

**INTERPREGNANCY INTERVAL AND PREGNANCY
OUTCOMES AMONG POSTPARTUM MOTHERS: FACILITY
BASED CROSS SECTIONAL STUDY**

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Abstract

Back ground

Non optimal (short or long) interpregnancy interval is one of common modifiable obstetric factors which is associated with multiple maternal, obstetric and fetal adverse outcomes such as preeclampsia, 3rd trimester bleeding, anemia, preterm delivery, low birth weight, small for gestational age and low APGAR score. There are few studies in our set up which assess interpregnancy interval and bad pregnancy outcomes. The aim of this study is to assess the prevalence of interpregnancy intervals (long and short) and to determine association of non-optimal (short and long) interpregnancy interval and bad pregnancy outcomes (maternal & obstetric and fetal) among postnatal mothers at St. Paul's Hospital Millennium Medical College.

Methods

Facility based cross sectional analytic study was utilized from March 1-June 30, 2021. Convenient sampling technique was used to enroll 394 postnatal mothers who delivered at SPHMMC. Data was collected using an interview and chart review by a structured pretested questionnaire. Univariate descriptive analysis was presented with frequency and percentage table, bivariate and multivariate analysis was done to assess association of non-optimal interpregnancy and composite bad maternal/obstetric and fetal outcomes. Composite fetal outcome is dichotomized as bad (if "Yes" to any of the following: SGA, LBW, Preterm delivery, low APGAR score and NICU admission) and good (if "No" to all of the above mentioned outcomes). Maternal and obstetric composite outcome is dichotomized as bad (if "Yes" to one of the following: hypertensive disorders of pregnancy, PROM, APH, Anemia or uterine dehiscence/rupture) or good (if "No" to all of the above components). AOR with 95% CI is measured to show association between independent variables and dependent variable with strength of association to be significant when p-value is <0.05

Results

Prevalence of short and long interpregnancy (IPI) interval is 41.9% and 9.4% respectively. Those mothers with short IPI are found to have a 77% higher likelihood of a bad composite maternal pregnancy outcome compared to mothers with optimal IPI [AOR 1.77, 95%CI (1.106-2.832)]. Mothers with long IPI have 2.9 times likelihood of having bad composite neonatal outcome compared with mothers with optimal IPI [AOR 2.89, 95%CI (1.350-6.208), p-value=0.06].

Conclusion

Short interpregnancy interval is significantly associated with bad composite maternal and obstetric outcomes compared to optimal interpregnancy interval. However, it is not significantly associated with composite bad neonatal outcome except small for SGA. On the other hand, long interpregnancy interval is associated with bad composite neonatal outcome but not with composite neonatal outcome.

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Lists of abbreviation

A.A- Addis Ababa

ACOG- American College of Obstetricians and Gynecologists

APH- Antepartum hemorrhage

BMI- Body mass index

CI- Confidence interval

CKD- Chronic kidney disease

DM- Diabetes mellitus

EGOPD- Emergency Gynecology Outpatient Department

IPI- Interpregnancy interval

LGA- Large for gestational age

LW- Labor ward

NICU- Neonatal intensive care unit

OR- Odds ratio

PROM- Premature rupture of membrane

RR- Relative risk

SGA- Small for gestational age

SIPI- Short interpregnancy interval

SPHMMC- St. Paul Hospital and Millennium Medical College

TOLAC - Trial of labor after Cesarean Section

WHO- World Health Organ

1 Introduction

Interpregnancy interval (IPI) is the time between the end of last pregnancy and conception of current pregnancy irrespective of outcome of last pregnancy (1-4). World Health Organization (WHO) recommends the optimal interpregnancy interval to be 2-5 years to optimize pregnancy outcomes (5). Non optimal (long or short) interpregnancy intervals are associated with obstetric complications such as preterm delivery(6), low birth weight(6, 7), small for gestational age (SGA), stillbirth, poor APGAR score, neonatal intensive care unit (NICU) admission(8). It also increases the risk of maternal and obstetric complications including hypertensive disorders of pregnancy (HDP) (9), antepartum hemorrhage (APH), anemia (10), premature rupture of membrane (PROM) (11) and uterine dehiscence/rupture(12, 13). It is one of modifiable factors which, if intervened, decrease the maternal and fetal mortality by 30% and 10% respectively (5).

Internationally, there are few studies done to assess both maternal and fetal effects of interpregnancy interval on bad pregnancy outcomes comprehensively. In Ethiopia, most studies done are community level based retrospective studies which are liable for recall bias.

The aim of this study is to assess the prevalence of interpregnancy intervals (long and short) and to determine association of non-optimal (short and long) interpregnancy interval and bad pregnancy outcomes (maternal &obstetric and fetal) among postnatal mothers at St. Paul's Hospital Millennium Medical College.

2 Methods

Study area, period, design and population

This study was done in the delivery unit (labor ward, EGOPD and recovery room) of Saint Paul's Hospital and Millennium Medical College (SPHMMC), A.A Ethiopia from March 1- June 30, 2021. SPHMMC is found in the northern part of the capital city (Addis Ababa). It's one of the largest tertiary hospitals in Ethiopia which receives referral from several catchment hospitals & health centers in the city and surrounding Oromia region. On average, there are more than 900 deliveries per month (14).

Facility based quantitative cross sectional analytic study was utilized. All postpartum mother who delivered at SPHMMC were used as source population. While all postpartum mothers who fulfill inclusion criteria during data collection were studied

Inclusion criteria: All postpartum mothers who gave birth at the institution within 24hrs of delivery during data collection.

Exclusion criteria: Primigravida, multiple gestation, lethal congenital anomaly which is detected antepartum or immediate postpartum.

Sample size determination: Pilot study was done in 39 postnatal mothers with the same questionnaire, in the same setting to calculate the proportion of women with composite bad maternal and obstetric pregnancy outcome with short interpregnancy interval, which is found to be 46.1%. Using single proportion formula, sample size was calculated with the following assumption:

- 95% confidence interval
- 5% non-response rate
- 5% precision

Considering the non-response rate of 5%, the final sample size was 401.

Data was collected using structured pretested questionnaires. Questionnaire consists of sociodemographic factors, obstetric profile, acute maternal and fetal adverse pregnancy outcomes and chronic medical illnesses and social risk factors.

Questionnaire was prepared in English and four BSc midwives who can speak Amharic and Afaan Oromoo fluently were trained for 1day on data collection processes and questionnaires. Data was collected on day and duty activities until the required number of

samples was achieved. Pretesting and pilot study was done on 10% of total sample size which is 40 postpartum women of which 1 questionnaire discarded because of lack of complete data. Hence analysis was done on 39 samples. These mothers in pilot study were not included in final analysis of the research. Supervision was done daily on phone calls and weekly on face to face by the principal investigator.

Operational definitions

Interpregnancy interval- the time duration from the end of last pregnancy and the conception of current pregnancy. It is calculated by adding inter-delivery interval and duration of gestation in months.

Short interpregnancy interval – Interpregnancy interval less than 24months

Optimal interpregnancy interval – Interpregnancy interval of 24-59months

Long interpregnancy interval- Interpregnancy interval more than or equal to 60months

Composite bad neonatal outcome- presence of one or more of: LBW, SGA, preterm delivery, low APGAR score or stillbirth

Composite bad maternal and obstetric outcome- presence of one or more of: hypertensive disorders of pregnancy (gestational HTN, preeclampsia/eclampsia), PROM, APH, anemia (Hb<11 mg/dl) or uterine dehiscence/rupture.

