ISSN: 2091-2889 (online)
2091-2412 (print)

Received: 16 Jan 2025
Accepted: 05 Feb 2025
Published: 28 Feb 2025

DOI: 10.54530/jcmc.1625

OPEN ACCESS

Risk factors and neonatal outcome in preterm births: A hospital-based case-control study

Sabita Shrestha[1], Rakshya Joshi[1], Jyoti Pandey[2], Jully Chaudhary[3], Jaya Prasad Singh[4]

[1]Associate Professor; [2]Resident; [3]Assistant Professor; Ob-Gyn Chitwan Medical College Teaching Hospital (CMCTH), Bharatpur, Nepal
[4]Assistant Professor Statistics; CMC, Bharatpur, Nepal

Peer reviewed

Abstract

Introduction: Preterm birth is the delivery before 37 completed weeks of gestation. Prematurity is the leading cause of neonatal mortality globally. This study aims to determine the risk factors and neonatal outcomes of preterm birth.

Method: A case-control study was conducted in the department of Obstetrics and Gynaecology, Chitwan Medical College Teaching Hospital, Nepal, from December 2020 to November 2021. A total of 175 women who delivered between 28-37 weeks were taken as cases and 175 women who delivered at or beyond 37 weeks were included as controls. A structured proforma was used to collect relevant information like sociodemographic factors, past and present obstetric history, maternal physiological parameters and neonatal outcome. Data analysis was performed using IBM SPSS Statistics. The chi-square test (χ^2) was used to show the relationship between various risk factors and preterm birth. An odds ratio with a 95% confidence interval was estimated.

Result: The mean gestational age of cases and controls was 34.44±2.06 and 39.00±1.20 weeks respectively. The major maternal risk factors of preterm birth were hypertensive disorder of pregnancy, pre-labour rupture of membrane, urinary tract infection in pregnancy, anaemia, and abnormal liquor volume. The mean weight of preterm and term neonates was 2111.9±573.86gm and 2938.3±479.63gm respectively. Preterm neonates had a significantly increased rate of NICU admission and requirement for respiratory support and phototherapy.

Conclusion: The study establishes an association between maternal hypertensive disorder, pre-labour rupture of membrane, anaemia and preterm birth. Neonates of preterm gestational age are at increased morbidities.

How to cite

Shrestha S, Joshi R, Pandey J, Chaudhary J, Singh JP. Risk factors and neonatal outcome in preterm births: A hospital-based case control study. Journal of Chitwan Medical College. 2025;15(51):120-7.

Correspondence

Sabita Shrestha, Chitwan Medical College, Bharatpur, Chitwan, Nepal. Email: drsabitashrestha@gmail.com, Telephone: +977 9841690196

Introduction

WHO defines preterm birth as all births occurring before 37 completed weeks of pregnancy.[1] In 2020, an estimated 13.4 million live births were preterm accounting for 9.9% of all live births.[2] The highest incidence of preterm birth was reported in Southern Asia and Sub-Saharan Africa.[2,3] The preterm birth rate varies from 4 to 16% in different nations with the highest rate in Bangladesh.[2] Preterm birth remains the leading cause of neonatal mortality worldwide.[4,5] In 2021, over 1/3rd of neonatal deaths were due to direct complications of preterm birth.[2]

Prevention of preterm birth is important for achieving the United Nations Sustainable Development Goal(SDG) target #3 aiming to end all preventable deaths of newborns by 2030.[6] In Nepal, each year 81,000 babies are born preterm and prematurity is a leading cause of neonatal mortality.[7] A study conducted in 12 government hospitals reported the incidence of preterm birth to be 9.3% among live births.[8] Nepal has a neonatal Mortality Rate (NMR) of 22 deaths per 1,000 live births, of which 30.8% are due to prematurity and so to achieve the SDG 3 target, the burden of preterm birth must be addressed.[9,10]

A wide range of factors are implicated in the aetiology of preterm birth.[11] Determination of these risk factors can help identify the women at risk of preterm birth. It not only improves the neonatal survival rate but also decreases the financial burden imposed by prematurity. We, therefore conducted a hospital-based case control study to determine the risk factors and neonatal outcome of preterm birth.

