8 (4.7)
	Forceps	6 (1.8)	6 (3.5)
	CS	145 (42.5)	61(35.7)
History of adverse birth outcome	Yes	29 (8.5)	13 (7.6)
	No	312 (91.5)	158 (92.4)

Health behaviors and nutritional-related characteristics
Alcohol consumption during pregnancy was higher among IFA users (6.2%) and non-users (3.5%). Coffee drinking was higher among IFA users (80%) than non-users (75%). However, chat chewing is higher among IFA non-users (52%) than users (35%).

The magnitude of mothers who received dietary counseling was higher among IFA users (73%) than non-users (45%). During pregnancy, 33% of IFA users consumed an extra meal or snack, whereas only 22% of non-users consumed an extra meal or snack (Table 3).

Table 3: Health Behavioral and nutritional related factors among Iron folic acid user and non-user women who gave birth in public hospitals in Harari region, Eastern Ethiopia, 2021(n=512)

Variables		Iron folic acid	
		User N (%)	Non-user N (%)
Alcohol drinking	Yes	21(6.2)	6 (3.5)
	No	320 (93.8)	165 (96.5)
Coffee drinking	Yes	271(79.5)	129 (75.4)
	No	70 (20.5)	42 (24.6)
How often drink coffee	Many times a day	134 (49.4)	68 (52.7)
	Daily	58 (21.4)	20 (15.5)
	Weekly	26 (9.6)	11(8.5)
	Occasionally	53 (19.6)	30 (23.3)
Chat chewing	Yes	118 (34.6)	88 (51.5)
	No	223 (65.4)	83 (48.5)
Dietary counseling	Yes	248 (72.7)	37 (21.6)
	No	93 (27.3)	134 (78.4)
Extra meal	Yes	111(32.6)	38 (22.2)
	No	230 (67.4)	133 (77.8)

Adverse birth outcomes among IFA users and non-users

The overall magnitude of adverse birth outcomes was 28 % (95% CI: 20.0, 37.5). The adverse birth outcomes among non-iron folic acid users and users were 53% (95% CI: 45.0, 61.0) and 16% (95% CI: 12.0 20.0), respectively (P< 0.001).

The magnitude of adverse birth outcomes, such as low birth weight, preterm, and stillbirth, were significantly higher among non-IFA users than users (P<0.05). The congenital anomaly was detected only among non-users of IFA (Table 4).

Table 4: Adverse birth outcome based on maternal iron folate utilization in public hospitals in Harari region, Eastern Ethiopia, 2021(n=512)

Variables		Iron Folic acid	
		User N (%)	Non-user N (%)
Low birth weight	Yes	5(1.5)	58(33.9)
	No	336(98.5)	113(66.1)
Macrosomia	Yes	35(10.5)	9(5.3)
	No	306(89.7)	162(94.7)
Congenital anomalies	Yes	0	13(7.6)
	No	341(100)	158(92.4)
Preterm	Yes	2(0.6)	37(21.6)
	No	339(99.4)	134(78.4)
Stillbirth	Yes	17(5)	28(16.4)
	No	324(95)	143(83.6)

Factors associated with adverse birth outcome among iron folate users

In bivariate analysis maternal age, birth interval, PROM, oligohydramnios, onset of labor, and mode of birth were factors to be included in multivariate analysis among IFA users. In multivariate analysis, the onset of labor and the presence of oligohydramnios were factors identified to be associated with adverse birth outcomes among IFA users (P<0.05).

Spontaneous onset of labor (AOR= 0.06; 95% CI: 0.04, 0.68) and induction of labor (AOR=0.20; 95%CI: 0.05, 0.90) were found to be protective against adverse birth outcomes compared to elective cesarean birth. The odds of adverse birth outcomes were approximately six times (AOR=5.76: 95%CI; 1.56, 21.25) higher among women who developed oligohydramnios compared to those without this complication (Table 5).

Table 5: Factors associated with adverse birth outcomes among IFA users' women who gave birth in public hospitals in Harari region, Eastern Ethiopia, 2021(n=341)