Independent variables- Interpregnancy interval, Sociodemographic factors, Obstetric profiles (past and current), non-obstetric medical disorders and social risk factors.

Dependent variables- Composite bad obstetric outcome, composite bad neonatal outcomes, each components of composite outcome.

Data processing and statistical analysis

Collected data were checked for completeness and entered into IBM SPSS software (IBM Corp, released 2021) for Windows version 26. Data were inspected for errors and missing data, coded and analyzed using the same software.

Frequency and percentages were used for categorical variables and mean with standard deviation calculated for continuous variables for univariate analysis.

Each component of composite outcomes were labeled “Yes” or “No”. Maternal and Obstetric composite outcome was dichotomized as bad or good. The composite outcome will be labelled ‘bad’ if “Yes” to any of the following: hypertensive disorders of pregnancy,

premature rupture of membrane, antepartum hemorrhage, maternal anemia prior to delivery and uterine dehiscence /rupture. The composite outcome was labelled “good” if all the above were answered “No”

Similarly, each component of fetal outcome was labelled “Yes” or “No”. Composite fetal outcome was dichotomized as “bad” or “good”. The composite outcome was labelled “bad” if any “Yes” to any of following: preterm delivery, small for gestational age, low birth weight, low, low APGAR score, neonatal intensive care unit admission or stillbirth. It was labelled “good” if “No” to all of the above mentioned outcome.

The association between composite bad maternal and obstetric outcome, composite bad fetal outcome and independent variables were assessed by binary logistic regression. Odds ratio with 95% confidence interval was used to measure strength of association between independent and dependent variables. Bivariate logistic regression model was performed to measure crude association between independent and dependent variables. Independent variables with P-value <0.25 were transferred to multivariate binary logistic regression in stepwise selection backward (Wall) method to eliminate confounders. The association is declared to be significant when p-value <0.05 and strength of association is measured in adjusted Odds ratio (AOR). Model fitting was checked with Goodness of fit, Hosmer and Lemeshow Test and Omnibus Tests of Model Coefficients.

Ethical consideration

Ethical clearance was secured from the Institutional Review Board (IRB) of SPHMMC. Written informed consent was taken from each participant during the interview and chart review of data collection. Confidentiality of participants was kept well and the name of the participant was not used in the questionnaire.

3 Results

3.1 Sociodemographic characteristics

A total of 401 postnatal mothers were interviewed and their chart reviewed making 100% response rate. Seven were excluded because of lack of essential data making the total sample analyzed 394. As can be seen from **Table 1**, majority of mothers were in the age range of 24 - 34years (70.1%) with mean age of 28.5 ± 4.934 . The minimum age is 18 and maximum is 42 years of age. Majority 383 (97.2%) of mothers are currently married.

table 1-Sociodemographic characteristic of postnatal mothers at SPHMMC, A.A, Ethiopia, 2021 (n=394)

Characteristics	Classification	Number	Percentage
Age in years	24-34	276	70.1
	<24	55	14.0
	≥ 35	63	16.0
Marital status	Married	383	97.2
	Divorced	7	1.8
	Separated	2	0.5
	Widowed	2	0.5
Religion	Orthodox	165	41.9
	Muslims	168	42.6
	Protestant	55	14.0
	Wakeffata	4	1.0
	Others	2	0.5%
Education status	Couldn't read and write	55	14.0
	Primary School	148	37.6
	Secondary School	109	27.7
	College and	82	20.8
	University		
Occupation	House Wife	266	67.5
	Farmer	5	1.3
	Employee	66	16.8
	Merchant	49	12.4
	Others	8	2.0
Place of residence	Urban	363	92.1
	Rural	31	7.9
Income category	<10,000EB	333	84.5
	$\geq 10,000$ EB	61	15.5

Most of them are Muslims and Orthodox Christian in religion, 168(42.6%) and 165(41.9%) respectively. Majority 363 (92.1%) of them are urban residents and attended formal school

(86.04%). Two hundred sixty six (67.5%) are house wife and 333(84.5%) get total monthly income <10,000 EB. The average income is 5518.9 ±5,292.2.EB

3.2 Present obstetric profile

As can be observed from **Table 2**, majority 348 (87.8%) of mothers are multiparous. Mean parity is 2.51±1.03. Minimum parity is 1 and maximum parity is 6. Most of the pregnancy is planned with an unplanned pregnancy rate of 15% and 90.1% of the participants said their pregnancy is wanted during the interview. Majority (85.5%) of mothers have the same husband from the last pregnancy while 14.5% of them changed their partner for the current pregnancy.

Table 2-Current Obstetric characteristics of postnatal mothers in SPHMMC, A.A, Ethiopia in 2021 (n=394

Characteristics	Classification	Number	Percentage
Parity	Primiparous	48	12.2
	Multiparous	346	87.8
Pregnancy intention	Planned	335	85.0
	Unplanned	59	15.0
Pregnancy type	Wanted	355	90.1
	Unwanted	39	9.9
Partner change for current Pregnancy	Yes	57	14.5
	No	337	85.5
Gestational age at delivery in wks	<37	64	16.2
	37-41 ^{6/7}	302	76.6
	≥42	28	7.1
ANC follow up?	Yes	390	99.0
	No	4	1.0
Timing of initial ANC visit	First Trimester	174	44.2
	Second Trimester	189	48.0
	Third Trimester	27	6.9
Number of ANC visit	≥4	329	83.5
	0-3	65	16.5
Iron/folic acid supplementation	Yes	360	91.4
	No	34	8.6
Duration of supplementation	≥3months	267	67.8
	<3months	127	32.2

Preterm (<37wks), term (37-41^{6/7}wks) and post term (≥42wks) deliveries were 16.2%, 76.6% and 7.1% respectively. Almost all (99%) of them have ANC follow up at least once and majority of them attended 4 or more ANC visits (83.5%) while four (1%) mothers have no

ANC follow up at all. Three hundred and sixty (91.4%) took iron and /or folic acid during ANC visits and about 2/3 (67.8%) of them took the supplementation for at least 3months

3.3 Past obstetric profile, chronic medical illnesses and social risk factors

While majority [310(78.7%)] of mothers delivered live birth the last pregnancy, there are 61(15.5%), 22(5.6%) and 1(0.3%) women with last pregnancy outcome of abortion, still birth and ectopic pregnancy respectively. More than 2/3 (70.6%) of them were delivered by SVD with spontaneous onset of labor (68.5%) and 107 (27.4%) women underwent CS for their last delivery. Sixty six (16.8%) of mothers experienced one of the following obstetric complication during their last delivery or abortion: Hypertensive disorders of pregnancy (HDP) (9.6%), premature rupture of membrane (4.6%), antepartum hemorrhage (3.3%) and combination of the above obstetric condition in 1 (0.3%) of cases. Thirty three of women (8.4%) have an existing medical disorder(s) before conception of current pregnancy. Chronic hypertension is the most common medical disorder(s) identified (2.5%) followed by pregestational DM (2.3%), HIV (1.3%), chronic kidney diseases (CKD) and others 1.8%. Majority (83.5%) of mothers drink coffee and few mothers drink alcohol (11.7%), smoke cigarettes (2%) and chew Khat (1.8%) during the current pregnancy (See **Table 3**).

