Review Article

Pregnancy-Induced Complications and Neonatal Outcome

Boskabadi Hassan[1], Bagheri Fatemeh[2*]

[1]Department of Pediatrics, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran; [2]Department of Nursing, School of Nursing and Midwifery, Mashhad Branch, Islamic Azad University, Mashhad, Iran

ABSTRACT

Background and objectives: Maternal problems during pregnancy are an important and influential factor on the health status and consequences of newborns. This study was performed to compare the status of premature infants born to mothers with pregnancy problems and without pregnancy problems.

Materials and methods: This cross-sectional study examined the files of 1110 premature infants admitted to Ghaem Hospital in Mashhad from 2015 to 2022. Sampling was available in this study. After reviewing information about mothers (gestational age, maternal age, type of delivery, parity, underlying diseases, pregnancy complications, placental and membranous problems) and infant (age, height, weight, head circumference, Apgar score of the first and fifth minutes), infants were divided into two groups: mothers with and without pregnancy problems.

Results: 79.7% and 20.3% of preterm infants were in the mothers with and without medical pregnancy complications groups, respectively. Higher Maternal age and cesarean-section delivery rate were associated with medical pregnancy complications (P-value <0.001). Preeclampsia, hypertension, diabetes, and heart problems were the most prevalent complications found among our population. The first minute Apgar score, weight, height, head circumference in infants of mothers with medical pregnancy complications were lower than in another group (P-value <0.05). In addition, pregnancy complications were a significant contributor to the incidence of Premature Rupture of Membranes (PROM) (P=0.012) and Respiratory Distress Syndrome (RDS) (P=0.001).

Conclusion: This study has shown that pregnancy complications adversely pose the risk of severe consequences such as preterm delivery, cesarean section, PROM, Lower weight and gestational age and RDS. In the light of our findings, proper control of high-risk mothers may face the prospect of adverse outcomes.

Keywords: Pregnancy-induced complications; Mother; Neonate; Preeclampsia; Hypertension; Diabetes; Prematurity; Premature rupture of membranes

INTRODUCTION

While most pregnant women experience healthy pregnancy and childbirth, some women encounter Pregnancy-Induced Complications (PIC) that threatens the health of both themselves and their neonates [1]. Risk factors such as Maternal medical conditions, maternal sociodemographic factors, past obstetric history, adverse environmental conditions, unhealthy lifestyles, and adolescent pregnancy play a critical role in the emerging PIC [1-3]. The scope of high-risk pregnancy is immense and has damaging consequences on the psychological health of the mother, neonates, and all functional aspects of the family [4-6]. Maternal medical complications such as PROM, urogenital infection, preeclampsia, cervical insufficiency, fetal malformations, polyhydramnios endanger not only the health of the mother but are also considered as strong risk factors for preterm delivery [7]. Premature birth refers to all live births before completion the 37th week of pregnancy or less than 259 days after the first day of the last menstrual period and makes up 10.6% of the total number of births [8]. Prematurity accounts for 35% of death of neonates, and 16% of children under five years [8,9]. Prematurity is a growing public health concern worldwide that has known as a principal cause of neonatal mortality and a significant contributor to neonatal long-term adverse effects [10,11]. There is mounting evidence that premature birth poses a considerable economic burden on the healthcare system, and their families are more likely to deal with psychological and financial problems [12,13].

Measuring the height, weight, and head circumference of neonates at birth are reliable methods in monitoring fetal growth and

development during pregnancy. Measuring these indices deem also an informative determinant of the risk of long-term abnormalities [14]. The importance of these indicators is becoming greater when it comes to high-risk pregnancies. The literature on HC growth has highlighted the significant association of head size growth with neurodevelopmental disorders involving socio-emotional, cognitive, and motor impairments, especially in preterm neonates [15].