Variables		Adverse birth outcome		COR(95% CI)	P-values	AOR(95% CI)
		Yes	No			
Maternal age (in years)		28.39 (4.6)	26.44 (4.9)	1.09 (0.99, 1.20)	0.24	1.07 (0.99, 1.17)
Birth interval (in years)		2.59 (1.2)	2.75 (1.9)	0.79 (0.58, 1.08)	0.23	0.86 (0.67, 1.11)
Dietary counseling	Yes	43 (17.3)	205 (82.7)	1.91(0.65, 5.59)	0.21	2.52 (0.98, 6.48)
	No	11 (11.8)	82 (88.2)	1		1
PROM	Yes	6 (11.3)	47 (88.7)	0.36 (0.10, 1.28)	0.32	0.451(0.13, 1.53)
	No	48 (16.7)	240 (83.3)	1		1
Oligohydramnios	Yes	7 (41.2)	10 (58.8)	6.44 (1.56, 26.63)	0.001	5.76 (1.56, 21.25)*
	No	47(14.5)	277 (85.5)	1		1
Onset of labor	Spontaneous	28 (11.4)	217 (88.6)	0.17(0.04, 0.77)	0.03	0.06 (0.04, 0.68)*
	Induced	16 (20.8)	61 (79.2)	0.17(0.03, 0.89)	0.00	0.20 (0.05, 0.90)*
	Elective CS	10 (52.6)	9 (47.7)	1		1
Mode of birth	SVD	19 (11.3)	149 (88.7)	0.61(0.26, 1.45)	0.01	0.57 (0.26, 1.25)
	Vacuum	1 (4.5)	21(95.5)	0.12 (0.01, 0.26)	0.05	0.11(0.01, 1.07)
	Forceps	2 (33.3)	4 (66.7)	4.25 (0.42, 42.87)	0.51	3.57 (0.41, 31.18)
	Cesarean	32 (22.1)	113 (77.9)	1		1

*SVD: Spontaneous Vaginal Delivery, CS: Cesarean section, COR: Crude Odds Ratio: AOR, Adjusted Odds Ratio: CI, Confidence Interval: PROM: premature rapture of membrane, * P<=0.05.*

Factors associated with adverse birth outcome among iron folate users

In bivariate analysis, pregnancy-induced hypertension, anemia, daily maternal working hours, sex of newborn, and mode of birth were factors to be included in multivariate analysis. Pregnancy-induced hypertension, anemia, and long working hours factors were identified to be associated with adverse birth outcomes (P<0.05). Women who developed pregnancy-induced hypertension were nearly five times more

(AOR=4.50, 95%CI; 1.61, 12.58) likely to experience adverse birth outcomes compared to those without pregnancy-induced hypertension. The odds of adverse birth outcomes were three times (AOR=3.38; 95%CI: 1.43, 7.98) higher among women who experienced anemia during pregnancy compared to those who did not. Working long hours during pregnancy was also marginally associated with adverse birth outcomes among non-IFA users (AOR=1.27; 95%CI: 1.07, 1.50) (Table 6).

Table 6: Factors associated with adverse birth outcomes among non-IFA users' women who gave birth in public hospitals in Harari region, Eastern Ethiopia, 2021 (n=171)

Variables		Adverse birth outcomes		COR (95% CI)	P-values	AOR (95% CI)
		Yes	No			
Pregnancy-induced hypertension	Yes	22 (78.6)	6(21.4)	24.40 (3.74-159.13)	0.003	4.50 (1.61, 12.58)*
	No	69 (48.3)	74 (51.7)	1		1
Anemia	Yes	26 (68.4)	12 (31.6)	13.36 (2.07, 86.35)	0.03	3.38 (1.43, 7.98)*
	No	65 (48.9)	68 (51.1)	1		1
Daily maternal working hours	>8hrs	26 (60.5)	17 (39.5)	1.23 (0.90, 1.67)	0.27	1.27 (1.07, 1.50)*
	≤8hrs	65 (50.8)	63 (49.2)	1		1
Sex of newborn	Male	48 (58.5)	34 (41.5)	1.75 (0.72, 4.23)	0.18	1.69 (0.86, 3.30)
	Female	43(48.3)	46 (51.7)	1		1
Mode of birth	SVD	58 (60.4)	38 (39.6)	2.05 (1.01 4.15)	0.029	1.67 (0.82, 3.42)
	Vacuum	3 (37.5)	5 (62.5)	1.36 (0.15, 12.45)	0.78	0.63 (0.13, 3.01)
	Forceps	4 (66.7)	2 (33.3)	0.4 (0.02, 7.03)	0.25	2 (0.31, 13.03)
	CS	26 (42.6)	35 (57.4)	1		1

*SVD: Spontaneous Vaginal Delivery, CS: Cesarean section, COR: Crude Odds Ratio: AOR, Adjusted Odds Ratio: CI, Confidence Interval: PROM: Premature Rapture of Membrane, * P<=0.05.*

Discussion

The overall magnitude of adverse birth outcomes was 28 % in the study, which is comparable with findings from other parts of Ethiopia, such as Gonder (23%) (Adane *et al*., 2014), Hosanna (24.5%) (Abdo *et al*., 2016), and North Wollo (31.8%) (Kassahun *et al*., 2019). However, our finding was higher than the study conducted in Hawasa (18.3%) (Tsegaye and Kassa, 2018). The possible reasons for the observed discrepancies might be due to differences in the study area and population in this study population category as IFA and non-IFA users.