Table 3-Past obstetric profile, chronic medical illness and social factors in postnatal mothers in SPHMMC, A.A, Ethiopia, 2021 (n=394)

Characteristics	Classification	Frequency	Percentages
Last pregnancy outcome	Live birth	310	78.7
	Stillbirth	22	5.6
	Abortion	61	15.5
	Ectopic	1	0.3
Mode of delivery of previous	SVD	278	70.6
	CS	108	27.4
	Instrumental	7	1.8
	Laparotomy	1	0.3
Onset of labor of previous	Spontaneous	270	68.5
	Induced	90	22.8
	Labor doesn't start	34	8.6
Previous pregnancy complication	Yes	66	16.8
	No	328	83.2
Pregnancy complication	HDP	38	9.6
	PROM	18	4.6
	Third Trimester bleeding (APH)	13	3.3
	Combinations of above	1	0.3
Previous chronic medical illness	Hypertension	10	2.5
	Pregestational Diabetes Mellitus	9	2.3
	HIV	5	1.3
	Chronic Kidney Disease	2	0.5
	Others	7	1.8
	Total	33	8.4
Drinking coffee	No drinking habit	65	16.5
	Drinking habit	329	83.5
Smoking	Non-smoker	386	98.0
	Smoker	8	2.0
Khat chewing	Non Khat chewer	387	98.2
	Khat Chewer	7	1.8
Alcohol drinking	Not drinking	348	88.3
	Drinking	46	11.7

3.4 Interpregnancy interval and pregnancy outcomes

As shown on **Table 4**, of 394 mothers, 181 (45.9%) have an optimal interpregnancy interval (24-59months) while 48(12.2%) have a long interpregnancy interval. Hundred and 65

(41.9%) of women have short interpregnancy interval among which 7.6% ,12.4%,12.4% and 9.4% have interpregnancy interval of 18-24 months,12-17 months, 6-11 months and <6months respectively .

Table 4-Interpregnancy interval in postnatal mother in SPHMMC, A.A, Ethiopia, 2021 (n=394)

Characteristics	Classification	Sub classification	Frequency	Percentage
Interpregnancy interval	Optimal		181	45.9
	Short		165	41.9
		18-24 months	30	7.6
		12-17 months	49	12.4
		6-11 months	49	12.4
		<6months	37	9.4
	Long		48	12.2

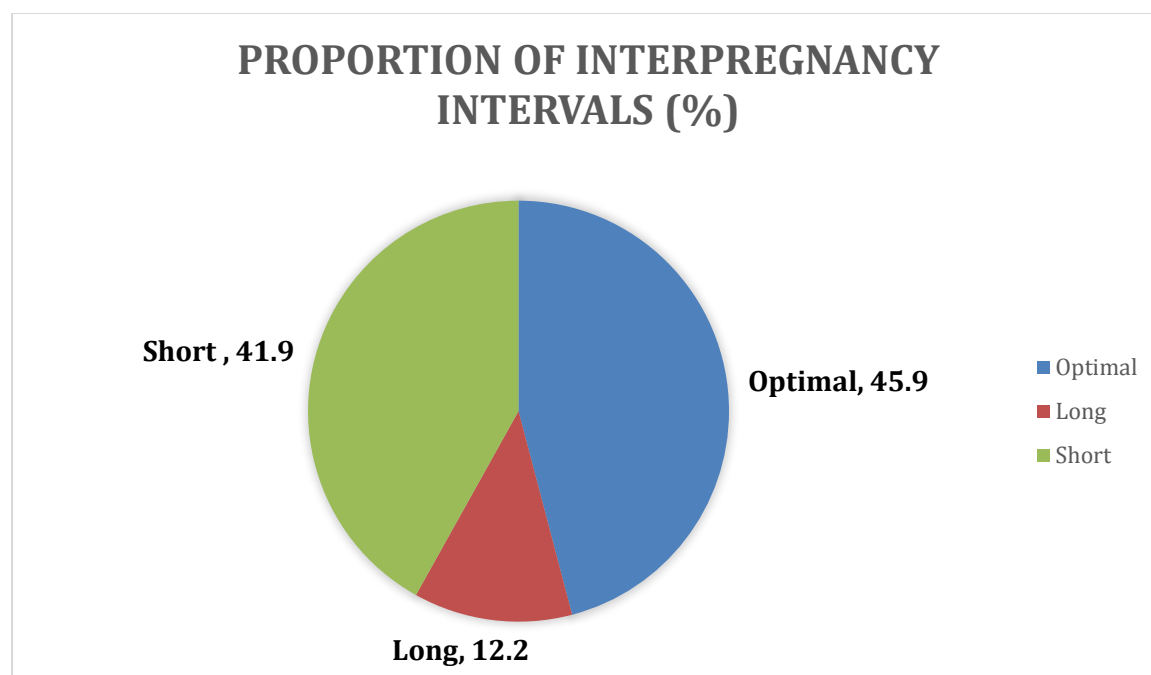


Figure 1-Pie chart showing distribution of interpregnancy interval in postnatal mothers in SPHMMC, A.A, Ethiopia, in 2021 (n=394)

The mean for interpregnancy interval (IPI) is 31.4±26.4 months. Minimum IPI is 1month and the maximum IPI is 229.57months. The mean IPI varies with last pregnancy outcomes. It is 18.1 months in mothers in last pregnancy outcome of abortion, 34.1 months in still birth and 31.7 months in live birth group.

3.4.1 Bad maternal and obstetric pregnancy outcomes

As shown on **Table 5** and **Figure 2**, among 394 mothers, 169 experienced one or a combination of the bad maternal and obstetric outcome making prevalence of 42.9%. Of these, 94 (23.9%) hypertensive disorders of pregnancy (HDP) which is the most common bad obstetric outcomes observed in the study, followed by PROM (12.7%), APH(7.1%) and uterine dehiscence or rupture (only 3 (0.8%)) cases. Only 18 (4.6%) mothers have anemia (Hb level<11 mg/dl) before delivery which is the only maternal bad outcome measured in this study.

Table 5-Maternal and fetal bad obstetric outcome of postnatal mothers at SPHMMC, A.A, Ethiopia, in 2021 (n=394)

	Complication	Frequency /394	Percentages
Maternal	HDP	94	23.9
	PROM	50	12.7
	APH	28	7.1
	Anemia prior to delivery	18	4.6
	Uterine dehiscence	3	0.8
	Composite	169	42.9
Neonatal	Low birth weight	70	17.8
	Preterm delivery	64	16.2
	Small for gestational age	59	15.0
	NICU admission	57	14.5
	Low APGAR Score (<7)	24	6.1
	Still birth	13	3.3
	Composite	138	35.0

