Original Article

The Effect of Antenatal Dexamethasone to Improve Respiratory Neonatal Outcomes in Late Preterm Birth: A Randomized Controlled Trial

Pimon Kongprayoon MD[1], Thanvarat Tilagul MD[1]

[1] Department of Obstetrics and Gynecology, Queen Savang Vadhana Memorial Hospital, Chonburi, Thailand

Objective: To evaluate the effect of dexamethasone on the rate of respiratory distress syndrome in late preterm infants

Materials and Methods: One hundred ninety-four singleton pregnant women at risk for late preterm delivery were randomly allocated into two groups. Ninety-seven patients received 6 mg dexamethasone (group 1) and 97 patients received 1.5 mL normal saline (group 2), intramuscularly every 12 hours for four doses or until delivery. The primary outcome was the rate of neonatal respiratory distress syndrome. The secondary outcomes were the need for continuous positive airway pressure (CPAP), the neonatal intensive care unit admission, the Apgar scores at 1 minute and 5 minutes, the rate of transient tachypnea of the newborn (TTN), intraventricular hemorrhage, neonatal hypoglycemia, neonatal sepsis, and adverse effects.

Results: The rate of neonatal respiratory distress syndrome was lower in group 1, five cases (5.2%), compared with group 2, six cases (6.2%) (p=0.756, relative risk 0.83, 95% CI 0.26 to 2.64). The need for CPAP, NICU admission, rate of TTN, and intraventricular hemorrhage were not significantly different. Group1 had significantly higher Apgar scores at 1 minute and 5 minutes (p=0.021 and 0.043, respectively). No adverse effects were reported.

Conclusion: Administration of dexamethasone in late preterm birth did not decrease the rate of neonatal respiratory distress and the need for CPAP and NICU admission but statistically significantly improved the Apgar scores at 1 minute and 5 minutes. More research in the future is needed to correct the limitation in the present study.

Keywords: Late preterm, Dexamethasone, Respiratory distress syndrome, Apgar scores

Received 14 September 2020 | Revised 8 November 2020 | Accepted 12 November 2020

J Med Assoc Thai 2021;104(4):514-21

Website: http://www.jmatonline.com

Preterm birth is the main cause of both short-term and long-term complications in infants, including cerebral palsy, sensory deficit, slow development, and respiratory illness[1,2]. Every year, at least one out of 10 births globally is reported as a preterm. Fifteen million people (11%) give birth before 37 weeks gestation. Further, more than one million infants die[3]. Preterm birth not only decreases quality of life for both infants and mothers, but also requires a significant amount of resources to take care of them. In developed countries, the preterm birth rate is approximately 5% to 7%, which is lower than that in developing countries. Late preterm birth rates among singleton births vary from 3% to 6%. Infant mortality is about four times higher for late preterm births and about 50% higher for early term births compared to full-term births[4]. In Thailand, the rate of preterm birth was 12% in 2010 (100,700 out of 838,300 live births), ranking 55th in the world[5]. Between 2015 and 2017, the preterm birth rate for Queen Savang Vadhana Memorial Hospital was between 9% to 13%. Even though, late preterm birth (34 to 36^{+6} weeks gestation) has lower risk and complications than other stages of gestations, recent studies have indicated that late preterm birth has higher risks than birth at term due to immaturity[6-8]. The hospitalization rate for late preterm infants at Queen Savang Vadhana Memorial Hospital between January 2017 and June 2018 was 29.2% (194 out of 663 infants), which is considered a high rate. In current practice, a single course of corticosteroids is recommended only for pregnant women who are between 24 and 36^{+6} weeks gestation and at risk for preterm delivery within seven days[9]. Recently, the 2017 Cochrane Review showed a significant decrease

Correspondence to:

Kongprayoon P.

