SERBIAN ARCHIVES OF MEDICINE Est.1872

Address: 1 Kraljice Natalije Street, 11000 Belgrade, Serbia
☎ +381 11 4092 776, Fax: +381 11 3348 653
E-mail: srparhiv@bvcom.net, Web address: www.srpskiarhiv.rs

Paper Accepted* **ISSN Online 2406-0895**

Original Article / Оригинални рад

Aiqun Xu[1], Ping Yang[2], Wei Cui[2], Lei Li[2], Hui Yu[2], Haining Wang[1], Rengui Quan[1], Yuchun Song[1], Min Xia[2,†]

Causes and short-term outcomes of preterm infants

Узроци и непосредни исход код превремено рођене новорођенчади

[1] Department of Obstetrics and Gynecology, Yantai Affiliated Hospital of Binzhou Medical University, Yantai 264000, Shandong Province, China
[2] Department of Obstetrics and Gynecology, Yuhuangding Affiliated Hospital of Qingdao University, Yantai 264000, Shandong Province, China

Received: August 18, 2016
Revised: April 22, 2017
Accepted: April 23, 2017
Online First: May 9, 2017
DOI: https://doi.org/10.2298/SARH160818108X

† **Correspondence to:**
Min XIA
Department of Obstetrics and Gynecology,
Yuhuangding Affiliated Hospital of Qingdao University, Yantai 264000, Shandong Province, China
E-mail: **MinXiadoc@126.com**

Causes and short-term outcomes of preterm infants

Узроци и непосредни исход код превремено рођене новорођенчади

SUMMARY

Introduction/Objective Preterm birth (PB) is the most important reason of neonatal mortality, and the second direct reason of death for children under 5 years.
The aim of this study was to analyze the clinical features and outcomes of preterm infants.
Methods The clinical data of 307 preterm infants delivered in the university hospital from January 1, 2012, to December 31, 2012, were retrospectively analyzed.
Results The incidence of preterm birth was 6.52%. There were cases of preterm prelabour rupture of the membrane (PPROM) 46.58%, 66 cases of spontaneous PB (21.50%), and 98 cases of therapeutic PB(31.92%). Deliveries with gestational weeks (GW)<32 weeks were mainly vaginal delivery (60.72%), but deliveries with GW≥32 weeks exhibited higher C-section rate (60.99%) than the vaginal delivery rate (p<0.05). The birth weight was 2340.46± 606.26 g, and the Z score at birth was -0.15±1.08. The Z score in the group with GW within 28 to 31^{+6} weeks was less than those with GW within 32 to 33^{+6} weeks and with GW≥34 weeks (p<0.05). The average hospital stay of the preterm infants was 15.17±12.35 days, and the most common complication in these preterm infants was respiratory distress syndrome 13.92%.
Conclusions Preterm birth could cause a variety of serious complications in infants. The main causes of preterm birth should be actively prevented and treated, such PPROM; meanwhile, preterm infants should also be actively treated so as to improve their outcomes.
Keywords: infant; pregnancy outcomes; preterm birth; Z score

САЖЕТАК

Увод/Циљ Превремени порођај (ПП) је главни узрок смртности новорођенчади, а други директни узрок смрти до пете године живота детета.
Циљ овог рада је био да анализира клиничке ток и исход код превремено рођене деце.
Методе Ретроспективно су анализирани подаци за 307 превремено рођене деце у универзитетској болници у периоду од 1. јануара 2012. до 31. децембра 2012.
Резултати Учесталост превременог рађања деце је 6,52%. Превремено пуцање водењака је био разлог у 46,58% ПП, спонтани ПП код 66 (21,5%), а терпијски ПП код 98 (31,92%). Природни порођај је чешћи (60,72%) код трудноћа са <32 недеља, а чешћи царским резом (60,99%) код трудноћа са се ≥32 недеље (p<0.05). Порођајна тежина је била 2340.46±606.26 g, а З-скор на рођењу -0.15±1.08. З-скор је био мањи у групи $28–31^{+6}$ недеља, него у грипи $32–33^{+6}$ и групи ≥34 недеља (p<0.05). Просечно су хоспитализована 15.17±12.35 дана, а најчешћа компликација је била респиратпорни дистрес синдром (13,92%).
Закључак Превремени порођај доводи до озбиљних компликација код новорођенчета. Главни разлози, као прерано пуцање водењака, морају се превенирати и лечити, а само новорђенче интензивно лечити.