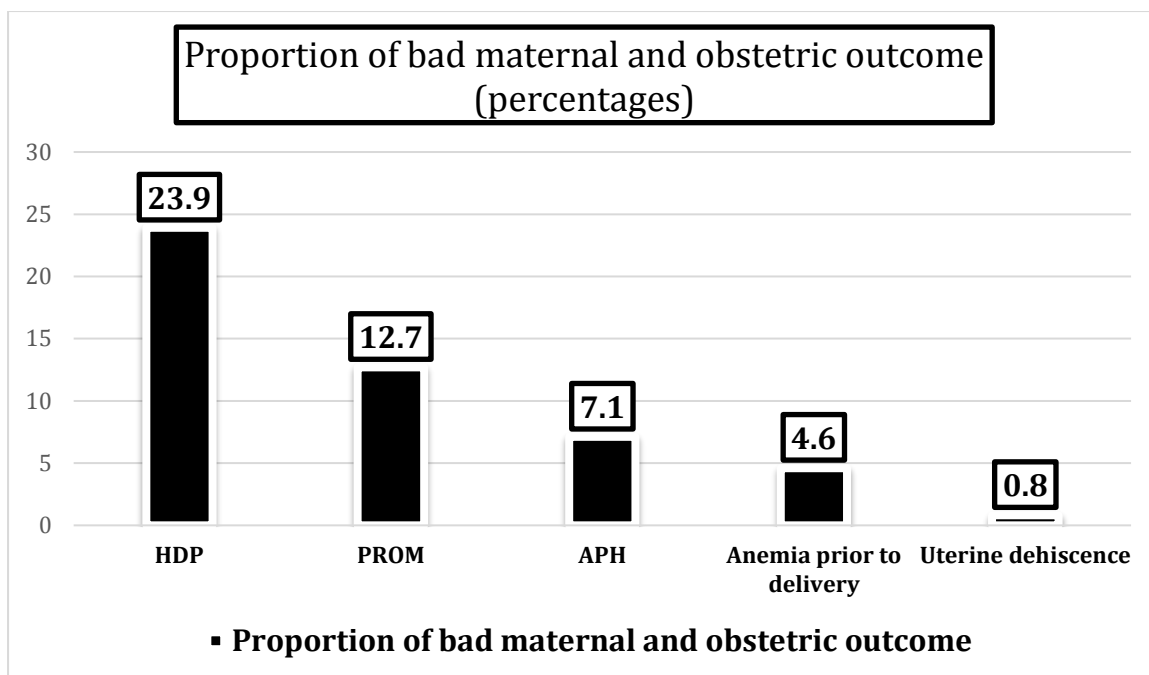


Figure 2 Bar chart showing proportion of bad maternal and obstetric pregnancy outcomes among postnatal mothers at SPHMMC, A.A, in 2021 (n=394)

3.4.2 Bad Fetal pregnancy outcome

In this study, a total of 138 neonates developed one or more of the bad neonatal outcomes, making the prevalence of composite prevalence rate of 35.0%. This includes LBW (17.8%), SGA (15.0%), NICU admission (14.5%), low APGAR score (6.1%) and stillbirth (3.3%) (Shown on **Figure 3** and **Table 5**)

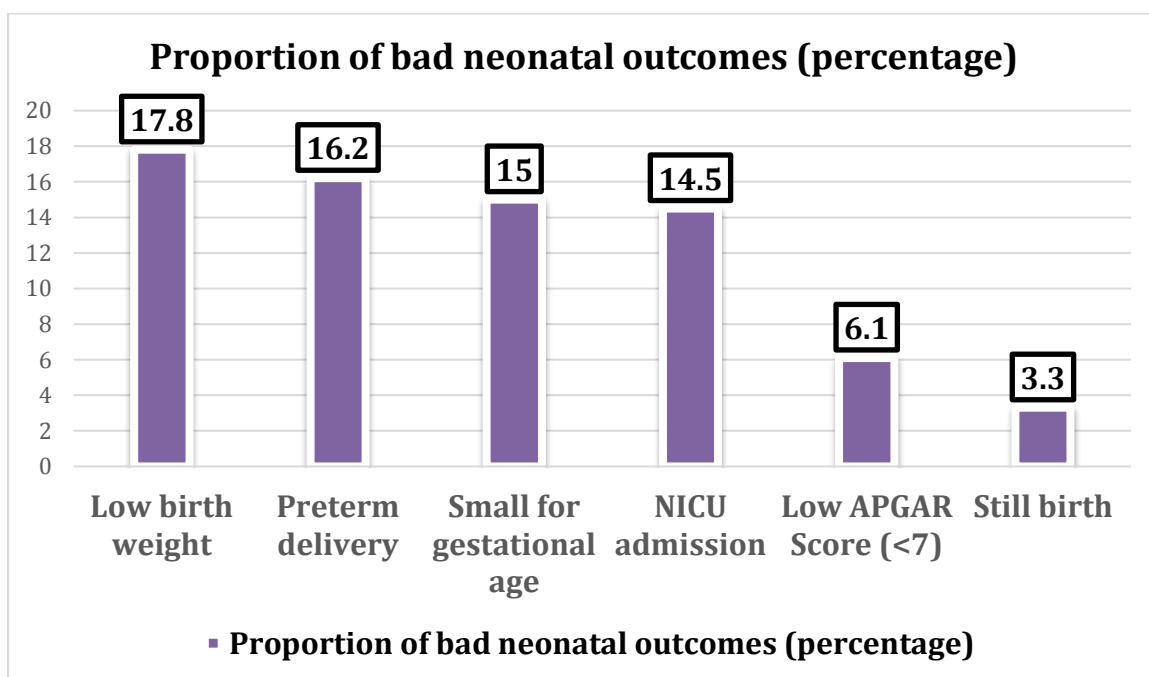


Figure 3-Bar chart showing proportion of bad neonatal outcomes among postnatal mothers at SPHMMC, A.A, in 2021 (n=394)

3.5 Interpregnancy interval and pregnancy outcome

3.5.1 Association of Interpregnancy interval and maternal & obstetric outcomes

As we can see **Table 6**-from ----, mothers with short interpregnancy interval have at least twice likelihood of having composite maternal & obstetric bad pregnancy outcome compared to mothers with optimal interpregnancy interval [COR 2.19, 95%CI (1.423-3.381) with p-value of 0.0004]. However, there is no significant association between women with long interpregnancy interval compared to optimal interpregnancy interval

Table 6-Bivariate analysis assessing factors associated with composite maternal and obstetric among postnatal mothers who delivered at SPHMMC, A.A, Ethiopia (n=394)

Factors	Classification	Composite maternal and obstetric outcome		COR (95%CI)	P-value
		Good	Bad		
Age in years	<35	194	137	1	0.168
	≥35	31	32	1.46 (.852-2.509)	
Place of residency	Urban	215	10	1	0.005
	Rural	148	21	3.05(1.396-6.666)	
Income	>10,000EB	30	31	1	0.175
	<10,000EB	195	138	0.67 (0.3961.184)	
Educational status	Formal school	203	136	1	0.007*
	No formal school	22	33	2.24(1.252-4.005)	
Parity	Primiparous	21	27	1	0.048*
	Multiparous	204	142	0.54 (0.294-0.996)	
Number of ANC follow up	≥4	199	26	1	0.003*
	<4	130	29	2.296(1.334-3.953)	
Iron/Folic acid supplementation	≥3months	160	107	1	0.1020
	<3Months	65	62	1.426(0.932-2.183)	
Last pregnancy outcomes	Live birth	195	115	1	0.0000*
	Non live birth	30	54	3.052(1.847-5.044)	
Previous pregnancy complication	No	199	126	1	0.0020*
	Yes	26	40	2.373(1.381-4.077)	
Interpregnancy interval	Optimal	118	63	1	0.0004*
	Short	76	89	2.193(1.423-3.381)	
	Long	31	17	1.027(0.528-1.027)	

* P-value <0.05 (statistically significant)

