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Risk Factors for Late Preterm Infants in One Public Hospital at Banyumas District Indonesia

Haryatiningsih Purwandari, Eni Rahmawati, Aprilia Kartikasari
Jurusan Keperawatan, Fakultas Ilmu Ilmu Kesehatan, Universitas Jenderal Soedirman

ABSTRACT

Background. Late preterm infants are near-term infants, but it is a critical development period. Evidence supported that late preterm infants' birth impact on the short-and long-term outcomes. Investigating the risk factors associated with late preterm infants in Indonesia is important since Indonesia has a high number of preterm infants. However, a limited study investigating risk factors for late-preterm infants in Indonesia.

Methods. A cross-sectional study was used in this study. A convenience sample of 46 dyads of mothers and preterm infants (33 late preterm infants aged equal and more than 34 weeks gestation as case, and 13 preterm infants age < 34 weeks gestation as control) retrieved from level 1 and 2 neonatal care in one public hospital at Banyumas district, Indonesia. Self-reported questionnaire and medical record were utilized to collecting the data. Univariate, Chi-Square, Logistic regression, Hosmer and Lemeshow test, and Area under Curve with Receiver Operating Curve method (AUC ROC) were used in this study.

Results. Working mother had risk 16.2 times for developing late preterm infant (LPI) compared to housewife (OR= 16.2; 95% CI: 2.315-123.444). Mother's age < 31 years old, and multipara mother were found as the protective factors for delivering LPI (OR= .148; 95%CI: .013-1.632; OR=.059; 95%CI: .004-.927), however, the chance as the protective factors of LPI seems very low. The model prediction was y= 2.900-1.913 (mothers' age) -2.833 (parity) +2.828 (mothers'occupation). Application the model was discussed. Hosmer and Lemeshow test demonstrated that the model had good calibration (p=.869).The AUC ROC was .809 indicated the model had good discriminant.

Conclusion. The LPIs' birth can be predicted by the mothers' age, parity, and occupation. The mothers' occupation was identified as the dominant factor in the model prediction. The model for predicting LPIs' delivery had good quality and can be used for predicting the LPIs' birth in the clinical practice.

KEYWORDS
Late preterm infants, prediction model, risk factors, Indonesia

BACKGROUND

Late-preterm infants (LPIs) are defined as those born at 340/7 weeks' gestational age (GA) until 366/7 weeks' GA since the first day of the mother's last menstrual period (Engle et al., 2007). Late preterm infants were born near-term, but they still immature and a critical development period time. During the last six weeks' gestational age, LPIs interrupt the normal fetal development that signifies for the brain and lung's development (Kugelman and Colin, 2013)

One study comparing term infants and healthy LPIs on respiratory function found that LPIs has decreased respiratory compliance and time to peak tidal expiratory flow to expiratory time (McEvoy et al., 2013). Another study focus on the school outcomes of LPIs found that LPIs had 30% higher adjusted of special education need than those delivered full-term. LPIs also had lower adjusted math and English score than those full-term infants (Lipkind et al., 2012).

According to Blencowe's study, Indonesia was identified as the fifth country in the world with a high number of preterm infants. Moreover, Indonesia placed as 11th country in the world with the preterm infants' birth rate more than 15% annually (Blencowe et al., 2013) . One of the hospitals in Indonesia with a high number of preterm infants' delivery located in Banyumas district. One previous study in one hospital at Banyumas district found that preterm infants' birth rate at the hospital reached 342 cases of the 3137 infants' delivery (10.9%) in 2013 (Anasari and Pantiawati, 2016). It means that every 10 infants' birth there is one preterm infant's delivery.

Since the LPIs'delivery effects on the preterm infants' short and long-term outcomes (Kugelman and Colin, 2013, Lipkind et al., 2012, McEvoy et al., 2013), investigating the related factors for LPI's delivery is important. One previous study supported that mothers' age, parity, and occupation as predictor variables for preterm infants' delivery (Anasari and Pantiawati, 2016). Mothers' education also identified as one of the predictors for preterm infants' delivery (Sulistiarini and Berliana, 2014). However, limited research in Indonesia for investigating risk factors for preterm infants based on their age categorization. The preterm infants can be categorized as extremely (< 28 weeks' GA), very (28-<32 weeks' GA), moderate

(31-<34 weeks' GA), and LPIs that born at $34^{0/7}$ to < $37^{6/7}$ weeks' GA (Blencowe et al., 2013, Engle et al., 2007). The proportion of the moderate and late preterm infants was identified as the highest proportion compared to other preterm infants' categories in one national referral hospital in Indonesia (Sungkar et al., 2017).