In this study, the magnitude of adverse birth outcomes was significantly higher among IFA non-users (53%) as compared to users (16%). Adverse birth outcomes such as low birth weight were considerably greater among non-IFA users. This finding has been supported by a systematic review and meta-analysis studies conducted in Ethiopia (Zenebe *et al*. 2021) and China (Shi *et al*., 2021). The current study was conducted in referral hospitals where complicated cases were referred from nearby health centers. Furthermore, due to the COVID-19 outbreak, most of the less complicated births (normal cases) were recommended to be handled in health centers, increasing mainly the number of complicated births in referral hospitals.

The finding suggested that among non-IFA users, working more than eight hours per day marginally increased the likelihood of bad delivery outcomes, which is consistent with prior studies (Cai.*et al*., 2019; Stylianou-Riga *et al*., 2018). Women who are working long hours might experience physical and psychological stress which increases the risk of hypertensive disorders and threatened preterm labor (Zhao *et al*., 2014, Kim *et al*., 2014, Hassan *et al*., 2016, Suzumori *et al.,* 2020).

In the current study, The odds of adverse birth outcomes are higher among non-IFA users women with pregnancy-induced hypertension This finding is in agreement with the studies conducted in Gonder (Adane *et al*., 2014), North West Ethiopia (Adane and Dachew, 2018), and Southern Ethiopia (Lolaso *et al.,* 2019). Pregnancy-induced hypertension is also associated with disruption of adequate blood flow to the fetus, increasing various feto-maternal complications such as preterm and low birth weight (Mammaro *et al.,* 2009).

In this study, women with anemia were more likely to experience adverse birth outcomes among non-IFA user. This is consistent with findings reported in the studies conducted in Western Ethiopia (Abadiga *et al.,* 2021), Woliat Sodo (Lake and Olana Fite, 2019), Jima (Yeshialem *et al*., 2019), and India (Nair *et al*., 2016). Anemia causes a stress reaction in the mother and fetus by increasing corticotrophin-releasing hormone or cortisol levels, resulting in preterm labor and restricted fetal growth (Tomashek *et al*., 2006).

This study's findings indicated that women who experienced oligohydramnios during pregnancy had a higher odds of adverse birth outcomes among IFA-users, which is corroborated by studies conducted in Iran(Alijah *et al.,* 2014) and India (Undela *et al.*, 2022). One possible explanation is that oligohydramnios might cause the infant to be delivered with significant abnormalities, such as underdeveloped lungs. This is because amniotic fluid is essential for lung development and increases the risk of miscarriage or stillbirth (Shumway *et al*., 1999, Molla *et al.*, 2023).

This study indicates that the spontaneous onset of labor was found to be protective against adverse birth outcomes among IFA users. This finding is similar to another study conducted in Ethiopia (Senanayake *et al.,* 2022). Spontaneous onset of labor causes rising cortisol and supports lung maturation and other organs and these may help in the reduction of some adverse birth outcomes (Hillman *et al*., 2012). In line with prior research, this study also indicated that IFA users with induced not likely to have adverse birth outcomes like stillbirth, a newborn death, or other serious problems (Grobman, 2018, Grobman *et al*., 2019).

This study used a large sample size to produce a complete report on adverse birth outcomes and associated variables based on maternal IFA usage. As an institution-based study, reaching study participants proved difficult, particularly during COVID-19 outbreaks. The cross-sectional nature of the study was also not possible to determine the temporal link between independent variables and adverse birth outcomes. Furthermore, IFA usage and several related factors were examined exclusively based on mothers' self-reports, which may impose recollection bias.

Conclusion

The magnitude of adverse birth outcomes was significantly higher among non-iron folic acid users women than and users. Adverse birth outcomes, such as low birth weight, preterm, and stillbirth, were significantly higher among non-IFA users. Pregnancy-related complications, such as pregnancy-induced hypertension, anemia, and working long hours were found to increase the risks of adverse birth outcomes among non-IFA users. Therefore, it is important to identify and intervene in pregnancy-related complica-

tions such as anemia and pregnancy-induced hypertension, particularly during ANC visits. Maternal counseling regarding the effects of maternal workload on pregnancy and promoting on importance of utilization and adherence to IFA should be conducted during an ANC visit. A community-based longitudinal study should be carried out to determine the true relationship between IFA use and adverse birth outcomes.

Competing Interests
The authors declare that they have no competing interests.

Authors' Contributions
EL designed the study, collected, analyzed, interpreted data, and drafted the manuscript. KT, TW, AK, and TB participated in the conceptualization of the study design, analysis, and interpretation of results and in reviewing the drafted manuscript. TA, MT HM GZ, and BY participated in the analysis, and interpretation of results and drafting and reviewing the manuscript.

List of abbreviations
ANC: Antenatal Care, AOR: Adjusted Odds Ratio, CI: Confidence Interval, COR: Crude Odds Ratio, CSA: Central Statistical Agency, Hgb: Hemoglobin, IFAS: Iron- Folic acid supplements, WHO: World Health Organization.

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