Multivariate binary logistic regression analysis showed that mothers with short interpregnancy interval have 77% higher likely to experience one or more of bad maternal and

obstetric outcomes when compared with women with optimal interpregnancy interval [AOR 1.77, 95%CI (1.10-2.83)] with P-value of 0.017. However, the mothers with long interpregnancy interval have similar composite maternal and obstetric outcomes with their optimal interpregnancy interval counterpart [AOR 1.02, 95%CI (0.05-2.05)]

Table 7-Multivariate analysis assessing factors associated with composite maternal and obstetric among postnatal mothers who delivered at SPHMMC, A.A, Ethiopia (n=394)

Factors	Classification	Composite maternal and obstetric outcome		COR (95%CI)	AOR(95%CI)	P-value
		Good	Bad			
Age in years	<35	194	137	1	1	0.124
	≥35	31	32	1.46 (.852-2.509)	1.594(0.880-2.885)	
Place of residency	Urban	215	10	1	2.738(1.184-6.331)	0.018*
	Rural	148	21	3.05(1.396-6.666)		
Income	>10,000EB	30	31	1	1	0.215
	<10,000EB	195	138	0.67 (0.3961.184)	0.688(0.381-1.242)	
Educational status	Formal school	203	136	1	1	0.220
	No formal school	22	33	2.24(1.252-4.005)	1.516(0.779-2.948)	
Parity	Primiparous	21	27	1	1	0.524
	Multiparous	204	142	0.54 (0.294-0.996)	1.331(0.553-3.203)	
Number of ANC follow up	≥4	199	26	1	1	0.010*
	<4	130	29	2.296(1.334-3.953)	2.144(1.203-3.821)	
Iron/Folic acid supplementation	≥3months	160	107	1	1	0.508
	<3Months	65	62	1.426(0.932-2.183)	1.174(0.730-1.888)	
Last pregnancy outcomes	Live birth	195	115	1	1	0.0003*
	Non live birth	30	54	3.052(1.847-5.044)	2.738(1.60-4.70)	
Previous pregnancy complication	No	199	126	1	2.65(1.50-4.70)	0.001*
	Yes	26	40	2.373(1.381-4.077)		
Interpregnancy interval	Optimal	118	63	1	1	0.017*
	Short	76	89	2.193(1.423-3.381)	1.770(1.106-2.832)	
	Long	31	17	1.027(0.528-1.027)	1.018(0.505-2.052)	

* P-value <0.05 (statistically significant)

As depicted in **Table 8**, further subgroup analysis of composite maternal and obstetric outcome showed women with short interpregnancy interval have 1.6 fold increased chance of

experiencing hypertensive disorders of pregnancy (HDP) in comparison with optimal interpregnancy interval. However, it is not statistically significant [AOR 1.66, 95%CI (0.98-2.81)]. There is positive association between short interpregnancy interval and APH, PROM and maternal anemia but associations are not statistically significant. Association between short interpregnancy interval and uterine dehiscence is difficult to interpret because of small number of mothers with the condition (only 3 cases seen) in the study. However, there is no significant difference of bad maternal & obstetric outcomes between mothers with long interpregnancy interval and mothers with optimal interpregnancy interval.

Table 8-Adjusted Odds ratio of each bad maternal and obstetric outcomes with interpregnancy interval at SPHMMC, A.A, Ethiopia, 2021 (n=349)

Outcome variable	Interpregnancy interval	AOR [¥] (95%CI)	P-value
	Optimum	1	
HDP	Short	1.6589(0.976- 2.817)	0.062
	Long	1.735(0.818-3.680)	0.151
	Optimum	1	
PROM	Short	1.299 (0.647-2.607)	0.462
	Long	0.746(0.239-2.329)	0.615
	Optimum	1	
APH	Short	1.894(0.766-4.686)	0.167
	Long	0.693(0.13-3.485)	0.656
	Optimum	1	
Anemia	Short	1.516(0.446-5.153)	0.505
	Long	0 .	0.997

Key- ¥-Odd's ratio is adjusted for relevant sociodemographic factors, current & past obstetric risk factors, maternal medical disorders, social and behavioral risk factors

Abbreviation

- HDP-Hypertensive disorders of pregnancy
- PROM- Premature rupture of membrane
- APH- Antepartum hemorrhage

3.5.2 Association between interpregnancy interval and composite neonatal outcome

As depicted in **Table 9**, bivariate binary logistic regression analysis done to asses association between interpregnancy interval and composite neonatal outcome showed that mothers with long interpregnancy interval have almost two times likelihood of experiencing composite bad

neonatal outcomes in subsequent pregnancy when compared to women with optimal interpregnancy interval [COR1.98(1.03-3.82) with p-value of 0.004. Similarly women with short interpregnancy interval have 1.7 times the odds of having composite bad neonatal outcomes when compared with their optimal interpregnancy interval counterparts [COR 1.70, 95%CI (1.084-2.63) with p-value of 0.02.

Table 9- Bivariate analysis showing factors associated with bad composite neonatal outcomes, SPHMMC, A.A, Ethiopia, 2021 (n=394)

Factors	Classification	Composite neonatal outcome		COR (95% CI)	P-value
		Good	Bad		
Place of residency	Urban	246	117	1	0.00021*
	Rural	10	21	4.42(2.015-9.68)	
Education status	Formal school	229	110	1	0.009*
	No formal school	27	28	2.16(1.21-3.84)	
Number of ANC follow up	≥4	228	101	1	0.0001*
	<4	28	37	2.983(1.73-5.14)	
Iron/Folic acid supplementation	≥3months	179	88	1	0.213
	<3months	77	50	1.32(0.85-2.05)	
Last pregnancy outcomes	Live birth	211	99	1	0.014*
	Non live birth	45	39	1.85(1.13-3.02)	
Partner change	No	214	123	1	0.139
	Yes	42	15	0.621(0.331-1.167)	
Previous pregnancy complication	No	221	107	1	0.027*
	Yes	35	31	1.829(1.071-3.126)	
HDP	No HDP	211	89	1	0.00009*
	HDP	45	49	2.582(1.606-4.149)	
APH	No APH	243	123	1	0.037*
	APH	13	15	2.280 (1.05-4.942)	
PROM	No PROM	230	114	1	0.042*
	PROM	26	24	1.862(1.024-3.388)	
Route of delivery	SVD	160	76	1	0.152
	Operative	96	62	1.360(0.893-2.070)	
Interpregnancy interval	Optimal	130	51	1	0.021*
	Short	99	66	1.699(1.084-2.663)	
	Long	27	21	1.983(1.029-3.820)	

* P-value <0.05 (statistically significant)

Abbreviation

ANC- antenatal care

HDP- hypertensive disorders of pregnancy

PROM- premature of membrane

APH- antepartum hemorrhage

SVD- spontaneous vaginal delivery

As shown in **Table 10-**, multivariate analysis showed there is no statistically significant difference in likelihood of composite bad neonatal outcome in mothers with short interpregnancy interval when compared with mother with optimal interpregnancy interval [AOR 1.31, 95%CI (0.79-2.18)] with p-value of 0.299.