Pre-existing maternal medical conditions or pregnancy-induced complications are doubtlessly influential factors that lead to dire consequences on the growth of the fetus that prematurity is one the most noticeably undesired results. Prematurity can be directly caused by a related disorder such as diabetes or an adverse outcome of the treatment of a maternal condition such as preeclampsia which ultimate treatment is the termination of pregnancy. It is hoped that this research will contribute to a deeper understanding of maternal medical condition's impact on the consequences of preterm neonates. Therefore, this essay aims to provide a comparison between the health condition of premature infants born to mothers with and without pregnancy complications.

MATERIALS AND METHODS

This cross-sectional study comprised 1110 preterm neonates admitted to the neonatal ward of Ghaem Hospital in Mashhad during 2015-2022. Selecting neonates was based on the availability sampling method. This study was conducted in accordance with the declaration of Helsinki and has been approved by the ethics committee of Mashhad University of Medical Sciences. The ethics committee reference number and project code are IR.MUMS. MEDICAL.REC.1399.31 and 990608, respectively. Initially, preterm newborns were recruited from the intensive neonatal care unit. Maternal, prenatal, and neonatal medical records were thoroughly evaluated in detail by the researchers. Primary inclusion criteria for the neonates were less than 37 gestational weeks and singleton. Neonates diagnosed with congenital anomalies and stillbirth deliveries were excluded from the study. Data were collected using a checklist designed in two parts of maternal and neonatal sections. The first part consists of maternal characteristics, including maternal age, delivery mode, parity, pre-pregnancy medical conditions, and pregnancy-induced complications. The second section includes data on neonatal characteristics, including gestational age, height, weight, head circumference, first and five Apgar score, and respiratory distress syndrome. Preterm neonates were divided into two groups according to a maternal medical condition, which case and control groups were made up of preterm newborns of mothers with and without experiencing PICs.

Gestational age at birth was determined based on the last menstrual period and initial ultrasound findings (before 20th week's gestation). Maternal pregnancy complications in the case group include pre-pregnancy and pregnancy-induced diabetes, hypertension, preeclampsia, eclampsia, Help syndrome, hypothyroidism, epilepsy, infection, vaginal bleeding, severe Depression, placental abruption (placenta Previa, oligohydramnios, polyhydramnios), history of obstetric complications (addiction, history of abortion, IVF, stillbirth). Maternal hypertension was considered Systolic Blood Pressure (SBP) over 140 mmHg and Diastolic Blood Pressure (DBP) over 90 mmHg or an increase in blood pressure compared to the first trimester (SPB>30 and DPB>15 mmHg) after 20 completed weeks.

Preeclampsia diagnosis criteria were as follows:

1. Pregnancy older than 20 completed gestational weeks.

2. High blood pressure (SBP>140 mmHg or DBP>90 mmHg on two times (at least 4 hours apart) (in a case that has previously had high blood pressure: SBP>160 mmHg, DPB>110 mmHg on one point).