Method

A hospital-based 1:1 case-control study was conducted in the Department of Obstetrics and Gynaecology, Chitwan Medical College Teaching Hospital, from Dec 2020 to Nov 2021 after obtaining approval from IRC. Chitwan Medical College is a tertiary care referral centre located in the central region of Nepal. The sample size was calculated using the formula:

$$n_{case} \geq \frac{n'}{4}\left(1+\sqrt{1+\frac{2(r+1)}{n'r|p_2-p_1|}}\right)^2$$

Where,

$$n' = \frac{\left[Z_{1-\alpha/2}\sqrt{(r+1)p(1-p)}+Z_{1-\beta}\sqrt{rp_1(1-p_1)+p_2(1-p_2)}\right]^2}{r(p_2-p_1)^2}$$

$$p_2 = \frac{p_1 OR}{1+p_1(OR-1)}$$

Alpha (α): Type 1 error rate=5%
Beta (β): Type 2 error rate=20%
OR: Expected odds ratio=7.2
p_1: Prevalence of exposure in Control group=1.2%[12]
r: Sample size ratio
Control/case=1:1
Sample size (n)=175 in each group
Total sample size 175+175=350

A convenience sampling technique was used. Cases were the postpartum mothers with preterm births between 28 weeks and 37 weeks of gestation calculated from the last menstrual period (LMP) or early scan and controls were those who delivered at or >37 completed weeks of gestation. Once a case was recruited, the immediate next-term delivery was selected as control. Mothers who denied consent, with intrauterine foetal demise, congenitally malformed foetus or with gestational age <28 weeks and >42 weeks and those whose gestational age was uncertain were excluded from the study, flowchart Figure 1.

After taking informed written consent, primary data were collected in a predesigned proforma through face-to-face interviews. Mothers of both groups were interviewed after delivery once they became stable. Sociodemographic characteristics such as age, gravida, parity, educational status personal history etc were recorded. Relevant information to elicit the risk factors of preterm birth from past and present pregnancy was also asked and recorded. History of preterm birth, abortion in a previous pregnancy, and pregnancy interval were asked and recorded. In the index pregnancy, the number of antenatal visits, duration of iron intake and any event during the index pregnancy such as history of threatened abortion, hypertensive disorder of pregnancy, antepartum haemorrhage, rupture of

membrane, gestational diabetes, abnormal liquor volume etc if present were recorded. Secondary data were obtained from the respective mother and newborn charts. Information such as mode of delivery, mother's height, weight and haemoglobin levels were noted. BMI was calculated. Condition of the newborn in terms of birth weight, AGAR score, need of NICU admission if present were noted from the chart file. The need for NICU admission was decided by the paediatric on-duty doctor. Neonatal outcomes were assessed for transient tachypnoea of newborn (TTN), respiratory distress syndrome (RDS), requirement of oxygen therapy, phototherapy and presence of neonatal sepsis. Newborn admitted with such diagnoses were managed as per our intuitional protocol. All newborns were followed up till discharge and final condition at the time of discharge were recorded.

Transient tachypnoea of newborn was diagnosed if the newborn has respiratory difficulty soon after birth without any significant positive blood and chest x-ray findings and resolves within few days.

Respiratory distress syndrome was diagnosed if the newborn had respiratory difficulty soon after birth with positive blood and x-ray findings and needed additional intervention for management

Data was analysed using IBM SPSS Statistics. Descriptive statistics were summarized using frequency and percentages for categorical variables while mean and standard deviation were calculated for continuous variables. Chi-square test (χ^2) was used to show the relationship between various risk factors and preterm birth. Odds ratio (OR) with 95% confidence interval (CI) for the factors associated with preterm birth was estimated. A p–value of less than <0.05 was considered to be statistically significant.