Department of Obstetrics and Gynecology, Queen Savang Vadhana Memorial Hospital, Jermjomphon street, Chonburi, 20110, Thailand

Phone: +66-89-6666966

Email: pimonkong@gmail.com

How to cite this article:

Kongprayoon P Tilagul T. The Effect of Antenatal Dexamethasone to Improve Respiratory Neonatal Outcomes in Late Preterm Birth: A Randomized Controlled Trial. J Med Assoc Thai 2021;104:514-21.

doi.org/10.35755/jmedassocthai.2021.04.11814

in severe respiratory distress syndrome (RDS) among those receiving antenatal corticosteroid therapy and provided evidence regarding the routine administration of antenatal corticosteroid therapy to women at risk of later preterm delivery[10]. The American College of Obstetricians and Gynecologists (ACOG) recommended that administration of antenatal corticosteroid is considered for pregnant women at high risk of late preterm birth and that have not received a prior course of antenatal corticosteroids[9]. Saccone et al. showed infants of mothers who received antenatal corticosteroid at 34 weeks or later had a significantly lower risk of RDS, use of surfactant, and mechanical ventilation, and lower time receiving oxygen[11]. Secondary analysis of the Antenatal Late Preterm Steroids (ALPS) showed that antenatal betamethasone treatment is associated with a statistically significant decrease in health care costs and with improved outcomes[12]. The ACOG and the Royal College of Obstetricians and Gynecologists list both as effective drugs for preventing complications of prematurity, using either a dosage of 24 mg dexamethasone (four 6 mg doses 12 hours apart) or 24 mg betamethasone (two 12 mg doses 24 hours apart)[9,13]. Betamethasone has been more commonly used in studies, which is not available at our hospital, and a small number of studies have evaluated the efficacy of dexamethasone in late preterm population. Dexamethasone has many advantages including lower cost than betamethasone, widespread availability, and less effect on fetal biophysical variables[14]. According to the Chonburi Provincial Health Office, it not only supports the prevention of preterm birth, but also establishes guidelines for reducing premature infant complications along with some hospital in Thailand that have limited equipment and potential care for premature babies.

The present study aimed to evaluate the effect of dexamethasone on rate of neonatal RDS in pregnant women with 34 to 36^{+6} weeks gestation. The results could be useful for clinical practice guidelines at Queen Savang Vadhana Memorial Hospital and other hospital in Thailand to reduce potential complications in late preterm infants and the cost of hospitalization.

Materials and Methods

The present study was a randomized controlled trial (RCT) conducted at Queen Savang Vadhana Memorial Hospital, Chonburi, Thailand. The study protocol was approved by The Research and Ethical Committee of Queen Savang Vadhana Memorial Hospital (IRB No. 007/2562) and registered with the Thai Clinical Trials Registry (TCTR20201108003). All participants have given their written informed consent.

Pregnant women with singleton pregnancies at 34 to 36^{+6} weeks gestation and at risk of preterm delivery within seven days admitted to the labor room at Queen Savang Vadhana Memorial Hospital between May 2019 and January 2020 were enrolled in the study. The authors calculated gestational age based on the last menstrual period (LMP) and correlated with an ultrasound measurement following the ACOG practice bulletin number 175 at first visit of antenatal care[15]. Criteria for inclusion were women (a) had preterm labor defined as regular uterine contractions before 37 weeks accompanied by a change of cervical dilatation, effacement, or both, or initial presentation with regular contractions and cervical dilatation at least 2 cm[16], or (b) had spontaneous rupture of membranes (preterm PROM), diagnosed by pooling of fluid at posterior fornix with speculum examination, positive cough test and positive alkaline pH test, or (c) had fetal or maternal indications for delivery between 34 and 36^{+6} weeks gestation, such as placenta previa or fetal growth restriction. The authors excluded women with multiple gestations, those received a previous course of corticosteroids, infection or chorioamnionitis (fetal tachycardia greater than 160 bpm, maternal fever higher than 37.8°C and foul-smelling amniotic fluid) during labor, overt diabetes mellitus, gestational diabetes mellitus, cervical dilation more than 5 centimeters, thrombocytopenia, allergy to corticosteroids, pre-eclampsia severe feature, and HELLP syndrome.