3. Proteinuria (protein/creatinine ratio>0.3, proteinuria>0.3 g (24-h urine) protein urine dipstick of 1) [16]. The diagnostic threshold of gestational diabetes was 92 mg/dl, 180 mg/dl, and 153 mg/dl of fast blood sugar, immediately, 1 and 2 hours after Oral Glucose Tolerance Test (OGTT), respectively [17]. Mothers who did not experience any medical complications with pregnancy were regarded as mothers with a normal perinatal period (control group).
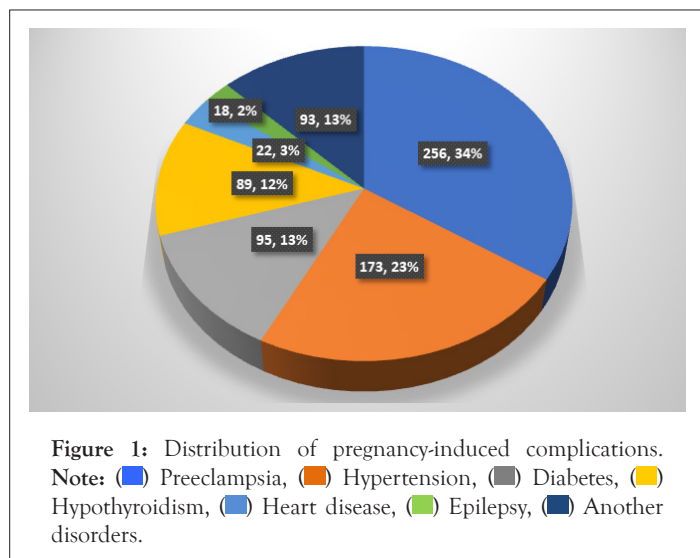
Statistical analysis was performed using SPSS software (version 21). To representing findings, tables, graphs, and descriptive statistical indices have been used. The data were normalized using Kolmogorov-Smirnov. Pearson correlation coefficient and t-test were applied for parametric variables, and Spearman's rank correlation coefficients and Mann-Whitney were employed for nonparametric ones. Significance levels were set at less than 5% in all tests.
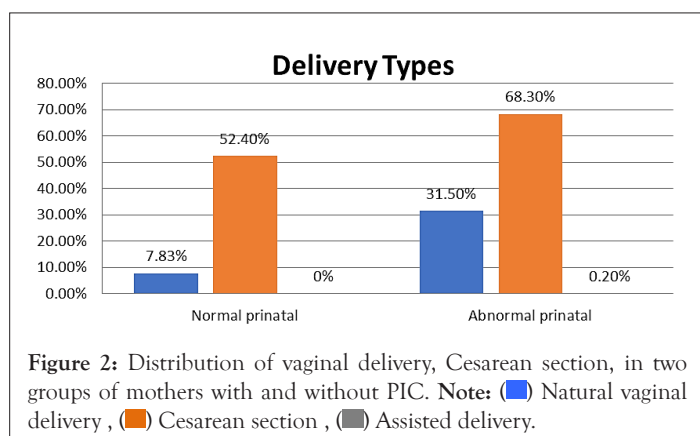
RESULTS

The initial sample consisted of 1110 preterm neonates,70 of whom died in the delivery room, 31 of whom had incomplete data, 59 of whom suffered from congenital anomalies, were excluded from the study. Ultimately, the project was performed on 950 eligible preterm infants. 79.7% of them were divided into those whose mothers were diagnosed with PIC and 20.3% whose mothers had a wholesome pregnancy period. As can be seen from Table 1, based on the independent t-test, the difference between the mean age of mothers, first Apgar score, weight, height, and head circumference at birth in the two groups were statistically significant. The figures below clearly illustrates the distribution of PIC containing preeclampsia (256 mothers), pregnancy hypertension (173), diabetes 95, hypothyroidism (89), heart disease (22), epilepsy (18), and other complications (93) (Figure 1).

Table 1: Maternal and neonatal characteristics, in two groups of mothers with and without PIC.

Characteristics	Mother groups	Mean ± SD	P-Value
Maternal age (year)	Normal prenatal	27.52 ± 6.57	P<0.001
	Abnormal prenatal	30.01 ± 6.01	
Parity	Normal prenatal	2.10 ± 1.38	P=0.386
	Abnormal prenatal	2.22 ± 1.33	
Apgar first minute	Normal prenatal	6.85 ± 1.81	P<0.001
	Abnormal prenatal	6.32 ± 2.14	
Apgar five minutes	Normal prenatal	7.99 ± 1.55	P=0.329
	Abnormal prenatal	7.84 ± 1.69	
Weight (g)	Normal prenatal	1587.07 ± 560.55	P<0.001
	Abnormal prenatal	1376.08 ± 392.87	
Length (cm)	Normal prenatal	41.59 ± 3.77	P<0.001
	Abnormal prenatal	39.94 ± 3.75	
Head circumference (cm)	Normal prenatal	29.28 ± 2.78	P=0.031
	Abnormal prenatal	28.77 ± 2.39	

Figure 1: Distribution of pregnancy-induced complications. **Note:** (■) Preeclampsia, (■) Hypertension, (■) Diabetes, (■) Hypothyroidism, (■) Heart disease, (■) Epilepsy, (■) Another disorders.