Table 10-Multivariate analysis of factors affecting bad composite neonatal outcomes among postnatal mothers at SPHMMC, A.A, Ethiopia, 2021(n=394)

Factors	Classification	Composite neonatal outcome		COR (95%CI)	AOR (95%CI)	P-value
		Good	Bad			
Place of residency	Urban	246	117	1	1	
Education status	Rural	10	21	4.42(2.015-9.68)	3.762(1.608-8.799)	0.002*
	Formal school	229	110	1	1	
	No formal school	27	28	2.16(1.21-3.84)	1.365(0.678-2.748)	0.384
Number of ANC follow up	≥4	228	101	1	1	
	<4	28	37	2.983(1.73-5.14)	2.735(1.520-4.922)	0.001*
Iron/Folic acid supplementation	≥3months	179	88	1	1	
	<3months	77	50	1.32(0.85-2.05)	1.050(0.635-1.736)	0.848
Last pregnancy outcomes	Live birth	211	99	1	1	
	Non live birth	45	39	1.85(1.13-3.02)	1.733(1.009-2.976)	0.046*
Partner change	No	214	123	1	1	
	Yes	42	15	0.621(0.331-1.167)	0.459(0.232-0.908)	0.025*
Previous pregnancy complication	No	221	107	1	1	
	Yes	35	31	1.829(1.071-3.126)	1.697(0.950-3.030)	0.074
HDP	No HDP	211	89	1	1	
	HDP	45	49	2.582(1.606-4.149)	2.539(1.513-4.259)	0.000416*
APH	No APH	243	123	1	1	
	APH	13	15	2.280 (1.05-4.942)	1.813(0.753-4.366)	0.185
PROM	No PROM	230	114	1	1	
	PROM	26	24	1.862(1.024-3.388)	2.013(1.037-3.907)	0.039*
Route of delivery	SVD	160	76	1	1	
	Operative	96	62	1.360(0.893-2.070)	1.311(0.805-2.138)	0.277
Interpregnancy interval	Optimal	130	51	1	1	
	Short	99	66	1.699(1.084-2.663)	1.310(0.787-2.180)	0.299
	Long	27	21	1.983(1.029-3.820)	2.895(1.350-6.208)	0.006*

* - shows P-value <0.05 (statistically significant)

However, women with long interpregnancy interval have 2.9 likelihood of having bad composite neonatal outcome compared with mothers with optimal interpregnancy interval [AOR 2.89, 95%CI (1.350-6.208), p-value=0.06].

As we can see from **Table 11**, subgroup analysis to assess association between each components of composite bad neonatal outcomes and interpregnancy interval further showed that: compared to optimal interpregnancy interval, mothers with short interpregnancy interval have higher risk of getting SGA and low 5th minute APGAR score with [AOR 2.59, 95% CI (1.29-5.18), p-value=0.007] and [AOR 4.40, 95% CI (1.38-14.22), p-value=0.013] respectively. Similarly women with long interpregnancy interval have higher risk of having LBW and SGA compared to their optimal interpregnancy interval counterpart [AOR 4.35, 95% CI (1.29-5.18), p-value=0.004] and [AOR 3.80, 95% CI (1.55-9.301), p-value=0.003] respectively. There is no significant different in incidence of preterm delivery and NICU admission among women all three interpregnancy intervals

Table 11-Multivariate analysis showing association between interpregnancy interval and each component of bad composite neonatal outcomes

	Interpregnancy interval	AOR[‡] (95%CI)	P-value
Preterm	Optimal	1	
	Short	1.100(0.550-2.200)	0.789
	Long	1.061(0.3613.117)	0.915
LBW	Optimal	1	
	Short	2.054(0.9774.319)	0.058
	Long	4.353(1.609-11.775)	0.004*
SGA	Optimal	1	
	Short	2.588(1.293-5.183)	0.007*
	Long	3.803 (1.554-9.305)	0.003*
NICU admission	Optimal	1	
	Short	1.457 (0.715-2.970)	0.300
	Long	0.605(0.146-2.502)	0.488
Low APGAR	Optimal	1	
	Short	4.425(1.376-14.225)	0.013*
	Long	3.827(0.850-17.230)	0.08

Key

‡ - Odd's ratio is adjusted for relevant sociodemographic factors, current & past obstetric risk factors, maternal medical conditions , social and behavioral risk factors.

* **P-value <0.05 (statistically significant)**

3.6 Other factors significantly associated with bad pregnancy outcomes

3.6.1 Maternal and obstetric outcomes and associated factors

As shown in **Table 7**, mothers with previous non live birth (still birth or abortion) have 2.7 times higher in getting composite maternal outcome when compared with women who had live birth in last pregnancy [AOR 2.73, 95% CI (1.6-4.7), p-value=0.0003]. With the same token, mothers with previous obstetric complication had experienced higher likelihood of having bad composite maternal and obstetric outcomes in comparison with women who didn't have complication [AOR 2.65, 95% CI (1.50-4.70), P-value=0.001]. Similarly, women who live in rural areas have higher odds of having bad maternal and obstetric outcomes than women living in urban areas [AOR 2.74, 95%CI (1.12-6.33), p-value=0.018]. Mothers with ANC visits less than 4 times during current pregnancy have higher Odds of getting bad maternal and obstetric outcomes than mothers with more than 4 visits of ANC [AOR 2.14, 95%CI (1.20-3.82, p-value=0.01].

3.6.2 Neonatal outcomes and associated factors

As we can see from **Table 10**, mothers who live in rural areas have a higher likelihood of having composite bad neonatal outcomes compared to mothers who live in urban areas [AOR 3.76, 95%CI (1.61-8.89), p-value=0.002]. Women with less frequent ANC follow up (<4 visits) have a 2.7 times higher chance of having composite bad neonatal outcomes compared with women with more visits [AOR 2.74, 95% CI (1.52-4.92), p-value=0.001]. Mothers who had previous non live birth in their last pregnancy have 73.3% higher chance of having current composite bad neonatal outcome compared to women with live birth in the last pregnancy [AOR 1.73, 95% CI(1.01-2.93), p-value=0.046]. Women with no partner change for conception of current pregnancy have 54% higher chance of experiencing bad neonatal outcomes compared to women who changed their partner for current pregnancy conception [AOR 0.46 , 95% CI (0.23-0.91), p-value=0.025]. Women with HDP have a 2.5 times higher chance of having one of bad pregnancy outcomes compared to women with no HDP [AOR 2.54, 95% CI (1.51-4.26), p-value=0.0004]. Similarly mothers with PROM have a 2 fold increased chance of having one of bad neonatal outcomes when compared to women with no PROM (AOR 2.01, 95% CI (1.04-3.91), p-value=0.039]

4 Discussion

The prevalence of short interpregnancy interval is 41.9%. The finding of this study is similar to the study done in Debreberhan town (15) but lower in Nigeria(16, 17). This difference can be explained by sociodemographic and cultural differences between the two countries. The prevalence of long interpregnancy interval is 12.2% in this study, which is higher than finding of study done in France which 7.2%(18). This can be explained by the period of study (2000-2017) because there is increased trends interpregnancy interval length worldwide now days(19). However, it is lower than finding in Norway which is 24.5%(20). This difference is probably as result of high difference in sociodemographic variation between the two setup. In addition to that, their study's cut off value for long interpregnancy interval is 49months which definitely exaggerates the prevalence.

Mothers who have a short interpregnancy interval have 77% higher risk of having maternal adverse outcomes than mothers with optimal interpregnancy interval. This is mainly because of increased risk of hypertensive disorders of pregnancy including preeclampsia in this study. This finding goes with the finding in Bangladesh (21), and cross country cohort study in Latin America (22). This is in contrast to systematic review done by Gabriela et al which showed there is no significant association between short interpregnancy interval and preeclampsia (12).