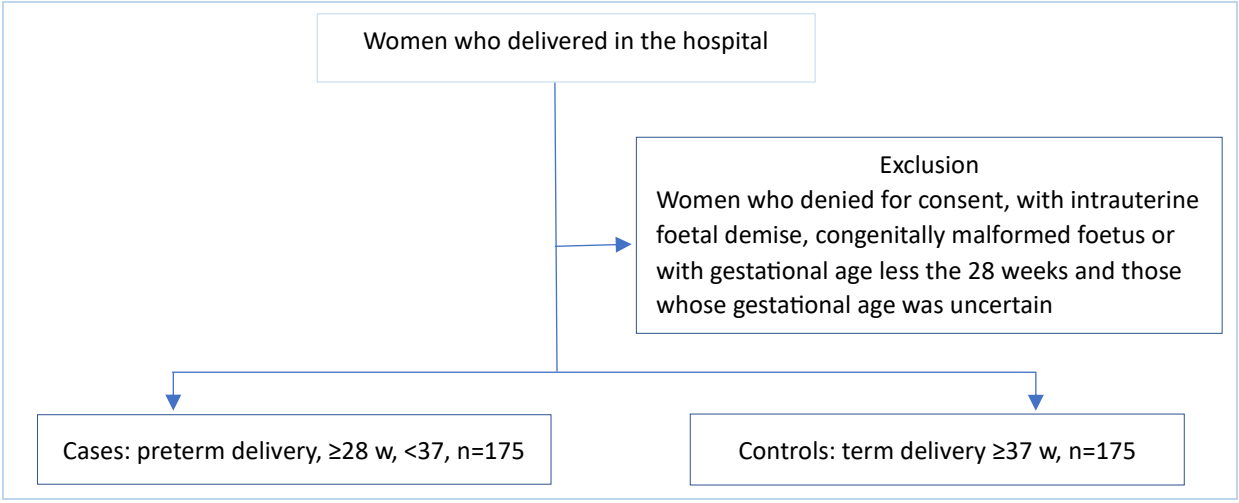


Figure 1. Flowchart of selection of case (preterm) and control (term delivery), 1:1, n=175

Result

A total of 350 women who delivered during the study period were included, with an equal number of cases and controls (175 in each group). Most of the women of both case and control groups belonged to the age group of 20-35 years with mean ages of 26.19±5.04 and 26.01±4.33 respectively and had secondary and higher level of education. The mean gestational age among cases and controls was 34.463 ± 2.065 and 39.006 ± 1.204 respectively, Table 1. Pre labour rupture of membrane and anaemia were most commonly seen in preterm birth

accounting for 26.85% and 38.85% respectively. Several factors were associated with increased odds for preterm birth. There was a significant association between preterm birth and hypertension during pregnancy (OR=3.275; 95% CI: 1.63-6.56). Mothers with anaemia during current pregnancy and those with pre labour rupture of membrane were 2 times and 8.8 times more likely to have preterm birth than their counter parts respectively (OR= 2.735 and OR=8.813 respectively) with p-value <0.001. the study also found a significant association between preterm birth and urinary tract infection and abnormal liquor volume, Table 2.

Table 1. Demographic characteristics of mother preterm vs term, n=350

Characteristics	Case (175) preterm n(%)	Controls (175) term n(%)
Maternal age year		
<20	12(6.9)	10(5.7)
20-35	154(88.0)	162(92.6)
≥35	9(5.1)	3(1.7)
Mean±SD	26.19±5.04	26.01±4.33
Educational status		
No formal education	3(1.7)	1(0.6)
Primary	45(28)	40(22.9)
Secondary and above	123(70.3)	134(76.6)
Gravida		
Primigravida	80(45.7)	79(45.1)
Multigravida	95(54.3)	96(54.9)
Gestational age weeks		
28-32	29(16.6)	0
33-36	146(83.4)	0
≥37	0	175(100.0)
Mean±SD	34.463±2.065	39.006±1.204