A chi-square test revealed no clear distinction between the need for cardiopulmonary resuscitation and neonatal gender in the two groups. The results of our study show that in mothers with pregnancy problems 68.5% had cesarean section and 31.5% had normal delivery, while mothers without pregnancy problem had 52.4% cesarean section and 47.6% normal delivery. Nevertheless, the cesarean section rate was significantly higher in mothers who experienced PIC (P-value=0.001). According to our results, 27% and 6.7% of mothers with and without PIC developed Premature Rupture of Membranes (PROM), respectively (P=0.012) (Figure 2).

Figure 2: Distribution of vaginal delivery, Cesarean section, in two groups of mothers with and without PIC. **Note:** (■) Natural vaginal delivery , (■) Cesarean section , (■) Assisted delivery.

DISCUSSION

In this study, maternal age was found to play a significant role in the incidence of preterm birth that older mothers were more likely to predispose to preterm delivery. In accordance with the present results, previous studies have demonstrated the direct impact of maternal aging on the increased chance of preterm delivery [18]. Jiang et al. [19], reported that the rate of preterm delivery was significantly higher in women over 35 years and adolescent mothers compared to mothers in other age ranging, and a U-shaped relationship of preterm birth risk and maternal age was observed. As noted by Faucett et al. [20], maternal aging does not increase the risk of preterm delivery by itself, indeed, they assumed that advanced maternal age potentially enhanced the risk of PICs such as placenta previa, intrauterine growth restriction, fetal death, gestational diabetes, gestational hypertension, preeclampsia, cesarean delivery, hence, maternal medical conditions related to increasing maternal age lead to preterm delivery.

Another remarkable finding showed that the incidence rate of prematurity was 4-folded higher in those experienced PICs. These statistics lend support to the view that PICs made a notable contribution to preterm delivery and are consistent with data obtained in previous studies that have confirmed a correlation between PICs and increased risk of preterm birth. Etuk et al. [21], identified mothers with PIC to be considerably prone to preterm delivery. Similarly, Morisaki et al. [22], have recognized preterm delivery as one of the detrimental consequences of high-risk pregnancy. Another study demonstrated that women with a history of diabetes, thyroid dysfunction, and heart disease were 2.3 times more likely to give birth prematurely than good medical conditions mothers [23]. In accord with the present study, another observation reported that pregnancy complications lead to an increased chance of preterm delivery by up to 6-16 times compared to women with a regular prenatal period [24]. To determine the effects of PICs, Wagura et al. [25], shown the risk of preterm birth increased 8-fold in mothers who developed pregnancy-induced hypertension and 4-fold in mothers who sustained antepartum hemorrhage. As mentioned above, apparently, maternal medical conditions are considered substantial contributors to preterm delivery, which occasionally can directly lead to preterm delivery, and in some cases, indirectly as consequences of treatment are able to pose preterm birth.

Another noteworthy finding indicates that PROM was four times higher in mothers diagnosed with PICs than healthful mothers. A parallel study established a connection between maternal medical conditions and PROM, which is higher 3-5 times in mothers with PICs in comparison with healthy ones [25]. A possible explanation for this might be due to the principal mechanism of PROM that refers to choriodecidual infections and inflammation and a reduction in the collagen of fetal membranes. Factors predisposing to PROM include a history of PROM, Maternal addiction, Urinary tract infection during pregnancy, Maternal diabetes, Preeclampsia, placental abruption, polyhydramnios, multiple pregnancies, Trauma, and genetic, nutritional, and enzymatic disorders which potentially pose challenges on pregnancy and enhanced the risk of PROM that lead to preterm delivery and its deleterious outcome [26,27].