Кључне речи: одојче; исход трудноће; превремени порођај; З-скор

INTRODUCTION

Preterm birth (PB) refers to the delivery with the gestational weeks less than 37 weeks, and it is estimated that there are more than 41,000 cases of preterm delivery daily in the world [1]. Preterm birth is the most important reason of neonatal mortality, and the second direct reason of death for children under 5 years. The global incidence of preterm birth is estimated to be 11.1% averagely, and there are differences in the incidence of preterm birth among different countries and regions, such as in Africa, it could be up to 15%, but in some European countries, it might be as low as 5% to 6%. In recent years, with the large-scale applications of assisted reproductive technologies and the increasing of mothers with advanced ages, the incidence of preterm birth is also rising [2, 3].

Preterm infants could occur serious complications, such as respiratory distress syndrome (RDS), sepsis, patent ductus arteriosus, cerebral palsy, and cognitive defects [4, 5]. Approximately 3.1 million neonatal deaths occur worldwide each year, among whom 35% dies of prematurity-related complications [6]. A global statistics showed that more than 60% of preterm birth occurred in South

Asia and Africa, while the incidences of preterm birth differ largely in Asia, which was the lowest in East Asia, about 7.2%, followed by in West Asia, about 10.1%, and the rate was the highest in Southeast Asia, about 13.6% [7]. As an Asian country, there has been no incidence of preterm birth report at the national Level for China, and the estimated incidence of preterm birth is below the global leve. Furthermore, China has large geographic span, the regional incidences of preterm birth are also different, for example, in Jiangsu Province, the incidence was reported as 2.6% ~ 2.9% [8, 9]. This study retrospectively analyzed the clinical data collected from two tertiary referral hospitals, aiming to explore the conditions of preterm birth, remedy levels, and outcomes of preterm infants in this region, thus hoping to provide evidence for the diagnosis and treatment of PB.

The aim of this study was to analyze the cause, clinical features and outcomes of preterm infants.

METHODS

Data sources

307 puerperae hospitalized in the *Yantai affiliated hospital of Binzhou medical university* and the *Yuhuangding Affiliated Hospital of Qingdao University* from January 1, 2012, to December 31, 2012, and pretermly delivered with gestational age as 28 ~36^{+6} weeks were enrolled. This study was conducted in accordance with the declaration of Helsinki. This study was conducted with approval from the Ethics Committee of Binzhou medical university and Qingdao University. Written informed consent was obtained from all participants.

Study methods and diagnostic criteria

A retrospective analysis was performed, and the records of preterm birth that met the criteria were inspected, including general information of pregnant women, pregnancy complications, delivery mode, gestational age at delivery, preterm outcomes(including both neonates and parturient women), as well as the therapy and the course Meanwhile, the Z score of neonatal birth weight was also recorded, which depends on the birth weight, Z score = (birth weight of the infant - mean birth weight with the same gestational weeks) / standard deviation of the birth weight with the same gestational weeks. The evaluation criteria referred to the standards of neonatal physical development with different gestational weeks in 15 Chinese cities, and the normal range was usually considered as within ±2.

Preterm birth: delivery within 28–36^{+6} weeks. Classification (three categories according to the reasons): spontaneous preterm birth, preterm prelabour rupture of the membrane (PPROM), and iatrogenic preterm birth.

Statistical methods

SPSS 13.0 software was used for the statistical analysis; the qualitative data were performed the χ^2 test, and the quantitative data were performed the t test, with P<0.05 considered as statistically significant.

RESULTS

The average age of women with the preterm birth was (30.09±4.45) years old, and the mean pregnancy time was (2.0±1.29) times, including 257 primipara (83.71%) and 50 multipara (16.29%) Table 1.

Table 1. Comparison of pregnancy and delivery with different GW.