Two hundred seventy-seven women were assessed for eligibility and 83 were deemed ineligible. After explaining the study details and obtaining their inform consent, the authors randomized the 194 eligible women into intervention group and placebo group by a resident or attending physician using simple random sampling by picking the envelope (1:1). The envelope was taken to the head nurse to prepare the medicine. The other nurse who took care of the patient was the person injecting the medicine. Intervention group (group 1) received dexamethasone 6 mg administered intramuscularly every 12 hours for four doses or until delivery. The placebo group (group 2) received normal saline 1.5 mL administered intramuscularly every 12 hours for four doses or until delivery. The authors blinded the patients and healthcare providers who injected medicine by using identical-looking syringes for dexamethasone and normal saline. Patients were also

blinded to which group they belonged. When became active phase, ampicillin 2 grams was administered intravenously followed by ampicillin 1 gram every four hours until delivery. In the authors' institute, augmentation of labor was done immediately if they had preterm PROM or a subsequent rupture of the membrane according to ACOG practice bulletin 188[17]. The authors recorded the vital signs of all women at 30 minutes after they received the intervention then every four hours and observed any adverse effects for both pregnant women and their infants until discharge from the hospital. The pediatrician who checked the babies did not know which group the baby belonged. After randomization, there were no cases lost to follow-up.

After delivery, study personnel blinded to the group assignments reviewed and documented the prenatal, delivery, neonatal, postpartum records, side effects, and adverse effects. The primary outcome was rate of neonatal RDS. The RDS has characteristic clinical signs including tachypnea, prominent (often audible) expiratory grunting, intercostal and subcostal retractions, nasal flaring, and cyanosis at birth with the presence of the characteristics, but not pathognomonic radiological findings appearance that includes low lung volume, a diffuse, fine reticular granularity of the parenchyma (ground-glass appearance), and air bronchograms[18]. The authors also recorded secondary outcomes including the need for respiratory support using continuous positive airway pressure (CPAP), duration of neonatal intensive care unit (NICU) admission, Apgar scores at 1 minute and 5 minutes, rate of transient tachypnea of the newborn (TTN), intraventricular hemorrhage, neonatal hypoglycemia, neonatal sepsis, and adverse effects. TTN is a clinical syndrome of self-limited tachypnea associated with the delayed clearance of fetal lung fluid, characterized by the early onset of tachypnea of more than 60 bpm, sometimes with retractions or expiratory grunting and occasionally with cyanosis that is vascular markings, fluid in the intralobar fissures, and rarely small pleural effusions[18]. Neonatal hypoglycemia was diagnosed by glucose levels less than 40 mg/dL in the symptomatic group, and less than 25 mg/dL in asymptomatic groups within four hours of birth[19].

Based on Balci (2010), respiratory distress in the unexposed group is 16% (p1=0.04, p2=0.16)[20]. A 50% reduction is expected with the intervention. Thus, a type I error of 5% and Zβ was set as 0.84 for 80% power based on Kelsey and Fleiss continuity correction. A sample size of 97 was required in each group and the total sample size was 194[21,22]. The analyses were performed using IBM SPSS Statistics, version 23.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed using mean and standard deviation (SD), compared with independent sample t-test. Categorical variables were presented as number and percentages, compared with chi-square test. Comparison of results, side effects and rates of complications between the dexamethasone groups and placebo was carried out using Z-test for proportion difference. The authors performed a per-protocol analysis in the present study. A p-value of less than 0.05 was considered statistically significant.

Results

One hundred ninety-four women were randomly assigned into two study groups. Ninety-seven patients in the intervention group and 97 patients in the control group were analyzed (shown in Figure 1). There was no significant difference between groups in baseline characteristics, mode of delivery, time from admission to delivery, gender, and birth weight of infant (shown in Table 1). Most of them had corrected gestational age in the first trimester and delivered within 12 hours after admission. Fifty-eight women (59.8%) received one dose of dexamethasone. Only 23 women (23.7%) completed the full dexamethasone course before delivery and all infants had no RDS. There was no statistically significant decreased rate of RDS and decreased in the need for CPAP and NICU admission in the dexamethasone group. All of infants with RDS in the dexamethasone group received only one dose of dexamethasone. Apgar scores at 1 minute and 5 minutes was statistically higher in the dexamethasone group. The rate of TTN, neonatal hypoglycemia, and neonatal sepsis were not different between the two groups. There were no reported adverse events related to hypoglycemia. No intraventricular hemorrhage was apparent. No maternal adverse effects were reported (shown in Table 2).