A higher incidence of cesarean delivery was observed in the mothers who represented PICS rather than the control group. In a large longitudinal study on 2496 cesarean deliveries by Pallsmaa et al. [28], it was shown that 27% of pregnant women experience pregnancy-induced complications, and 10% of them are diagnosed with severe complications. These results are in agreement with those obtained by Persson et al. [29], which showed the remarkable link between gestational diabetes and the cesarean section, which was considerably higher in this population. These findings match those observed in a study conducted by Grandi et al. [30].

Another finding to emerge from the analysis is that the first Apgar score in newborns of the high-risk pregnancy group was significantly lower than neonates born to mothers without PICs. Apgar score commonly has been used to represent neonatal health conditions, which are typically measured 1,5, and 10 minutes after birth. It is widely well-known that a low Apgar score, generally defined as a score below 7, is associated with an increased risk of neonatal mortality [31]. In agreement with the current study, Bayoumi et al. [32], reported a relationship between low first Apgar and preeclampsia. In the study conducted by Grandi et al. [30], on the preterm population, comparable to our results, there is no

affiliation between the fifth Apgar score of neonates and gestational diabetes.

The Finally yet importantly relevant finding showed that weight, height, and head circumference at the birth of preterm infants with an abnormal prenatal period were significantly lower than preterm infants in the normal prenatal period. Comparison of the range of neonatal anthropometric indices with those of other studies confirmed the akin neonatal weight range [33-35]. In findings represented by Bayoumi et al. [32], the low mean weight, height, head circumference, and gestational age at birth were noticeably related to preeclampsia. Correspondingly, multivariate logistic regression showed a strong relationship between gestational age, birth weight, height, and preeclampsia [32]. Sirenden et al. [36], demonstrate that the rate of preterm birth, low birth weight, and fetal complications were substantially higher in the group of neonates born to severe preeclampsia accompanying other maternal medical conditions. To determine the consequence of preeclampsia on neonates, Eviston et al. [37], demonstrated that low height and weight at birth were statistically related to preeclampsia. Surprisingly, after adjusting the confounding factors, increased head circumference at birth was observed in neonates born to mothers who experienced preeclampsia [37]. Another study indicated a relationship between the higher weight and gestational week at birth and gestational diabetes [38].

According to the results of our study, Respiratory Distress Syndrome was approximately 1.5 times more common in preterm infants with PIC (P=0.001) . In the study by Liu et al. [39], Diabetes in mothers during pregnancy was associated with an increased risk of RDS in infants. In a study revealed that maternal preeclampsia slightly increases the risk of severe RDS in VLBW infants [40].

CONCLUSION

The scope of this study was limited in terms of the retrospective nature of the study. Since the data were extracted from the medical records of neonates and mothers, it was not possible to assess other relevant factors naming economic and social status, maternal nutrition, etc. The study was performed on 950 eligible preterm infants. 79.7% of them were divided into those whose mothers were diagnosed with PIC and 20.3% whose mothers had a wholesome pregnancy period. This study has shown that pregnancy complications adversely pose the risk of severe consequences such as preterm delivery, cesarean section, PROM, Lower weight and gestational age and RDS. In the light of our findings, proper control of high-risk mothers may face the prospect of adverse outcomes.

REFERENCES

1. Isaacs NZ, Andipatin MG. A systematic review regarding women's emotional and psychological experiences of high-risk pregnancies. BMC Psychol. 2020;8(1):1-11.

2. Derakhshi B, Esmailnasab N, Ghaderi E, Hemmatpour S. Risk factor of preterm labor in the west of iran: A case-control study. Iran J Public Health. 2014;43(4):499.

3. di Renzo GC, Giardina I, Rosati A, Clerici G, Torricelli M, Petraglia F, et al. Maternal risk factors for preterm birth: A country-based population analysis. Eur J Obstet Gynecol Reprod Biol. 2011;159(2):342-346.

4. Treyvaud K, Doyle LW, Lee KJ, Roberts G, Cheong JL, Inder TE, et al. Family functioning, burden and parenting stress 2 years after very preterm birth. Early Hum Dev. 2011;87(6):427-431.