Table 2. Maternal risk factors associated with preterm vs term, n=350

Maternal factors		Cases (175) preterm n(%)	Controls (175) term n(%)	χ^2	p-value	OR (95% CI)
Hypertension in pregnancy	yes	34(73.9)	12(26.1)	12.114	0.001	3.275 (1.634-6.567)
	no	141(46.4)	163(53.6)			
Antepartum haemorrhage	yes	14(100)	0	14.583	<0.001	2.087 (1.867-2.333)
	no	161(47.9)	175(52.1)			
Rupture of membrane	yes	47(87.0)	7(13)	35.035	<0.001	8.813 (3.855-20.143)
	no	128(43.2)	168(56.8)			
Gestational diabetes	yes	10(90.9)	1(9.1)	7.603	0.011	10.545 (1.335-83.290)
	no	16 (48.7)	174(51.3)			
Urinary tract infection	yes	26(81.2)	6(18.8)	13.758	<0.001	4.915 (1.969-12.267)
	no	149(46.9)	169(53.1)			
Liquor volume	abnormal	40(67.8)	19(32.2)	8.990	0.004	2.433 (1.345-4.401)
	normal	135(46.4)	156(53.6)			
Anaemia in pregnancy	present	68(67.3)	33(32.7)	17.048	<0.001	2.735 (1.683-4.444)
	absent	107(43.0)	142(57)			

The most common mode of delivery was caesarean section in both case and control groups. Emergency lower segment caesarean section occurred more in the preterm group than in the control.

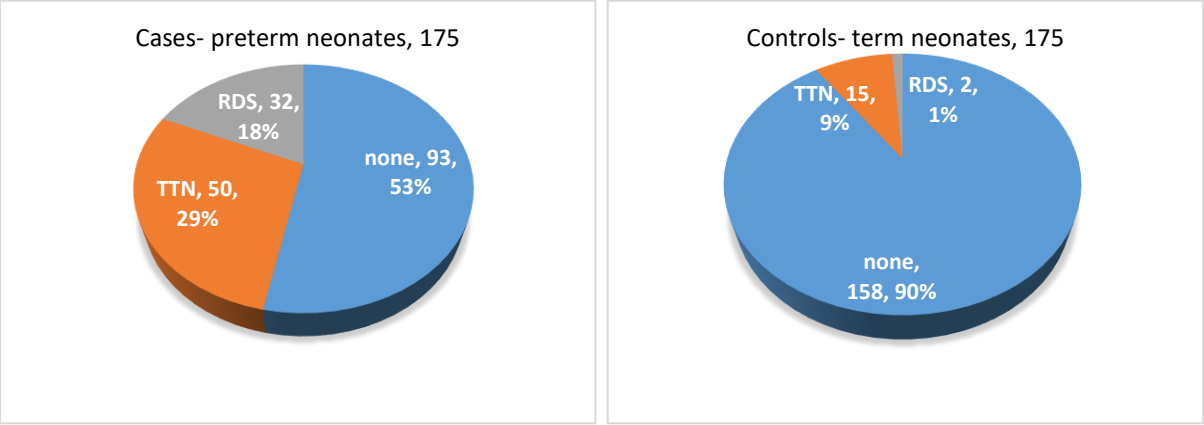
The mean birth weight and APGAR score of neonates born to case and control groups, Table 3. Admission to Neonatal Intensive Care Unit (NICU) and various other adverse perinatal outcomes were significantly increased in preterm neonates than in term, Table 4. This study concluded that preterm babies are approximately 8 times more likely to get admitted to NICU as compared to term (OR= 8.497; 95% CI. 4.849-14.889). Respiratory disorders like TTN and RDS were common in preterm newborns, Figure 2. Hence, requirement of respiratory support was found to be nearly 9 times compared to term. Preterm neonates were 10 times at increased risk of developing sepsis.

Table 3. Neonatal weight and APGAR score, preterm vs term, n=350

Outcome	Cases (175) preterm n(%)	Controls (175) term n(%)
Mean birth weight gram	2111.9±573.86	2938.3±479.63
APGAR 1 minute	7.37±1.09	7.37±1.09
APGAR 5 minute	8.51±1.00	8.88±0.43

Table 4. Neonatal outcome in preterm birth preterm birth vs term, n=350

Neonatal outcome		Cases (175) preterm n(%)	Controls (175) term n(%)	χ^2	p-value	OR (95% CI)
Admission in NICU	yes	89 (82.4)	19 (17.6)	65.618	0.001	8.497 (4.849-14.889)
	no	86 (35.5)	156 (64.5)			
Respiratory support	yes	85 (80.2)	21 (19.8)	55.428	0.001	6.926 (4.021-11.931)
	no	90 (36.9)	154 (63.1)			
Phototherapy requirement	yes	20 (95.2)	1 (4.8)	18.288	0.001	22.452 (2.978-169.247)
	no	155 (47.1)	174 (52.9)			
Neonatal sepsis	yes	42 (89.4)	5 (10.6)	33.646	0.001	10.737 (4.133-27.890)
	no	133 (43.9)	170 (56.1)			