Discussion

The present study was a randomized control trial illustrating that antenatal dexamethasone administration to pregnant women at risk of late preterm delivery did not decrease the rate of RDS in primary outcome, nor did it decrease the need for CPAP, NICU admission, rate of TTN, and intraventricular hemorrhage significantly. Dexamethasone administration had statistically significant higher Apgar scores at 1 minute and 5 minutes and did not significantly affect neonatal infection rates, neonatal hypoglycemia, or maternal

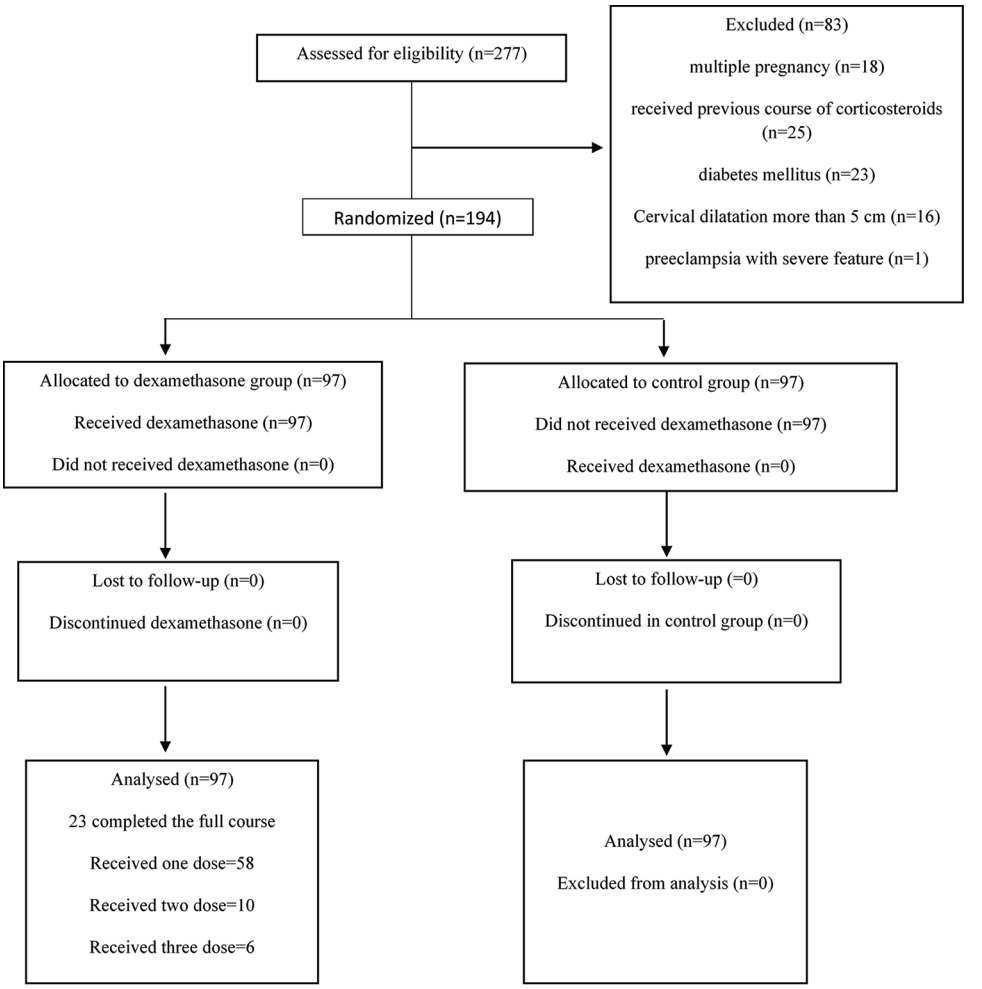

Figure 1. Enrollment, randomization, follow-up, and analysis of participants.

adverse effects.