Therefore, this research was intended: 1) to find risk factors related to LPIs in one public hospital at Banyumas district, Indonesia; 2) to result in the model for predicting the LPIs' delivery; 3) to investigate probability of the mother to deliver the LPI using a simulation case; 4) to test the quality of the prediction model using calibration and discriminant test.

RESEARCH METHOD

A cross-sectional study was used in this study. A convenience sample of 46 dyads of mothers and their preterm infants (33 LPIs as case and 13 preterm infants <34 weeks' GA as control) were recruited from level 1 and 2 neonatal care at one public hospital in Banyumas district, Indonesia. This study was part of the main project of the mothers and preterm infants' interaction study. Data retrieved from March to June 2017. The inclusion criteria for preterm infants and mothers were born less than 37 weeks' GA, clinically stable, mothers'literacy and consent to join in this study. Late preterm infants with a ventilator or Continuous Positive Airway Pressure (CPAP) was excluded from the study.

This study passed ethical review by Margono Soekarjo Hospital ethical board. Before collecting the data, the mothers were given an explanation about the aims and benefit of the study by the researchers. Then, mothers gave their consent to join in this study. A self-designed self-reported questionnaire was used to collecting mother's age, education, parity, and occupation. The preterm infants' category was identified from medical records. Shapiro-Wilk analysis for sample size < 50 (Dahlan, 2010), showed that variables mother's age, and the number years of education not normally distributed ($p< .05$; $p< .01$ respectively). The variables were categorized using a cut- off point using mean. Mother's age was differentiated as mother's age ≥ 31 years old (y.o.) and < 31 y.o. Mother's education was divided as mother's education ≥ 10 years and < 10 years.

Another variable such as mothers' occupation, parity, and preterm infants' category were categorized based on the review of literature and learning experience from prior study. Preterm infants were categorized as Late Preterm Infants born (LPIs) for infants who were born at 34 weeks' GA to < 37 weeks' GA and preterm infants (PT) born for infants who were born < 34 weeks' GA. Parity differentiated as primi- and multipara. The mothers' occupation was divided as house-wife and worker (i.e. public/private staff, business women, farmer, and labor).

Bivariate analysis and multivariate analysis using regression logistic with a backward method were used for analyzing the data. The variables with *p*-value <.25 were included in the multivariate analysis. The quality of the model was analyzed using calibration and discriminant test. The calibration test using Hosmer and Lemeshow to test for goodness of fit the regression logistic model. The test assesses whether or not the observed event rates match expected event rates in subgroups of the model population. The *p*-value >.05 represents the model has good calibration (Dahlan, 2013).

The discriminant test was tested with assessing the Area Under Curve (AUC) using Receiver Operating Curve (ROC) method. The test examines whether the model able to discriminate between two categories which comprise the researchers' our target variable. The AUC ROC value >50%-60% indicated a very weak model The value >60%-70% of AUC ROC represented a weak model. Value of AUC ROC >70%-80% indicated moderate model. Value of AUC ROC >80%-90% indicated a strong model, and value >90%-100% represented a very strong model to discriminating between two categories (Dahlan, 2013).

RESULT

The study involved 46 dyads of mothers and preterm infants from level 1 and 2 neonatal care in one public hospital in Banyumas district, Indonesia that consisted of 33 dyads mothers with LPIs (aged ≥ 34 - < 37 weeks' GA) and 13 preterm infants aged < 34 weeks' GA.

Table 1 showed that the respondents' characteristics in total were dominated by the mothers' age of more than 31 y.o. (24 or 52.2 %), education more than 10 years (24 or 52.2%), multipara (33 or 71.7%), worked as house-wife (35 or 76.1), and LPIs (33 or 71.7%). In detail, the mothers' age from 18 to 44 y.o and mothers' education from 6-17 years.

Table 1. Characteristic of respondents

Variables		Late preterm infants aged ≥ 34 -<37 weeks' GA (n=33)		Preterm infants aged < 34 weeks GA (n=13)		Total	
		n	%	n	%	n	%
Mothers' age (year)	< 31 y.o.	18	81.8	4	18.2	22	47.8
	≥ 31 y.o.	15	62.5	9	37.5	24	52.2
Mothers' education (year)	< 10 years	18	81.8	4	18.2	22	47.8
	≥ 10 years	15	62.5	9	37.5	24	52.2
Parity	multipara	24	72.7	9	27.3	33	71.7
	primipara	9	69.2	4	30.8	13	28.3
Mothers' occupation	Worker	4	36.4	7	63.6	11	23.9
	House-wife	29	82.9	6	17.1	35	76.1

The bivariate analyses (see table 2) showed that only mothers' occupation had a significant association with the dependent variable. However, all variables with p <.25 were also included into multivariate analyses (Dahlan, 2020), since mother's age, education, and parity may influence the LPIs' delivery based on prior studies (Sulistiarini and Berliana, 2014, Anasari and Pantiawati, 2016).