TTN- Transient tachypnoea of newborn, RDS- Respiratory distress syndrome

Figure 2. Respiratory disorders in the newborn preterm birth vs term, n=175 each

Discussion

The cause of preterm birth is multifactorial. This study has attempted to assess the determinants of preterm birth by incorporating as many risk factors as possible. In this study, most of the participants of both case and control were below 35 years and the mean age of both groups was comparable at 26 years. This result is consistent with that shown by Ayebare et al. conducted in Uganda.[13] It may be due to the fact this age group is the most common age of marriage and pregnancy. However, a cross-sectional study done in Ethiopia and another

population-based study demonstrated a significant risk of preterm birth in women above 35 years.[14,15] This association may be due to the presence of pre-existing chronic diseases in older women. Another case-control study done in western Iran found a significantly increased rate of preterm birth in women <20 years and those >35 years.[16]

The present study revealed a strong association between various maternal factors and preterm birth. In accord to the studies done in India by Patil et al. and Rao et al, this study also reported that hypertension in pregnancy increases the risk of preterm birth by more than 3 fold.[12,17] Similar results were published in different studies conducted in Ethiopia, Iran and Zimbabwe.[14,16,18,19] The fact that termination of pregnancy is the only definite management of any form of hypertensive disorder in pregnancy explains this strong and consistent association.

Pre-labour rupture of the membrane was one of the frequent findings among cases in this study and increased the risk of preterm birth by 8-fold. Studies have reported comparable results with an OR of 8.5.[18] Several other studies also find an increased risk of preterm birth in women with pre-labour rupture of the membrane.[14,16,17,20] Rupture of the foetal membrane releases prostaglandins and initiates a cascade of reactions that causes the onset of labour, hence resulting in preterm birth usually within 24-48 hours of rupture.

Similar to the study in Tanzania, we also found that the risk of preterm birth was almost five times in women who had UTI.[5] This positive relation between preterm birth and UTI was reported by other authors as well.[16,21] As pregnant women are at higher risk of UTI due to altered immunity and the effect of progesterone, this association between UTI and preterm birth emphasizes the importance of screening and timely treatment of UTI.

In this study, the risk of preterm birth was also higher among women with anaemia. A multicentric study done in different hospitals of Nepal reported a similar result.[8] This finding was corroborated by other studies.[18,19,22,23] Deworming, optimization of haemoglobin level during the adolescent period and prenatal supplementation of iron tablets all help to decrease the incidence of anaemia during pregnancy and thus can prevent preterm birth which ultimately improves the neonatal outcome.

Abnormality of liquor volume, either oligo or polyhydramnios, carries a higher risk of preterm birth. consistent with the findings shown in southern India and Tanzania, this study concluded that preterm birth was twice more likely to occur with abnormal liquor volume.[12,21] Polyhydramnios causes overdistension of the uterus and oligohydramnios is usually secondary to rupture of membrane. Both the condition imposes the risk of spontaneous as well as iatrogenic preterm delivery.

More than half of both cases and controls underwent caesarean deliveries in the present study. CMC being one of the largest referrals centres, complicated obstetric cases are referred from within its catchment area and the increasing number of women with previous c/s also accounts the higher cs rate. This study further demonstrates that the rate of emergency cs was much higher in cases than in controls which was consistent with results reported by Rao et al.[12] This higher rate of emergency cs in cases may be contributed by the associated maternal obstetric conditions with preterm as discussed above.