	28~31^{+6} weeks (group 1, n=25)	**32~33^{+6} weeks (group 2, n=58)**	**34~36^{+6} weeks (group 3, n=224)**
Age (years)	30.52±5.88	30.50±4.57	29.91±4.25
GW on admission (weeks)	29.67±1.54	32.44±1.19	35.17±1.39
Pre-pregnancy BMI	23.45±3.31	22.98±3.78	22.69±3.72
Time for tocolyis (days)	5.48±10.08	4.88±7.53	3.81±7.50
Delivery mode			
Cephalic vaginal delivery	14 (56.00%)	19 (32.76%)	86 (38.39%)
C-section	9 (36.00%)	38 (65.52%)	134 (59.82%)
Breech vaginal delivery	2 (8.00%)	1 (1.72%)	4 (1.79%)
Number of the newborns	31	67	269

Comparison between GW 28~31^{+6} weeks and GW 34~36^{+6} weeks, p <0.05
Comparison between GW 28~31^{+6} weeks and GW 32~33^{+6} weeks, p <0.05
Comparison between GW 32~33^{+6} weeks and GW 34~36^{+6} weeks, p <0.05

Causes of preterm birth

The age of the pregnant women with iatrogenic preterm birth was (31.26±4.98) years, higher than the PPROM group (p<0.05), while showed no difference with that of the spontaneous preterm birth (p>0.05). The vaginal delivery rates of the spontaneous preterm birth and the PPROM were higher than the iatrogenic preterm birth (p<0.05), Table 2.

Table 2. Short-term outcome of the neonates in different GW groups.

	28~31 $^{+6}$ weeks (group 1, n=25)	**32~33^{+6} weeks (group 2, n=58)**	**34~36^{+6} weeks (group 3, n=224)**
Birth weight (g)	1483.23±418.47	1963.88±418.72†	2562.42±488.31*‡
Z score of birth weight	-0.54±0.89	-0.28±0.93†	-0.08±1.12*
Number of the newborns	31	67	269
1-minute Apgar			
≤3 points	7(22.58%)	3(4.48%)	1(0.37%)
≤7 points	3(9.68%)	8(11.94%)	10(3.72%)
Numbers transferred to NICU	25(80.65%)	64(95.52%)	99(36.80%)
Pediatric hospitalization (days)	26.86±22.07	16.57±9.29†	10.67±6.29*‡
Ventilator usage	19(61.29%)	20(29.85%)	18(6.69%)

* Comparison between GW 28~31 $^{+6}$ weeks and GW 34~36 $^{+6}$, p <0.05
† Comparison between GW 28~31 $^{+6}$ weeks and GW 32~33 $^{+6}$, p <0.05
‡ Comparison between GW 32~33 $^{+6}$ weeks and GW 34~36 $^{+6}$, p <0.05

The average gestational age on admission of the 307 cases with preterm birth was 34.13±2.31 weeks, the hospitalization time for tocolysis was 4.13±7.69 days, and the gestational age at delivery was 34.70±2.02 weeks, in which the gestational age on admission of the iatrogenic preterm birth was less than the PPROM (p<0.05). There was no significant difference in the gestational age at delivery among three groups (p>0.05). The duration for tocolyis of the spontaneous preterm birth was less than the iatrogenic preterm birth but longer than the PPROM (p <0.05) (Table 3).

Table 3. Comparison of pregnancy and delivery with different PD reasons.

	SPD(n=66)	PPROM (n=143)	TPD (n=98)
Age (years)	30.01±4.27	29.32±3.99	31.26±4.98†
GW on admission (weeks)	34.04±2.87	34.55±2.08	33.58±2.09†
Pre-pregnancy BMI	21.52±3.38	22.92±3.75*	23.71±3.62‡
GW at delivery(weeks)	34.66±2.58	34.84±1.86	34.53±1.80
Time for tocolyis (days)	4.46±8.54	2.01±4.40*	7.05±9.71†‡
Delivery mode			
Cephalic vaginal delivery	32 (48.48%)	85 (59.03%)	3 (3.06%)
C-section	32 (48.48%)	54 (37.50%)	95 (96.94%)
Breech vaginal delivery	2 (3.04%)	5 (3.47%)	0