5. Hodek JM, Von der Schulenburg J, Mittendorf T. Measuring economic consequences of preterm birth-Methodological recommendations for the evaluation of personal burden on children and their caregivers. Health Econ Rev. 2011;1(1):1-10.

6. Haas JS, Fuentes-Afflick E, Stewart AL, Jackson RA, Dean ML, Brawarsky P, et al. Prepregnancy health status and the risk of preterm delivery. Arch Pediatr Adolesc Med. 2005;159(1):58-63.

7. Shapiro-Mendoza CK, Lackritz EM. Epidemiology of late and moderate preterm birth. Semin Fetal Neonatal Med. 2012;17(3):120-125.

8. 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;7(1):e37-e46.

9. Walani SR. Global burden of preterm birth. Int J Gynaecol Obstet. 2020;150(1):31-33.

10. Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C. Global, regional, and national causes of child mortality: An updated systematic analysis for 2010 with time trends since 2000. Lancet. 2012;379(9832):2151-2161.

11. Abrishami M, Maemori GA, Boskabadi H, Yaeghobi Z, Mafi-Nejad S, Abrishami M. Incidence and risk factors of retinopathy of prematurity in mashhad, northeast iran. Iran Red Crescent Med J. 2013;15(3):229-233.

12. Petrou S, Abangma G, Johnson S, Wolke D, Marlow N. Costs and health utilities associated with extremely preterm birth: Evidence from the EPICure study. Value Health. 2009;12(8):1124-34.

13. Bérard A, Le Tiec M, De Vera MA. Study of the costs and morbidities of late-preterm birth. Arch Dis Child Fetal Neonatal Ed. 2012;97(5):F329-F334.

14. Kheirouri S, Alizadeh M. Impact of prenatal maternal factors and birth order on the anthropometric status of newborns in Iran. J Biosoc Sci. 2017;49(2):251-264.

15. Dupont C, Castellanos-Ryan N, Séguin JR, Muckle G, Simard MN, Shapiro GD, et al. The predictive value of head circumference growth during the first year of life on early child traits. Sci Rep. 2018;8(1):1-9.

16. Visintin C, Mugglestone MA, Almerie MQ, Nherera LM, James D, Walkinshaw S. Management of hypertensive disorders during pregnancy: summary of NICE guidance. BMJ. 2010;341.

17. Jamilian M, Mirhosseini N, Eslahi M, Bahmani F, Shokrpour M, Chamani M, et al. The effects of magnesium-zinc-calcium-vitamin D co-supplementation on biomarkers of inflammation, oxidative stress and pregnancy outcomes in gestational diabetes. BMC Pregnancy Childbirth. 2019;19(1):1-8.

18. Yuan W, Duffner AM, Chen L, Hunt LP, Sellers SM, Bernal AL. Analysis of preterm deliveries below 35 weeks' gestation in a tertiary referral hospital in the UK: A case-control survey. BMC Res Notes. 2010;3(1):1-10.

19. Jiang M, Mishu MM, Lu D, Yin X. A case control study of risk factors and neonatal outcomes of preterm birth. Taiwan J Obstet Gynecol. 2018;57(6):814-818.

20. Faucett AM, Metz TD, DeWitt PE, Gibbs RS. Effect of obesity on neonatal outcomes in pregnancies with preterm premature rupture of membranes. Am J Obstet Gynecol. 2016;214(2):287.

21. Etuk SJ, Etuk IS, Oyo-Ita AE. Factors influencing the incidence of pre-term birth in Calabar, Nigeria. Niger J Physiol Sci. 2005;20(1):63-68.

22. Morisaki N, Togoobaatar G, Vogel JP, Souza JP, Rowland Hogue CJ, Jayaratne K, et al. Risk factors for spontaneous and provider-initiated preterm delivery in high and low Human Development Index countries: A secondary analysis of the World Health Organization Multicountry Survey on Maternal and Newborn Health. BJOG. 2014;121:101-109.