Women with short interpregnancy intervals have 2.5 times higher likelihood of having small for gestational age compared with women with optimal interpregnancy interval. This finding is similar to findings in the USA(23, 24), Brazil (25), Australia (26), Canada (27) and China (28). This is thought to be as a result of maternal nutritional depletion, new pregnancy stress and hormonal imbalance in short interpregnancy intervals. This is in contrary to study done in Swedish registry which showed there is no as such strong association between the two after multiple confounding factors held constant(29). Mothers with Short IPI have a 4 fold increased chance of having a baby with a low 5th minute APGAR score. This is similar to a study done by Lilungulu et al in Tanzania(11). However, there is a high chance that it is confounded by SGA and LBW (other neonatal outcomes in this study) since these neonates have lower APGAR score. Thus; it is difficult to conclude that mere presence of a short interpregnancy interval increases the chance of having a low 5th minute APGAR score.

Mothers with long interpregnancy interval have a higher chance of having composite neonatal adverse outcomes compared to their optimal interpregnancy interval. At sub group

level, this association is because of significant strong association between long interpregnancy interval and both SGA & LBW. This finding agrees with the finding done in Brazil(25),China (28)and New Zealand(30). These mothers also have a low 5th minute APGAR score compared to optimal interpregnancy interval counterparts. This is probably as result of higher cases of both LBW and SGA in this category of mothers (since IUGR and LBW lower APGAR score than normal birth weight babies).

Unlike other several studies (12, 31, 32), there is no statistically significant association between composite maternal and obstetric outcomes such as hypertensive disorders of pregnancy and long interpregnancy interval in this study. This may be explained by the low number of mothers with long interpregnancy interval in this study (only 48).

Finally there are many factors associated strongly with both bad neonatal and maternal outcomes in addition to interpregnancy interval. This included living in rural area, having previous obstetric complications, delivering non non-live birth baby in a previous pregnancy and having a lower number of ANC visits during the current pregnancy.

4.1 Strength of the study

This is the first study to assess the association of interpregnancy interval and bad pregnancy outcomes in our set up. It tried to incorporate maternal, obstetric and neonatal outcomes together. It uses the primary information from mother and chart review just within 24hrs of delivery hence decreases recall bias.

4.2 Limitation of study

Since it is cross-sectional in nature, it only shows association but it can't tell exactly which variable is the cause and which one is an effect. There are multiple confounding factors that can affect the outcome variables such as obesity and other obstetric conditions that were not measured in this study.

It also assessed only immediate outcomes; therefore, late outcomes such as early neonatal death, infant morbidity & mortality were not assessed by the study. Some outcome variables are small in number that makes it difficult to assess the association with independent variables. E.g stillbirth and uterine dehiscence.

Since data was collected in a referral facility, it can't be generalized to the whole country.

5 Conclusion and recommendation

Conclusion

In summary, more than half (54.1%) postnatal mothers have non optimal interpregnancy, which is associated with higher likelihood of bad pregnancy outcomes compared with optimal interpregnancy interval. Mothers with short interpregnancy interval have higher likelihood of hypertensive disorder of pregnancy, SGA and low APGAR score while mothers with long interpregnancy interval have higher likelihood of LBW and SGA compared to mothers with optimal interpregnancy interval

Recommendations

With this high prevalence of non-optimal interpregnancy interval in general and short interpregnancy interval in particular, we recommend health institution and care provider to emphasis on contraception counselling and provision to optimize interpregnancy interval.

Further analytic studies with larger sample size are recommended to be done to assess causal relationship between interpregnancy interval and each components of our composite outcomes.

6 Annexes

6.1 Annex- 1 Conceptual framework

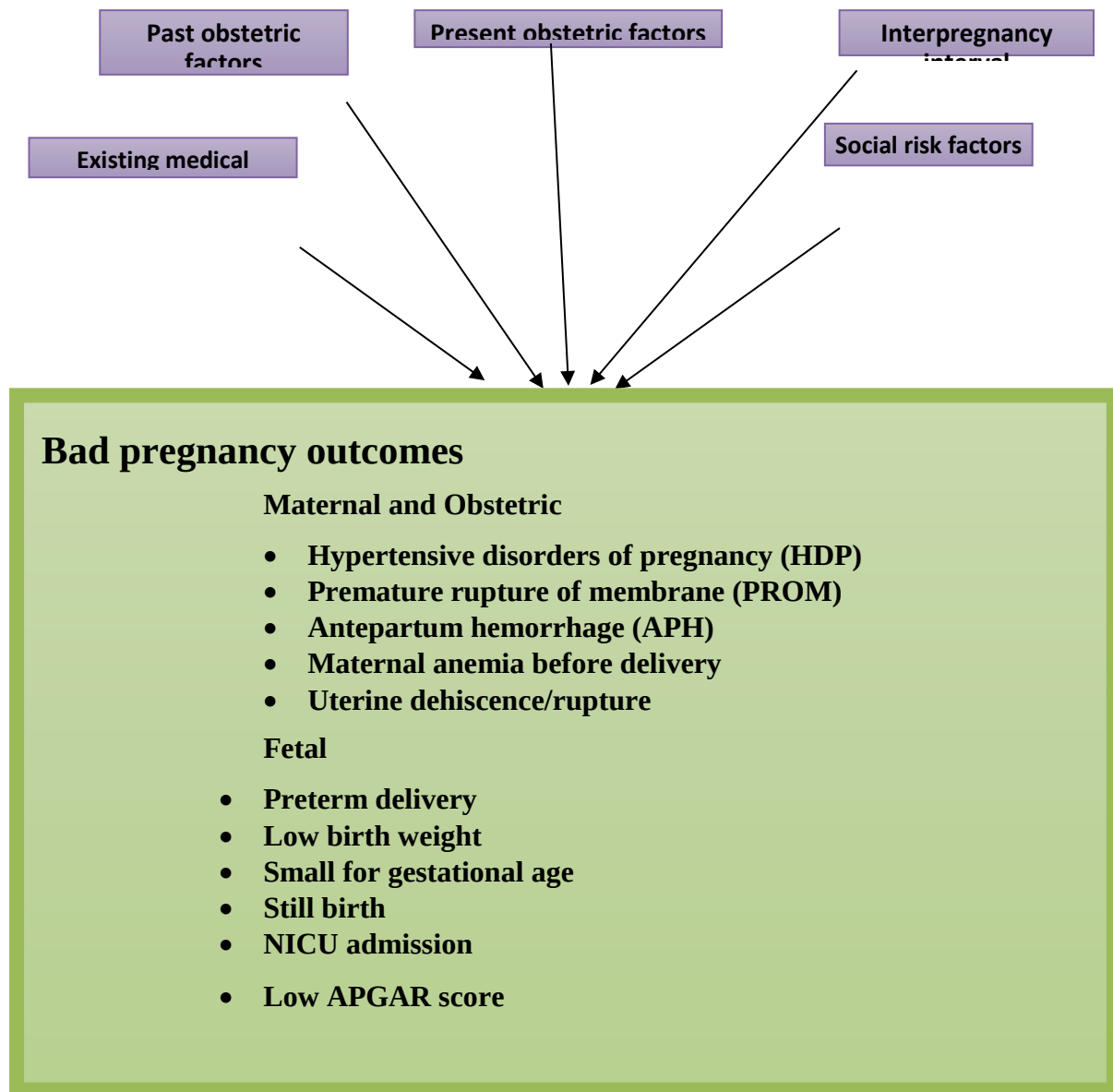


Figure 4 –conceptual framework showing the factors affecting bad pregnancy outcomes including Interpregnancy interval

6.2 Annex -2 Consent form and Introduction

I'm Dr. Workineh Idesa OBGYN final year resident at SPHMMC and I want to study the effects of short interpregnancy interval on pregnancy outcomes. To achieve this I ask you a few questions about you and your pregnancy and review your medical chart. You can ask questions or explanations in between or decline to be asked. Information you will be giving will be kept secret and you don't need to give your name. There is no financial benefit you get in participating in the study nor does it affect your treatment if you decline.