* Comparison between the sPD group and the PPROM group, p <0.05
† Comparison between the tPD group and the PPROM group, p <0.05
‡ Comparison between the sPD group and the tPD group, p <0.05

Outcomes of the preterm infants

The 307 cases with preterm birth delivered a total of 367 neonates, including 56 cases of twin pregnancy (both live birth), 3 cases of twin pregnancy while one fetus died in utero, and 2 cases of triplet pregnancy (both live birth). Eight neonates had congenital malformations, including 3 cases of hypospadias, 1 of anal atresia,1 of congenital esophageal stenosis, 1 of complete endocardial cushion defect, 1 of congenital choanal atresia, and 1 of omphalocele (treated surgically). Among the 367 newborns, 32 occurred neonatal asphyxia, including 11 cases of severe asphyxia, and 6 newborns died within 30 minutes after birth; a total of 188 neonates were referred to neonatal intensive care unit (NICU).

Birth weight and Z score of the birth weight for neonates of preterm birth

The birth weight of the neonates of preterm birth was 2340.46±606.26 g, among who the birth weight of the single-pregnancy neonates was 2432.77±602.23 g, and that of the twin-pregnancy neonates was 2148.55±565.10 g, showing no significant difference between these two groups (p>0.05). The average Z score of the birth weight of neonates of preterm birth was -0.15±1.08. The birth weights gradually increased with gestational weeks, and there were significant differences among preterm birth with 28~31^{+6} weeks, 32~33^{+6} weeks and 34~36^{+6} weeks (p<0.05); the Z score of preterm birth with 28~31^{+6} weeks was lower than that with 32~33^{+6} weeks and with 34~36^{+6} weeks(p<0.05), but Z score between 32~33^{+6} weeks and 34~36^{+6} weeks showed no significant difference (p>0.05) (Table 1). The birth weights and Z scores of the spontaneous preterm birth and the PPROM were higher than the iatrogenic preterm birth group (p<0.05). The birth weight of the

neonates without glucocorticoids administration was higher than those with glucocorticoids administration(p<0.05), but the Z scores among the glucocorticoids administration less than 1 course, 1 course and none showed no significant difference (p>0.05) (Table 3).

Hospitalized treatment of the Preterm Neonates

Among the 188 neonates with preterm birth referred to NICU, 3 died of ineffective rescue, and the average hospital stay was (15.17±12.35) days. There was no significant difference in hospital stay among the spontaneous preterm birth, PPROM, and iatrogenic preterm birth groups, but the hospital stay of neonates with delivery less than 32 weeks was longer than that of neonates with 32~36^{+6} weeks(P<0.05), Table 3 and table 4.

A total of 57 neonates of preterm birth were applied ventilator, accounting for 30.32% of those transferred for NICU; the duration of ventilator usage was (5.09±6.91) days. A total of 19 preterm neonates were administrated with pulmonary surfactant (PS) once, and another three infants were received with PS twice.

There were 60 cases were diagnosed other diseases except preterm neonates: 27 cases of RDS (13.92%), 6 cases of hypoxic-ischemic encephalopathy (3.09%), 2 cases of intracranial hemorrhage (1.03%), 1 case of gastrointestinal bleeding (0.52%), 1 case of necrotizing enterocolitis (0.52%), 2 cases of gastroesophageal reflux (1.03%), 7 cases of congenital heart diseases (3.61%), 3 cases of shock (1.55%), 1 case of persistent pulmonary hypertension (0.52%), 5 cases of disseminated intravascular coagulation (2.58%), 2 cases of anemia (1.03%), and 1 case of retinal dysplasia (0.52%).