23. Alijahan R, Hazrati S, Mirzarahimi M, Pourfarzi F, Hadi PA. Prevalence and risk factors associated with preterm birth in Ardabil, Iran. Iran J Reprod Med. 2014;12(1):47-56.

24. Nguyen N, Savitz DA, Thorp JM. Risk factors for preterm birth in Vietnam. Int J Gynaecol Obstet. 2004;86(1):70-78.

25. Wagura P, Wasunna A, Laving A, Wamalwa D, Ng'ang'a P. Prevalence and factors associated with preterm birth at kenyatta national hospital. BMC Pregnancy Childbirth. 2018;18(1):1-8.

26. Boskabadi H, Zakerihamidi M. Evaluation of maternal risk factors, delivery, and neonatal outcomes of premature rupture of membrane: A systematic review study. J Pediatr Rev. 2019;7(2):77-88.

27. Boskabadi H, Zakeri Hamidi M, Maamouri GA, Najafi A. Frequency of maternal risk factors and neonatal complications of premature rupture of membranes. J Babol Univ Medical Sci. 2016;18(10):32-39.

28. Pallasmaa N, Ekblad U, Aitokallio-Tallberg AN, Uotila J, Raudaskoski T, Ulander VM, et al. Cesarean delivery in Finland: Maternal complications and obstetric risk factors. Acta Obstet Gynecol Scand. 2010;89(7):896-902.

29. Persson M, Shah PS, Rusconi F, Reichman B, Modi N, Kusuda S, et al. Association of maternal diabetes with neonatal outcomes of very preterm and very low-birth-weight infants: An international cohort study. JAMA Pediatr. 2018;172(9):867-875.

30. Grandi C, Tapia JL, Cardoso VC. Impact of maternal diabetes mellitus on mortality and morbidity of very low birth weight infants: A multicenter Latin America study. J Pediatr (Rio J). 2015;91:234-241.

31. Cnattingius S, Johansson S, Razaz N. Apgar score and risk of neonatal death among preterm infants. N Engl J Med. 2020;383(1):49-57.

32. Bayoumi MA, Ali AA, Hamad SG, Ali AA, Elmalik EE, Elkalaf MM, et al. Effect of maternal preeclampsia on hematological profile of newborns in Qatar. Biomed Res Int. 2020;2020.

33. Deng Y, Yang F, Mu D. First-year growth of 834 preterm infants in a Chinese population: A single-center study. BMC Pediatr. 2019;19(1):1-10.

34. Bagheri F, Askari Hosseni Z. Developmental disorders in preterm neonates during the first two years of life using the ages and stages questionnaire. J Babol Univ Medical Sci. 2016;18(2):7-13.

35. Boskabadi H, Maamouri G, Hemmatipour A, Parvini Z, Ramazani A, Bagheri F. Comparison of serum vitamin D in the umbilical cord of survived with not survived premature infants. Iran J Pediatr. 2019;29(3):6.

36. Sirenden H, Sunarno I, Arsyad MA, Idris I. Birth weight, Apgar score, and fetal complications in mothers with severe preeclampsia. Enfermeria clinica. 2020;30:533-536.

37. Eviston DP, Minasyan A, Mann KP, Peek MJ, Nanan RK. Altered fetal head growth in preeclampsia: A retrospective cohort proof-of-concept study. Front Pediatr. 2015;3:83.

38. Bental Y, Reichman B, Shiff Y, Weisbrod M, Boyko V, Lerner-Geva L, et al. Impact of maternal diabetes mellitus on mortality and morbidity of preterm infants (24-33 weeks' gestation). Pediatrics. 2011;128(4):e848-e855.

39. Jing Li, Na YA, Ying Li. High-risk factors of respiratory distress syndrome in term neonates: A retrospective case-control study. Balkan Med J. 2014;2014(1):64-68.

40. Wen YH, Yang HI, Chou HC, Chen CY, Hsieh WS, Tsou KI, et al. Association of maternal preeclampsia with neonatal respiratory distress syndrome in very-low-birth-weight infants. Sci Rep. 2019;9(1):1-8.