Table 3 particulary step 2 showed that working mothers have risk 16.9 times (see OR) for developing LPIs (95% CI: 2.315-123.444). The mothers' age < 31 y.o. reduced .148 times (see negative value in coefficient's column and OR) for delivering LPIs (95% CI: .013-1.632), while multipara mothers diminished .059 times for developing LPIs (95%CI: .004-.927). Although the mothers' age < 31 y.o and multipara mothers were identified as protective factors of LPIs, the possibility as the protective factors for LPIs seems very low.

The final model for predicting the LPIs' delivery can be seen in figure 1. The application of the model in predicting the LPIs' delivery can be seen in figure 2.

In this article, we also give a simulation case for predicting the LPIs' delivery using the model and its' application. For example, we meet one mother aged 20 y.o., multipara mother, and worked as private staff. The mother's age 20, multipara, working mother were given score 1, 1, 1, respectively. Then, the scores are calculated using the model and its application using the formula.

Table 2. Bivariate analyses

Variables		Late preterm infants (n=33)		Preterm Infants (n=13)		*p*	OR	CI 95%	
		n	%	n	%			Min	Max
Mothers' age	< 31 y.o.	18	81.8	4	18.2	.146	.370	.095	1.447
	≥ 31 y.o.	15	62.5	9	37.5				
Mothers' education	< 10 years	18	81.8	4	18.2	.146	2.700	.691	10.547
	≥ 10 years	15	62.5	9	37.5				
Parity	multipara	24	72.7	9	27.3	1	1.185	.291	4.830
	primipara	9	69.2	4	30.8				
Mothers' occupation	Worker	4	36.4	7	63.6	.006*	.118	.026	.535

Signifiant at p < .05

Table 3. Multivariate analyses

	Variable	Coefficient	*p*	OR	(CI 95%)
Step 1	mothers' age < 31 y.o.	-1.902	.122	.149	(.013-1.660)
	mothers' education < 10 years	-.177	.833	.838	(.161-4.356)
	Multipara mother	-2.807	.048	.061	(.004-.978)
	Working mother	2.758	.009	15.775	(1.975-126.022)
	Intercept	3.240	.398	25.526	
Step 2	mothers' age < 31 y.o.	-1.913	.119	.148	(.013-1.632)
	multipara	-2.833	.044	.059	(.004-.927)
	working mother	2.828	.005	16.904	(2.315-123.444)
	Intercept	2.900	.404	18.182	

The calculation explained below:

y= 2.900-1.913 (mothers' age) -2.833 (parity) +2.828 (mothers'occupation).
y= 2.900-1.913 (1) -2.833 (1) +2.828 (1) = 4.818
p= 1/ $(1+e^{-y})$=1/$(1+2.7^{-4.818})$= 1/(1.00835)=0.9917

Finally, we can identify the probability for the mother from a simulation case to deliver LPI is 99.17%. After calculating the model formula, we tested the quality of the model using Hosmer and Lemeshow test and Area Under Curve (AUC) with ROC method.

Hosmer and Lemeshow test (table 3) have shown that the *p-value* for step two was .869. It means that the model has good calibration (a good fit). In another word, using the model resulted observed events matched the expected rate in group LPIs and PT of the model population.

y= 2.900-1.913 (mothers' age) -2.833 (parity) +2.828 (mothers' occupation)

Explanation:
The mothers' age <31y.o. given score "1" and aged ≥ 31 y.o. given score "0". The multipara mother given score"1" and primipara given score "0". Working mother given score "1" and as housewife given score"0".

Figure 1. The final model for predicting the LPIs' delivery

p=1/ $(1+e^{-y})$

Explanation:
p= probability for mother to LPIs'delivery
e= natural value that is 2.7
y= Constanta+a1x1+a2x2+a3x3
Intercept (often labelled as constant)= 2.900
a1= -1.913
x1= mothers' age (score 1 for mother's age < 31 y.o)
a2=.-2.883
x2:parity (score 1 for multipara mother)
a3= 2.828
x3:mothers' occupation (score 1 for mother's occupation as worker)

Figure 2. Application the model for predicting the LPIs' delivery

Figure 3 described that the AUC was 80.9% indicating the model had a strong ability for discriminating the group of LPIs and PT. It means the model had a good quality for discriminating between two groups (LPIs and PT).

Discrimination between late preterm infants aged ≥ 34 weeks'GA to < 37 weeks' GA and preterm infants aged < 34 weeks' GA is needed to confirm the quality of the model formula.

DISCUSSION

The study found that working mothers increased 16.9 times for LPIs' delivery. This result is in line with the previous study. Mothers' occupation was identified as one of the predictor variables for preterm infants' delivery (Anasari and Pantiawati, 2016). Working as a mothers to deliver LPIs were workload and exposing tobacco.