DISCUSSION

Incidence of preterm birth

In recent years, the incidence of preterm birth has been increased mainly due to the popularity of assisted reproductive technologies and the increasing of mothers with advanced ages [8]; however, the incidences of preterm birth reported all over the world, including Asia, are not consistent, for example, 7% in British, 13% in India, and more than 15% in Indonesia, Pakistanetc [1]. China has large geographical span; therefore, the variation of the incidence of preterm birth is also large; the investigation targeting 14 Chinese provinces and cities reported the incidence of preterm birth as 7.04% [10]. Furthermore, it showed that the incidence of preterm birth was the highest in southwest China regions (10.3%) but the lowest in central regions (2.3%), and 6.0% in eastern coastal areas [11]. Another report from Jiangsu Province displayed that its incidence was low, about 2.6% - 2.9% [12]. Because the lower limit of gestational age defined by preterm birth in China is 28 weeks, those delivered before 28 weeks are not included in the scope of preterm birth, so there exists certain differences between Chinese and international information about preterm birth. The two hospitals included in this study were both tertiary hospitals in Yantai district, as well as the upper level referral hospitals, and the incidence of preterm birth was reported as 6.58%, similar to the national level.

Causes of preterm birth

Many reports considered PPROM as the common type of preterm birth, and more than 40 % of preterm birth were caused by PPROM; PPROM accounted for 2% to 4% of singleton pregnancy and 7% to 20% of twin pregnancy [4, 13]. There still exists controversies about the optimal gestational age of delivery for PPROM, and ACOG once recommended it to be more than 34^{+6} weeks [14]. In this study, PPROM was the most common, accounting for 46.58 % of preterm birth and 3.06% of the total deliveries; the gestational age at delivery was (34.84±1.86) weeks, among which the delivery time more than 34^{+6} weeks accounted for 68.75%; the tocolyis time was significantly shorter than spontaneous preterm birth and iatrogenic preterm birth groups. Therefore, PPROM should be actively prevented before 37 gestational weeks, and the delivery time should be tried to extend after 34^{+6} gestational weeks.

In recent years, an important reason leading to the increased incidence of preterm birth is the increasing of iatrogenic preterm birth, and it was reported to account for 35% to 40% of all preterm birth cases in other countries [5]. In this study, the incidence of iatrogenic preterm birth accounted for 31.61%, similar to the reports abroad. The increasing of iatrogenic preterm birth is related with the improvements of medical care level, which makes many pregnancy conditions that were not suitable for pregnancy in the past maintain after 28 weeks. In this study, the pregnant women in the iatrogenic preterm birth were older, had less gestational weeks on admission and longer tocolyis time, which all indicated that patients' own diseases had significant impacts on preterm birth.

The reasons of iatrogenic preterm birth could be further divided into three categories, one is caused by maternal diseases, such as intrauterine infection, chorioamnionitis, preeclampsia, or other maternal system disorders; the second is caused by fetal diseases, such as fetal distress or fetal growth restriction; the third is caused by placental diseases, such as placenta previa, or placental abruption [9]. This study showed that the most important reason of iatrogenic preterm birth was pregnancy-induced hypertension (57.14%), similar to those in Australia and Beijing [15]. The second reason in this study was the prenatal placental factors, such as placenta previa and placental abruption, accounting for 28.57%, which was associated with the increased gravidity and parity, especially in the patients with previous history of Cesarean section [16]. Therefore, it suggested that the maternal management of late pregnancy in our region should be focused on the prevention and treatment of the occurrence and progression of pregnancy-induced hypertension.

Analysis of birth weight of the preterm infants

Birth weights of preterm infants are closely related to their mortality. In 2010, the mortality rate of live infant in US was 6.14 ‰, among which preterm birth accounted for 35.2%; the mortality of neonates with birth weight less than 1500 g was 100 times than those with birth weight greater than 2500 g [17]. This study introduced the Z score of birth weight,and the results showed that the Z score of the preterm infants with 28□31^{+6} weeks was lower than those with more than 32 weeks, while

those with 32~33^{+6} weeks and more than34 weeks showed no significant difference, indicating that gestational age less than 32 weeks had greater impacts on fetal body weight in this region, higher than the national average, so nutritional support treatments should be strengthened to increase the fetal body weight in utero.

The study also showed that the birth weight of the non-glucocorticoid administration group was higher than the other two groups with glucocorticoid therapy, but there was no significant difference in the Z score among these groups. It might because the gestational age on admission of the non-glucocorticoid group was higher than the other two groups with glucocorticoid therapy, so after eliminating the influence of gestational ages, no more difference could be displayed among the treatment groups, indicating that glucocorticoid therapies within one course would not affect fetal birth weight.