Regarding neonatal outcomes, there were substantial differences between term and preterm neonates. The chance of preterm neonates being admitted to NICU was found to be 8 times higher as compared to their counterparts. Moreover, a wide range of neonatal morbidities including neonatal sepsis, hyperbilirubinemia requiring phototherapy and respiratory disease requiring respiratory support was notably higher in preterm neonates. These results were comparable with those reported by Patil et al and Muhe et al.[17,24] Immaturity of the organ systems, particularly the respiratory system and diminished immune mechanism in preterm predisposes them to these complications. A case-control study

conducted in one of the largest maternity hospitals in Nepal showed a 12-fold increased risk of neonatal death among preterm compared to term.[25] In this study, there were only two Neonatal mortality. This improved outcome may be due to the availability of experienced paediatric manpower, and well-equipped NICU in our setup. In CMCTH with postgraduate programs, newborns at delivery are assessed by the paediatric on-duty resident, hence timely and appropriate resuscitation when required is initiated on time. This might be the major reason for decreased mortality in our hospital.

The strength of this study is that it was a case-control study and employed appropriate design and analysis. The controls were selected immediately after the cases to minimize selection bias. The limitations may be being a referral centre, women with high-risk pregnancies are referred from its catchment area may not represent general patients. Risk factors like previous pregnancy preterm birth, history of abortion, and pregnancy intervals were not matched. Only predischarge morbidity and mortality were analysed and not the long-term consequences of preterm birth.

Conclusion

Preterm birth remains a global health problem, adversely affecting neonatal health indicators. The present study found several risk factors for preterm birth. This study concluded that various obstetric conditions like hypertensive disorders, pre-labour rupture of membrane, UTI and anaemia have strong positive associations with preterm birth. Further, the study also demonstrated an increased neonatal morbidity in preterm as compared to term thus increasing the financial burden to the family and society. Therefore, identification of at-risk women and their timely management can help reduce the incidence of preterm birth and its consequences.

Author contribution

Concept design: SS, RJ, JC; Literature search: SS, RJ, JC; Data collection: SS, JP; Data analysis: SS, JPS; Draft manuscript: All; Final manuscript and accountability: All

Acknowledgement

None

Conflict of Interest

None

Funding

None

Supplementary material

The data and supplementary material that support the findings of this study are available from the corresponding author upon reasonable request.

References

1. Preterm birth [Internet. cited 2025 Jan 1. Link
2. Born too soon: decade of action on preterm birth [Internet. cited 2025 Jan 3. Link
3. Chawanpaiboon S, Vogel JP, Moller AB, Lumbiganon P, Petzold M, Hogan D, et al. Global, regional, and national estimates of levels of preterm birth in 2014: a systematic review and modelling analysis. Lancet Glob Health. 2019 Jan 1;7(1):e37–46. DOI PubMed Google Scholar Full Text
4. Mekuriyaw AM, Mihret MS, Yismaw AE. Determinants of Preterm Birth among Women Who Gave Birth in Amhara Region Referral Hospitals, Northern Ethiopia, 2018: Institutional Based Case Control Study. Int J Pediatr. 2020;2020:1854073. DOI PubMed Google Scholar Full Text
5. Rugaimukam JJ, Mahande MJ, Msuya SE, Philemon RN. Risk factors for preterm birth among women who delivered preterm babies at Bugando medical Centre, Tanzania. SOJ Gynecol Obstet Womens Health. 2017;3(2):1-7. DOI GoogleScholar FullText
6. Walani SR. Global burden of preterm birth. International Journal of Gynecology & Obstetrics. 2020 Jul;150(1):31-3. DOI PubMed Google Scholar
7. Every Preemie-SCALE Nepal Link
8. Gurung A, Wrammert J, Sunny AK, Gurung R, Rana N, Basaula YN, et al. Incidence, risk factors and consequences of preterm birth–findings from a multi-centric observational study for 14 months in Nepal. Archives of public health. 2020