Several studies have shown that corticosteroid administration can reduce neonatal respiratory and other complications. From the results of RCT using betamethasone by Maternal-Fetal Medicine units center, the study found a significant decrease in the need for respiratory support requirement in the first 72 hours, rates of severe respiratory morbidity, rates of NICU admission, but there was no difference in rate of RDS[23]. Moreover, the results of prospective observational study by Serrano et al[24] in the betamethasone group revealed significantly lower rates of NICU admission, RDS, respiratory support use, and neonatal hypoglycemia in the late preterm infants. Similar to Gyamfi-Bannerman et al published ALPS study in 2016[25], the betamethasone group in singleton pregnancy showed significantly reduced severe respiratory morbidity, severe respiratory complications, TTN, surfactant use, and bronchopulmonary dysplasia in late preterm birth. There was no significant difference in the rate of RDS. Some studies have shown no statistically significant results. Porto et al conducted a small RCT administering betamethasone for pregnant women at risk of later preterm birth. The result was no difference in respiratory morbidity, mechanical ventilation, RDS, or NICU admission, but this trial was underpowered for primary outcome and had a high rate of loss to follow-up[26]. In another study, Ramadan et al conducted a prospective cohort study to examine the effect of antenatal corticosteroids on the incidence of short-term neonatal morbidities in singletons born during the late preterm period. There was no statistically significant difference in the rates of NICU admission, RDS, TTN, and need for phototherapy[27].

Table 1. Baseline characteristics of participants and neonates in this study (n=194)

Characteristics	Dexamethasone group (n=97); n (%)	Placebo group (n=97); n (%)	p-value
Maternal			
Nationality			0.929
• Thai	92 (94.8)	91 (93.8)	
• Burmese	2 (2.1)	2 (2.1)	
• Cambodia	3 (3.1)	4 (4.1)	
Age (years); mean±SD	30.0±5.6	28.6±4.9	0.067
BMI (kg/m^2); mean±SD	26.7±4.3	26.9±4.4	0.805
Parity			0.246
• Nulliparous	38 (39.2)	46 (47.4)	
• Multiparous	59 (60.8)	51 (52.6)	
Gestational age (weeks)			0.957
• 34 to 34^{+6}	39 (40.2)	37 (38.1)	
• 35 to 35^{+6}	26 (26.8)	27 (27.8)	
• 36 to 36^{+6}	32 (33.0)	33 (34.0)	
Correct gestational age			0.455
• First trimester	69 (71.1)	67 (69.1)	
• Second trimester	21 (21.6)	18 (18.6)	
• Third trimester	7 (7.2)	12 (12.4)	
Maternal condition			
• Gestational hypertension	3 (3.1)	3 (3.1)	1.000
• Chronic hypertension	3 (3.1)	2 (2.1)	0.650
• Preeclampsia non severe feature	2 (2.1)	1 (1.0)	0.561
• Anemia	15 (15.5)	11 (11.3)	0.399
Neonatal			
Mode of delivery			0.267
• Vaginal	88 (90.7)	92 (94.8)	
• Cesarean section	9 (9.3)	5 (5.2)	
Sex			0.774
• Male	49 (50.5)	51 (52.6)	
• Female	48 (49.5)	46 (47.4)	
Birth weight (g); mean±SD	2,691.6±422.4	2,730.8±414.8	0.516
Time from admit to delivery			0.097
• <12 hours	58 (59.8)	51 (52.6)	
• 12 to <24 hours	10 (10.3)	23 (23.7)	
• 24 to <48 hours	27 (27.8)	21 (21.6)	
• >48 hours	2 (2.1)	2 (2.1)	

SD=standard deviation; BMI=body mass index

The present study protocol did not provide the use of tocolytic drugs, suggesting that the differences in the occurrence of primary and secondary outcomes were due to dexamethasone administration. A significant challenge in predicting time of birth involves identifying those pregnant women at risk for delivery within seven days after dexamethasone administration. Because of augmentation after prelabor rupture of membranes, most women delivered within 12 hours. Only 23.7% of participants received four doses, while 59.8% of participants received only one dose of dexamethasone. This approximation would likely have reduced the effect of dexamethasone, which might cause the result to be underestimated if