Working mothers in our study included public staff, private staff, business women, farmer, and labor. Hard-working during pregnancy also may increase maternal stress and impact on the LPIs' birth. One study supported that maternal stress during pregnancy has a chance to preterm's birth amount 2.15 times compared to women who gave birth at term (Lilliecreutz et al., 2016).

Our study showed that mothers' age < 31 y.o. reduced .148 times for developing LPIs compared to mothers' age ≥ 31 y.o. Most of the prior studies found that mothers' age <20 y.o was associated with preterm infants (Wagura et al., 2018, Giang et al., 2019). Maternal age in our study from 18-44 years. It means that mothers' age < 31 y.o. consisted of mother' age from 18 to <31 y.o. The scientific literature clearly stated the best age for pregnancy with less risky range for maternal age 20-30 years (Bellieni, 2016).

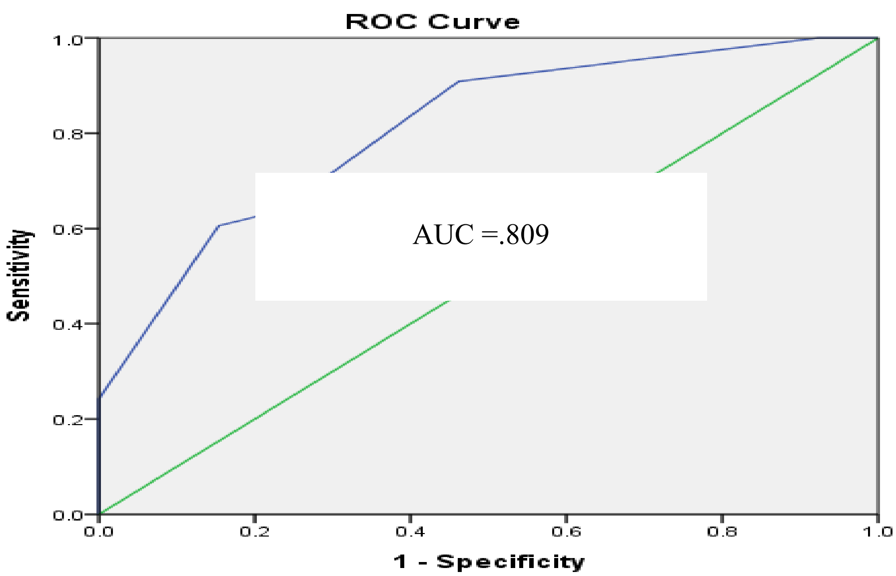

Figure 3.ROC Curve

farmer and mother's age < 20 y.o with history preterm birth was significantly associated with stillbirth and preterm infants birth at Da Nang Province, Vietnam (Giang et al., 2019).

Another study found that Hispanic women working in the service industry are exposed to environmental tobacco smoke which increases their risk of preterm birth (Mburia and Yang, 2016). These prior studies (Anasari and Pantiawati, 2016, Giang et al., 2019, Mburia and Yang, 2016) showed that the possibilities

Our study also found multipara mothers reduced .059 times for developing LPIs. This result contradicts with the previous research. The previous study has been investigated maternal parity > 4 have a significant association with preterm birth (Wagura et al., 2018). Another study also found that maternal parity as one of the predictors variable for preterm infants' delivery

(Anasari and Pantiawati, 2016).

The possibility multipara mothers in our study as one of the protective factors for LPIs is having adequate knowledge about pregnancy and delivery which is supported by 15 mothers had education for more than 10 years. Moreover, multipara mothers in our study consisted of twin and triplets and no case maternal parity >4 such as in Wagura and colleagues study.

LIMITATION OF THE STUDY

A cross-sectional study and minimum sample size were identified as a limitation from this study since predicting factors of the LPIs needs the longitudinal study. Also, using term infants as control group is suggested for the future study.

CONCLUSION AND IMPLICATION FOR PRACTICE

Working mothers increased 16.9 times for LPIs while mother's age < 31 y.o, and multipara mother reduced .148 and .059 times respectively for developing LPIs. Although maternal age < y.o. and multipara as the protective factors of LPIs, the possibility seems very low.

The final model for predicting the LPIs' delivery was y= 2.900-1.913 (mothers' age) -2.833 (parity) +2.828 (mothers'occupation). The model showed good calibration and discriminant. It means that the model has good quality for predicting the LPIs' birth.

Therefore, medical doctors, nurses, and midwives can use the model for predicting the LPIs' delivery in clinical practice. Healthcare professional particularly nurses and midwives can educate the mothers to preventing in hard-working during pregnancy.

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CONFLICT OF INTEREST

We declared that we have no conflict of interests.

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