Short-term outcomes of preterm infants

Due to immature organ developments, complications in preterm infants would be plenty [18]. In developed countries, the survival rate of preterm infants with 24 gestational weeks was about 50%, and those with 28 gestational weeks was 90%; however, in developing countries, the survival rate of infants with 28 gestational weeks was less than 10 %, which could only be greater than 50% until the gestational age reached 34 weeks. In 2011, Chinese large-sample data showed the average mortality of preterm infants was 3.3% [11]. In this study, it was 0.82%, lower than the national average.

Respiratory complications are one type of the most common complications in preterm infants, as well as the main cause of death [19, 20]. RDS in preterm infants is caused by the deficiency of pulmonary surfactant [21]. The incidence of RDSamong who those with gestational age less than 28 weeks accounted for up to 93% [18]. Among the survived preterm infants, approximately 40% would suffer bronchopulmonary dysplasia (BPB). When the gestational age of preterm infants is increased by one week, or the birth weight is increased by 100 g, the risk OR values of BPB would be 0.77 and 0.89, respectively; therefore, gestational age and birth weight are the key factors affecting the outcomes of preterm infants. In this study, the most common complication was RDS, accounting for 13.92 %.

Another serious complication in preterm infants is necrotizing enterocolitis (NEC), and it was reported abroad to be about 7% ~11% in preterm infants with birth weight <1500 g [22]. In this study, one male preterm infant occurred NEC (delivered at 31^{+1} weeks, PPROM, birth weight 1830 g, and hospital stay 35 days), and was discharged when the body weight was increased to 1920 g. In addition, nervous system complications in preterm infants should also be paid attention to, such as hypoxic-ischemic encephalopathy, intracranial hemorrhage, retinal development, etc.Perinatal infection and maternofetal inflammation caused by different virus is strongly associated with preterm birth which represents an important mechanism for cerebral damage. .

In short, the main causes of preterm birth should be actively prevented and treated during the whole pregnancy, such PPROM; at the same time, health care during pregnancy needs to be strengthened to actively prevent and treat iatrogenic preterm birth, such as pregnancy-induced hypertensive disorders. Establishing effective intrauterine transportation system and actively administrating respiratory complications could improve the outcomes of PB infants. In this study, there still were some shortcomings, for example, the long-term outcome data of these preterm infants, such as neural development monitoring were still lack. Therefore, if the perinatal information-sharing network among all the delivery units could be formed in the future, as well as doctors in department of obstetrics and pediatrics could systematically co-survey the outcomes of preterm infants, it would provide more accurate data of preterm birth in this region even all through China, thus providing better guidance for obstetricians towards the diagnosis and treatment of preterm birth.

CONCLUSION

The most common reason for preterm birth was iatrogenic, especially the maternal diseases, The birth weight of preterm neonates were less than normal so the Z score was more reasonable to define the organ maturity; therapy with glucocorticoid within one course would not affect fetal birth weight. At the same time, since preterm birth could cause a variety of serious complications in infants, avoiding that based on pre-pregnancy physical examination, pregnancy monitoring, and proper treatment(such as PPROM); meanwhile, preterm infants should also be actively treated so as to improve their outcomes.