Table 2. Outcomes of the dexamethasone and placebo groups (n=194)

Outcome	Dexamethasone group (n=97); n (%)	Placebo group (n=97); n (%)	p-value	Relative risk (95% CI)
Primary outcome				
RDS within 72 hours	5 (5.2)	6 (6.2)	0.756	0.833 (0.26 to 2.64)
34 to 34^{+6}	3/39 (7.7)	4/37 (10.8)	0.638	0.71 (0.17 to 2.97)
35 to 35^{+6}	1/26 (3.8)	1/27 (3.7)	0.978	1.038 (0.07 to 15.75)
36 to 36^{+6}	1/32 (3.1)	1/33 (3.0)	0.982	1.031 (0.07 to 15.79)
	1 dose	0 dose		
Secondary outcomes				
Neonatal outcomes				
RDS on CPAP				
• <96 hours	5 (100)	5 (83.3)	0.338	1.200 (0.84 to 1.72)
• ≥96 hours	0 (0.0)	1 (16.7)		Reference
RDS with NICU admission				
• <7 days	5 (100)	4 (66.7)	0.154	1.500 (0.85 to 2.64)
• ≥7 days	0 (0.0)	2 (33.3)		Reference
Apgar score; mean±SD				-
• 1 minute	8.01 (0.23)	7.90 (0.42)	0.021*	
• 5 minutes	8.97 (0.34)	8.86 (0.43)	0.043*	
TTN	2 (2.1)	2 (2.1)	1.000	1.010 (0.14 to 6.96)
Intraventricular hemorrhage	0 (0.0)	0 (0.0)	-	-
Neonatal hypoglycemia	5 (5.2)	7 (7.2)	0.551	0.714 (0.24 to 2.17)
Neonatal sepsis	8 (8.2)	5 (5.2)	0.389	1.600 (0.54 to 4.72)
Maternal outcomes				
Drug allergy				
• Anaphylaxis	0 (0.0)	0 (0.0)	-	-
• Acute urticaria	0 (0.0)	0 (0.0)	-	-
Chorioamnionitis	0 (0.0)	0 (0.0)	-	-

CI=confidence interval; RDS=respiratory distress syndrome; CPAP=continuous positive airway pressure; NICU=neonatal intensive care unit; TTN=transient tachypnea of the newborn; SD=standard deviation

* p<0.05 at significant

a full dose of dexamethasone was given. However, the frequency of the primary outcome in the present study was lower in pregnant women who delivered at 36 to 36^{+6} weeks compared with those who delivered at 34 to 35^{+6} weeks gestation, which is the same as the ALPS study[25]. The present study findings are consistent with the results of a prospective cohort study by Balci et al[20]. Apgar scores were significantly better in the betamethasone group[20]. In addition, Karakaya et al found that corticosteroids group had no statistically significant difference in rate of respiratory problems but had statistically significant higher Apgar scores[28]. Meta-analyses showed that neonatal hypoglycemia occurs significantly more frequently following antenatal corticosteroid administration in pregnant women at risk of later preterm delivery[25,26]. On the contrary, the present study found rates of neonatal hypoglycemia was not significantly different between the two groups.

In long term complications, follow-up data in preterm newborns who received antenatal corticosteroids does not suggest any increased risk for long-term adverse effects[23]. There are few human studies evaluating the neurodevelopmental outcomes in late preterm birth who received antenatal corticosteroid. Stutchfield et al evaluated between six and ten-year-old children who were exposed to a single course of antenatal corticosteroid prior to delivery at term[29]. There were no differences in hyperactivity, emotional symptoms, conduct or peer problems, or level achievement in standardized testing. Dalziel et al found no effect of betamethasone,

which included subjects up to 37 weeks' gestation on cognitive functioning or psychiatric morbidity in 30 years of follow-up of the original RCT by Liggins and Howie[30]. Benefits of antenatal corticosteroid should be weighted in context of the associated risks. There is concern for future neurodevelopment that will require long term follow-up.