I Agree----- I don't agree-----

ስሜ ዶ/ር ወርቅነህ ኢዴሳ ይባላል፡ የመጨረሻ ዓመት የማህፀንና ፅንሰ ከፔሻሊቲ ተማሪ ነኝ። ቶሎ ቶሎ ማርግዝ ና ታያያዝ ጉዳዮችን በተመለከተ ጥናት ለማድረግ ነው። ስለሆነም፡ ፍቃደኛ ከሆኑ ጥያቄዎች ለጠየቅና የርሱን የህክምና መዝገብን አያላሁ። ማንኛውም ጊዜ ጥያቄ መጠየቅ፣ ጥያቄና መልሱ ማቋረጥ ይችላሉ። የትሰጡት መረጃ ምስጢርነቱ የተጠበቀ ነው። ስለዝህ፣ ስም መናገር አያስፈልግም። በጥናቱ ተሳትፎ ምክንያት የምያገኙት ገንዘብ ወይም ቁሳዊ ጥቅም የለም።

ተስማምቻለሁ----- አልተስማማውም-----

Maqaan koo Dr. Warqinaa Iddeessaan jedhama. Barataa Ispeeshalitii Ulfaa fi Gadameessaa waggaa xumuraati. Qorannoo kiiyya waay'ee rakkinoota ulfa walitti siqsanii ulfaa'uudhaan dhufan adeemsisuufin jedha. Kanaafuu qorannichaaf filatamtaniittu. Yoo fedhii keessan ta'e, gaaffiiwwan waay'ee keessanii fi ulfa keessan waliin wal qabatun isin gaafadha. Akkasumas galmee fayyaa keessan nan fayyadama. Gidduutti gaaffii kamiyyuu gaafachuu fi adda kutuufn mirga keessani. Odeeffannoo isin kennitan haala kamuu keessatti icciitiinsaa eegamadha. Kanaafis maqaa keessan himuun hin barbaachisu.. Hirmannaa keessaniif faayidaan maallaqaa addaa argattan hin jiru. Yoo eeyyemamoo taatan itti walii galuu keessan mirkaneessaa.

Eeyyee ----- Lakki-----

6.3 Annexes 3 - Interview questionnaire

S.No	Questions and filters	Categories	Skip pattern
I. I. Sociodemographic factors			
1.	MRN		
2.	What is your age?		
3.	What is your marital status?	1. Married 2. Separated 3. Divorced 4. Widowed	
4.	What is your Religion?	1. Orthodox Christian 2. Muslim 3. Protestant 4. Wakeffata 5. Others _____	
6.	What is your estimated total family income in birr?	_____	
7.	What is your educational status?	1. Couldn't read and write 2. Primary school 3. Secondary school 4. University and college	
8.	What is your Job?	1. Housewife 2. Farmer 3. Employee 4. Merchant 5. Other_____	
9.	Where are you living?	1. Rural 2. Urban	
II. Current Obstetric factors			
10.	How many times do you get pregnant (Gravidity)?		

11.	Of your pregnancy how many times you deliver after 7 months (Parity)?		
12.	How many of your pregnancy end up in miscarriage or termination before 7 months of amenorrhea (abortion)?		
13.	What is the time period of time between the end of your last pregnancy and the conception of your current pregnancy (in months)?		
14.	Is your current pregnancy wanted?	1. Yes 2. No	
15.	Is your current pregnancy planned?	1. Yes 2. No	
16.	Were you using Family planning?	1. Yes 2. No	If you answer “No” to question number 16 pass to question number
17.	What family planning method were you using?	5. Injectable 6. Implanon 7. Jadelle 8. Pills 9. IUCD 10. Barrier method 11. Others (specify)	

18.	If you answer yes to question number 17, were get pregnant while using the family planning method?	1. Yes 2. No, I discontinued wanting pregnancy?	
19.	Is there a partner change for this pregnancy?	1. Yes 2. No	
20.	Did you have ANC follow up for this pregnancy?	1. Yes 2. No	If answer is No 20 th question go number 25
21.	When was the first ANC visit?	1. First trimester (<14wks) 2. Second trimester (14-27wks) 3. 3 rd Trimester (≥28wks)	
22.	How many ANC visits did you have?	_____	
23.	Did you get Iron/folic acid supplementation?	1. Yes 2. No	If answer is Not to 23 rd question go to 25 th
24.	How many times did you get the supplementation?	_____	
25.	What was your last pregnancy outcome?	1. Live birth 2. Still birth 3. Abortion 4. Ectopic	
26.	What was the mode of delivery of the previous pregnancy?	1. SVD 2. CS 3. Instrumental 4. Destructive	

		5. Laparotomy	
27.	Any pregnancy complications during previous pregnancy?	1. Yes 2. No	If No to 27 th question go question Nor 29
28.	What type of complication?	1. Hypertensive disorders of pregnancy 2. PROM 3. 3 rd TM bleeding (APH) 4. Scar dehiscence or uterine rupture	
29.	How is your labor started?	1. Started by itself 2. It was induced by labor inducing medication 3. Labor doesn't start	
III. Current pregnancy and labor related problems			
30.	Is (are) there Current pregnancy complication?	1. Yes 2. No	
31.	If your answer to question 30 th question, what type of complication did you experience?	1. Hypertensive disorders of pregnancy 2. PROM 3. 3 rd TM bleeding (APH) 4. Scar dehiscence or uterine rupture	

		5. Combination of above	
32.	Onset if labor for current pregnancy?	1. Spontaneous onset 2. Induced by labor inducing drugs? 3. Labor doesn't start	
33.	Hemoglobin level before delivery mg/dl?	_____	
34.	What is the current route of delivery?	1. SVD 2. CS 3. Instrumental 4. Destructive 5. Laparotomy	
IV. Medical disorder and other social factors			
35.	Do you have any known medical disorder prior to the pregnancy?	1. Yes 2. No	
36.	What type of medical disorders do you have?	1. Hypertension 2. DM (Overt) 3. HIV 4. CKD 5. Malaria 6. Others -----	

37.	How often do you drink coffee?	1. Never 2. Occasionally 3. Weekly 4. Daily	
38.	Do you smoke cigarettes?	1. Never 2. Daily 3. Weekly 4. Occasionally	
39.	Do you chew Khat?	1. Never 2. Daily 3. Weekly 4. Occasionally	
40.	Do you drink alcohol?	1. Never 2. Daily 3. Weekly 4. Occasionally	
V. Current neonatal outcomes			
41.	What is the Status of a newborn at delivery? (more than answer is possible)	1. Alive and by mother side 2. Alive and NICU admission 3. NICU admission 4. Still birth	
42.	What is the birth weight of the baby (in grams)?	_____	

43.	What is gestational age in weeks at delivery?	_____	
44.	How is weight comparing with GA	1. AGA(10-90 percentile) 2. SGA (<10percentil) 3. LGA (>90centile)	

7 Reference

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