Dec;78:1-9. DOI PubMed Google Scholar FullText
9. Maternal and newborn health disparities Nepal, UNICEF - Google Search Link
10. UNDP SUPPORT TO THE IMPLEMENTATION OF SUSTAINABLE DEVELOPMENT GOAL 3, SDG-3 Health.pdf Link
11. Cobo T, Kacerovsky M, Jacobsson B. Risk factors for spontaneous preterm delivery. International Journal of Gynecology & Obstetrics. 2020 Jul;150(1):17-23. DOI PubMed Google Scholar
12. Rao CR, de Ruiter LE, Bhat P, Kamath V, Kamath A, Bhat V. A Case-Control Study on Risk Factors for Preterm Deliveries in a Secondary Care Hospital, Southern India. International Scholarly Research Notices. 2014;2014(1):935982. DOI PubMed Google Scholar Full Text
13. Ayebare E, Ntuyo P, Malande OO, Nalwadda G. Maternal, reproductive and obstetric factors associated with preterm births in Mulago Hospital, Kampala, Uganda: a case control study. Pan African Medical Journal. 2018;30(1):272. DOI PubMed Google Scholar Full text
14. Abdo RA, Halil HM, Muhammed MA, Karebo MS. Magnitude of Preterm Birth and Its Associated Factors: A Cross-Sectional Study at Butajira Hospital, Southern Nations, Nationalities, and People's Region, Ethiopia. International Journal of Pediatrics. 2020;2020(1):6303062. DOI PubMed Google Scholar FullText
15. Soltani M, Tabatabaee HR, Saeidinejat S, Eslahi M, Yaghoobi H, Mazloumi E, Rajabi A, Ghasemi A, Keyghobadi N, Enayatrad M, Noori A. Assessing the risk factors before pregnancy of preterm births in Iran: a population-based case-control study. BMC pregnancy and childbirth. 2019 Dec;19:1-8. DOI PubMed Google Scholar Full text
16. Bakhteyar K, Lorzadeh N, Pournia Y, Birjandi M, Ebrahimzadeh F, Kamran A. Factors associated with preterm delivery in women admitted to hospitals in Khorramabad: A case control study. International Journal of Health & Allied Sciences. 2012 Jul 1;1(3):147. DOI Google Scholar Full Text
17. Patil S, Patil KP. Analysis of risk factors of late preterm birth: A case-control study. Indian Journal of Health Sciences and Biomedical Research kleu. 2017 Sep 1;10(3):283-7. DOI Google Scholar Full Text
18. Abaraya M, Seid SS, Ibro SA. Determinants of preterm birth at Jimma university medical center, Southwest Ethiopia. Pediatric health, medicine and therapeutics. 2018 Sep 18:101-7. DOI PubMed Google Scholar Full Text
19. Feresu SA, Harlow SD, Woelk GB. Risk factors for prematurity at Harare maternity hospital, Zimbabwe. International journal of epidemiology. 2004 Dec 1;33(6):1194-201. DOI PubMed Google Scholar Full Text
20. Sarhan AL, Anini HE. RN. Risk Factors of Preterm Birth among Palestinian Women: Case Control Study. Austin J Nurs Health Care. 2015;2(1):1011. Google Scholar Full Text
21. Mahapula FA, Kumpuni K, Mlay JP, Mrema TF. Risk factors associated with pre-term birth in Dar es Salaam, Tanzania: a case-control study. Tanzania Journal of Health Research. 2016;18(1). DOI Google Scholar Full Text
22. Mohamed HF, Mesabah M, Haroun HM, Mousa SR. Evaluation of the Incidence, Possible Risk Factors and Maternal & Neonatal Morbidity & Mortality in Cases of Preterm Labour at El Minya Maternity University Hospital. Minia Journal of Medical Research. 2022 Oct 1;33(4):49-58. DOI Google Scholar Full Text
23. Zhang X, Zhou M, Chen L, Hao B, Zhao G. Risk factors for preterm birth: a case-control study in rural area of western China. International journal of clinical and experimental medicine. 2015 Mar 15;8(3):4527-32. PubMed Google Scholar Full Text
24. Muhe LM, McClure EM, Nigussie AK, Mekasha A, Worku B, Worku A, Demtse A, Eshetu B, Tigabu Z, Gizaw MA, Workneh N. Major causes of death in preterm infants in selected hospitals in Ethiopia (SIP): a prospective, cross-sectional, observational study. The Lancet Global Health. 2019 Aug 1;7(8):e1130-8. DOI PubMed Google Scholar Full Text
25. Kc A, Wrammert J, Nelin V, Ewald U, Clark R, Målqvist M. Level of mortality risk for babies born preterm or with a small weight for gestation in a tertiary hospital of Nepal. BMC public health. 2015 Dec;15:1-9. DOI PubMed Google Scholar Full Text