REFERENCES

1. Platt MJ. Outcomes in preterm infants. Public Health. 2014; 128(5): 399–403.
2. Vulić M, Roje D, Mestrović Z, Strinić T, Stipić I, Vrkić I. Is there difference in perinatal outcome of singleton and twin pregnancies after assisted conception: two-year experience. Acta Clin Croat. 2013; 52: 241–6.
3. Caserta D, Bordi G, Stegagno M, Filippini F, Podagrosi M, Roselli D, et al. Maternal and perinatal outcomes in spontaneous versus assisted conception twin pregnancies. Eur J Obstet Gynecol Reprod Biol. 2014; 174: 64–9.
4. Walker MW, Picklesimer AH, Clark RH, Spitzer AR, Garite TJ. Impact of duration of rupture of membranes on outcomes of premature infants. J Perinatol. 2014; 34(9): 669–672.
5. Ananth CV, Vintzileos A. Medically indicated preterm birth: recognizing the importance of the problem. Clin Perinatol. 2008; 35(1): 53–67.
6. Gyamfi-Bannerman C, Ananth CV. Trends in spontaneous and indicated preterm delivery among singleton gestations in the United States, 2005-2012. Obstet Gynecol. 2014; 124(6): 1069–74.
7. Blencowe H, Cousens S, Oestergaard MZ, Chou D, Moller AB, Narwal R, et al. National, regional, and worldewide estimated of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. Lancet. 2012; 379(9832): 2162–72.
8. Newnham JP, Dickinson JE, Hart RJ, Pennell CE, Arrese CA, Keelan JA. Strategies to prevent preterm birth. Front Immunol. 2014; 5: 584.
9. Brown HK, Speechley KN, Macnab J, Natale R, Campbell MK. Maternal, fetal, and placental conditions associated with medically indicated late preterm and early term delivery: a retrospective study. BJOG. 2016; 123(5): 763–70.
10. Luo XL, Zhang WY. Obstetrical disease spectrum in China: an epidemiological study of 111,767 cases in 2011. Chin Med J (Engl). 2015; 128(9): 1137–46.
11. Zou L, Wang X, Ruan Y, Li G, Chen Y, Zhang W. Preterm birth and neonatal mortality in China in 2011. Int

J Gynaecol Obstet. 2014; 127(3): 243–7.
12. Newnham JP, Sahota DS, Zhang CY, Xu B, Zheng M, Doherty DA, et al. Preterm birth rates in Chinese women in China, Hong Kong and Australia - the price of Westernisation. Aust N Z J Obstet Gynaecol. 2011; 51(5): 426–31.
13. Buchanan S, Crowther C, Morris J. Preterm prelabour rupture of the membranes: a survey of current practice. Aust N Z J Obstet Gynaecol. 2004; 44(5): 400–3.
14. Subramaniam A, Cliver SS, Smeltzer S, Tita AT, Wetta LL. Preterm premature rupture of membranes (PPROM): outcomes of delivery at 32(°/7) -33(6/7) weeks after confirmed fetal lung maturity (FLM) versus expectant management until 34(°/7) weeks. J Matern Fetal Neonatal Med. 2016; 29(12): 1895–9.
15. Henderson JJ, McWilliam OA, Newnham JP, Pennell CE. Preterm birth aetiology 2004-2008. Maternal factors associated with three phenotypes: spontaneous preterm labour, preterm pre-labour rupture of membranes and medically indicated preterm birth. J Matern Fetal Neonatal Med. 2012; 25(6): 642–7.
16. Wong AE, Grobman WA. Medically indicated--iatrogenic prematurity. Clin Perinatol. 2011; 38(3): 423–39.
17. Matthews TJ, Mac Dorman MF. Infant mortality statistics from the 2010 period linked birth/infant death data set. Natl Vital Stat Rep. 2013; 62(8): 1–26.
18. Zysman-Colman Z, Tremblay GM, Bandeali S, Landry JS. Bronchopulmonary dysplasia - trends over three decades. Paediatr Child Health. 2013; 18(2): 86–90.
19. Tennant C, Friedman AM, Pare E, Bruno C, Wang E. Performance of lecithin-sphingomyelin ratio as a reflex test for documenting fetal lung maturity in late preterm and term fetuses. J Matern Fetal Neonatal Med. 2012; 25(8): 1460–2.
20. Machado Júnior LC, Passini Júnior R, Rodrigues Machado Rosa I. Late prematurity: a systematic review. J Pediatr (Rio J). 2014; 90(3): 221–31.
21. van Baaren GJ, Peelen MJ, Schuit E, van der Post JA, Mol BW, Kok M, et al. Preterm birth in singleton and multiple pregnancies: evaluation of costs and perinatal outcomes. Eur J Obstet Gynecol Reprod Biol. 2015; 186: 34–41.
22. Choi YY. Necrotizing enterocolitis in newborns: update in pathophysiology and newly emerging therapeutic strategies. Korean J Pediatr. 2014; 57(12): 505–13.