The strengths of the present study included 1) the use of a double blind RCT design, and 2) that no participant was loss to follow-up. However, there were some limitations in that 1) most cases received only one dose of dexamethasone, 2) augmentation of labor was done immediately if there had preterm PROM or subsequent rupture of the membrane according to currently practice guideline, and 3) the sample size was small.

Conclusion

The administration of dexamethasone for pregnant women at risk of late preterm does not decrease the rate of RDS, or the need for CPAP and NICU admission. It significantly improved Apgar scores at 1 minute and 5 minutes.

What is already known on this topic?

In August 2017, the ACOG advise a single course of corticosteroids recommended only for pregnant women who are between 24 weeks and 36^{+6} weeks gestation and at risk for preterm delivery within seven days to decrease severity, frequency, or both of RDS, other neonatal morbidity and mortality.

Administration of antenatal corticosteroid may be considered for pregnant women at high risk of late preterm birth and have not received a prior course of antenatal corticosteroids.

What this study adds?

The findings found that administration of antenatal corticosteroid for pregnant women at high risk of late preterm birth does not decrease neonatal morbidity and mortality significantly. More research in the future is needed to correct the limitation in this study.

Acknowledgement

The authors acknowledge Chuenrutai Yeekian, PhD, Center for Supporting and Developing Research, Queen Savang Vadhana Memorial Hospital, Chonburi, Thailand, Alisara Wongsuttilert, MD, Faculty of Medicine, Burapha University, Thailand, Wanlop Jaidee, PhD, Faculty of Public Health, Burapha University, Thailand for collaboration in this study.

Authors' contributions

Tilagul T, conceived the study, contributed to the study design and statistical analysis plan, reviewed, and revised the manuscript.

Conflicts of interest

The authors have no conflicts of interest to declare.

References

1. American College of Obstetricians and Gynecologists. Practice bulletin No. 159: Management of preterm labor. Obstet Gynecol 2016;127:e29-38.
2. Beck S, Wojdyla D, Say L, Betran AP, Merialdi M, Requejo JH, et al. The worldwide incidence of preterm birth: a systematic review of maternal mortality and morbidity. Bull World Health Organ 2010;88:31-8.
3. World Health Organization. Preterm birth [Internet]. 2015 [cited 2020 Aug 13]. Available from: http://www.who.int/mediacentre/factsheets/fs363/en/.
4. Delnord M, Zeitlin J. Epidemiology of late preterm and early term births - An international perspective. Semin Fetal Neonatal Med 2019;24:3-10.
5. Howson CP, Kinney MV, Lawn JE. Born too soon: The global action report on preterm birth. Geneva: March of Dimes, PMNCH, Save the Children, WHO; 2012.
6. Darcy AE. Complications of the late preterm infant. J Perinat Neonatal Nurs 2009;23:78-86.
7. Guasch XD, Torrent FR, Martínez-Nadal S, Cerén CV, Saco MJ, Castellví PS. Late preterm infants: A population at underestimated risk. An Pediatr (Barc) 2009;71:291-8.
8. Khashu M, Narayanan M, Bhargava S, Osiovich H. Perinatal outcomes associated with preterm birth at 33 to 36 weeks' gestation: a population-based cohort study. Pediatrics 2009;123:109-13
9. American College of Obstetricians and Gynecologists. Committee Opinion No. 713: Antenatal corticosteroid therapy for fetal maturation. Obstet Gynecol 2017;130:e102-9.
10. Roberts D, Brown J, Medley N, Dalziel SR. Antenatal corticosteroids for accelerating fetal lung maturation for women at risk of preterm birth. Cochrane Database Syst Rev 2017;3:CD004454.
11. Saccone G, Berghella V. Antenatal corticosteroids for maturity of term or near term fetuses: systematic review and meta-analysis of randomized controlled trials. Bmj 2016;355:i5044.
12. Gyamfi-Bannerman C, Zupancic JAF, Sandoval G, Grobman WA, Blackwell SC, Tita ATN, et al. Cost-effectiveness of antenatal corticosteroid therapy vs no therapy in women at risk of late preterm delivery: A secondary analysis of a randomized clinical trial. JAMA Pediatr 2019;173:462-8.
13. Royal College of Obstetricians and Gynaecologists. Antenatal corticosteroids to prevent respiratory

distress syndrome. RCOG Guideline No. 7 Revised February 2004.
14. Elimian A, Garry D, Figueroa R, Spitzer A, Wiencek V, Quirk JG. Antenatal betamethasone compared with dexamethasone (betacode trial): a randomized controlled trial. Obstet Gynecol 2007;110:26-30.
15. Committee on Practice Bulletins—Obstetrics and the American Institute of Ultrasound in Medicine. Practice bulletin No. 175: Ultrasound in pregnancy. Obstet Gynecol 2016;128:e241-56.
16. American College of Obstetricians and Gynecologists' Committee on Practice Bulletins—Obstetrics. Practice bulletin No. 171: Management of preterm labor. Obstet Gynecol 2016;128:e155-64.
17. Kuba K, Bernstein PS. ACOG Practice bulletin No. 188: Prelabor rupture of membranes. Obstet Gynecol 2018;131:1163-4.
18. Ahlfeld SK. Respiratory tract disorders. In: Kliegman RM, St. Geme JW, Schor NF, Blum NJ, Shah SS, Tasker RC, et al, editors. Nelson textbook of pediatrics. 21st ed. Philadelphia, PA: Elsevier; 20203. p. 929-49. e1.
19. Adamkin DH. Committee on Fetus and Newborn. Adamkin DH. Postnatal glucose homeostasis in late-preterm and term infants. Pediatrics 2011;127:575-9.
20. Balci O, Ozdemir S, Mahmoud AS, Acar A, Colakoglu MC. The effect of antenatal steroids on fetal lung maturation between the 34th and 36th week of pregnancy. Gynecol Obstet Invest 2010;70:95-9.
21. Cochran WG. Sampling techniques. 2nd ed. New York: John Wiley and Sons; 1963.
22. Chow SC, Sao J, Wang H. Sample size calculations in clinical research. 2nd ed. United States of America: Chapman and Hall/CRC; 2008.
23. Society for Maternal-Fetal Medicine (SMFM) Publications Committee. Implementation of the use of antenatal corticosteroids in the late preterm birth period in women at risk for preterm delivery. Am J Obstet Gynecol 2016;215:B13-5.
24. Gázquez Serrano IM, Arroyos Plana A, Díaz Morales O, Herráiz Perea C, Holgueras Bragado A. Antenatal corticosteroid therapy and late preterm infant morbidity and mortality. An Pediatr (Barc) 2014;81:374-82. [In Spanish]
25. Gyamfi-Bannerman C, Thom EA, Blackwell SC, Tita AT, Reddy UM, Saade GR, et al. Antenatal betamethasone for women at risk for late preterm delivery. N Engl J Med 2016;374:1311-20.
26. Porto AM, Coutinho IC, Correia JB, Amorim MM. Effectiveness of antenatal corticosteroids in reducing respiratory disorders in late preterm infants: randomised clinical trial. Bmj 2011;342:d1696.
27. Ramadan MK, Hussein G, Saheb W, Rajab M, Mirza FG. Antenatal corticosteroids in the late preterm period: A prospective cohort study. J Neonatal Perinatal Med 2016;9:15-22.
28. Karakaya BK, Tasci Y, Yoruk O, Kansu-Celik H, Canpolat FE. Comparing neonatal respiratory morbidity in neonates delivered after 34 weeks of gestation with and without antenatal corticosteroid. Pak J Med Sci 2017;33:1390-4.
29. Stutchfield PR, Whitaker R, Gliddon AE, Hobson L, Kotecha S, Doull IJ. Behavioural, educational and respiratory outcomes of antenatal betamethasone for term caesarean section (ASTECS trial). Arch Dis Child Fetal Neonatal Ed 2013;98:F195-200.
30. Dalziel SR, Lim VK, Lambert A, McCarthy D, Parag V, Rodgers A, et al. Antenatal exposure to betamethasone: psychological functioning and health related quality of life 31 years after inclusion in randomised controlled trial. BMJ 2005;331:665.