Send Orders for Reprints to reprints@benthamscience.ae

BENTHAM OPEN

CrossMark

The Open Public Health Journal

Content list available at: www.benthamopen.com/TOPHJ/

DOI: 10.2174/1874944501811010376, 2018, *11*, 376-383

RESEARCH ARTICLE

Maternal Risk Factors Associated with Low Birth Weight in Indonesia

Issara Siramaneerat[1,*], Farid Agushybana[2] and Yaowaluck Meebunmak[3]

[1]*Department of Social Science, Faculty of Liberal Art, Rajamangala University of Technology, Thanyaburi, Thailand*
[2]*Department of Biostatistics and Population Study, Faculty of Public Health, Diponegoro University, Semarang, Indonesia*
[3]*Boromrajonani College of Nursing Ratchaburi, Ministry of Public Health, Na Muang, Thailand*

Received: June 2, 2018 Revised: August 17, 2018 Accepted: August 20, 2018

Abstract:

Background:

Low birth weight (LBW) is a major risk factor for death and disease in the fetus and newborn infant. However, the study about LBW and maternal risk factors involved in Indonesia is still limited.

Objective:

The present study attempted to examine the association of maternal risk factors including mother's age, mother and husband education, mother and husband occupation and wealth, ANC visit, desired pregnancy and obstetric complication toward the occurrence of low birth weight infant across region and family wealthy.

Methods:

This study employed the data from the national survey of Indonesia Demographic and Health Survey (IDHS). The latest births from married women who gave birth within 2 years (2011 and 2012) preceding the IDHS were considered as sample selection. It was approximately 15,126 respondents. The predicted risks of low birth weight were estimated using multilevel logistic analysis.

Results:

Data were collected on 15,126 pregnant women who reported 10.2% were with LBW infants. When using the multilevel logistic analysis, the factors associated with LBW were maternal delivery-baby age, mother's education, antenatal care and pregnancy complication at significant levels of 0.01.

Conclusion:

The prevalence of preterm infants in this study was quite high. Factors affecting LBW were maternal age, maternal education, ANC visits and pregnancy complication. The ANC visit of pregnant women is a potential and feasible activity to reduce the incidence of LBW.

Keywords: Low birth weight, Infant, Maternal health, Maternal risk factors, Indonesia, Fetus.

1. INTRODUCTION

Every mother expects that the child will be born safe and healthy. However, sometimes there are factors that affect

* Address correspondence to the author at the Department of Social Science, Faculty of Liberal Art, Rajamangala University of Technology, Moo 1, Rangsit-Nakhonnayok Rd. (Klong6), Thanyaburi Pathum Thani 12110, Thailand; Tel: +66 2549 4960-1; Fax: +66 2577 5017; E-mails: issara_s@rmutt.ac.th, issara_sira@hotmail.com

the growth of the fetus so that babies who are born have Low Birth Weight (LBW), premature birth, and other abnormalities or even stillbirth [1]. This LBW baby is a new born baby which has a weight less than 2,500 grams.

LBW infants can be categorized into preterm delivery, intrauterine growth restriction (IUGR) and newborns with premature growth [2 - 4]. LBW infants are predicted to be more susceptible and more likely to die. LBW babies who can survive in general will experience health problems and cognitive impairment [5, 6]. Cases of morbidity and mortality include infectious disease, stunted in childhood period and underweight are more common in LBW babies [2, 4].

Neonatal Mortality Rate (NMR) in Indonesia is higher than the recommended level of the World Health Organization (WHO) [2]. According to Indonesian Demographic and Health Survey (IDHS) 2007, the NMR accounted for 34 per 1,000 live births in 2007, with no significant difference from 2002 [2]. The national target for the Millennium Development Goals (MDGs) 2015 is 23 per 1000 live births [7]. The IDHS survey also mentioned that 78.5% of neonatal deaths occur between 0 to 6 days old. It was estimated that 33,258 infants in Indonesia died due to complications of preterm delivery [8]. The variation between provinces is from the lowest in North Sumatra (7.2%) to the highest in Central Sulawesi (16.9%) [8].

The presence of LBW prevalence can illustrate poor mothers' health, malnutrition status in women, improper pregnancy care (ANC), and low socioeconomic status of mothers [2, 8]. A poor maternal reproductive health experienced, such as abortion, stillbirth, early neonatal death, pregnancy complications and large number of children, play important role in increasing the occurrence of LBW infants. Similarly, maternal behavior associated with antenatal examination, desired and undesirable pregnancy will also lead to the incidence of LBW babies [9 - 11].

Therefore, the underlying factors should be determined to elaborate proper strategies in reducing mother and child health problem. This study applied the data of Indonesia Demographic and Health Survey (IDSH) to explore maternal risk factors that are attributed to the prevalence of LBW of new born baby for health planning in order to gain effective and efficient interventions.

2. MATERIALS AND METHODS

The present study was conducted by employing the data from important IDHSsurveys covereing national representatives of Indonesia. The IDHS collected the data on socio demographic characteristics, health status and behavior, nutrition status of mother and children, and also HIV/AIDS knowledge. The IDHS was conducted by collaboration of National Statistic Board of Indonesia, Ministry of Health, National Population and Family Planning Board, International DHS program [12, 13]. In this survey, there were three kinds of structured-questionnaire, namely house hold questionnaire, women's questionnaire and men's questionnaire. This paper developed and retrieved the data from the women's questionnaire. The women's questionnaire provided information about women and family socio demographic data, reproductive history, pregnancy experience, Antenatal Care (ANC), as well as children immunization and nutrition [12, 13].

The respondents of IDHS survey were women aged 15-49 years old selected by multistage cluster random sampling. The first stages were based on the Census Blocks (CBs), while the second stage was the household. All the IDHS methods were explained in other resources elsewhere [12]. The selected respondents who were involved in this paper were those who delivered baby within 2 years (2011 and 2012) preceding the IDHS. In addition, the missing data was excluded. Accordingly, it was approximately 15,126 respondents which were included in this study.

The ethical clearance of this study was granted by the commission on health research ethics – Faculty of Public Health, Diponegoro University with the certificate of approval number 016/EC/FKM/2018, dated April 4, 2018. The statistical analysis applied the frequency and percentage distribution was conducted to represent the mother's characteristics. The calculation was performed by applying sample weight base on the IDHS 2012 [14].

The current study attempts to predict determinant on low birth weight of new born baby in Indonesia. The dependent variable was low birth weight of new born baby. The construction of this variable was based on questions in IDHS 2012. The low birth weight of new born baby was considered those who were delivered with the weight less than 2500 gram [15]. If the infant was less than 2500 gram then coded as 1 for "low birth weight" while else coded as 0.

While the independent variable was sex, mother's age while delivery-baby, mother education attainment, working status (mother and couple), wealth, desired pregnancy, Antenatal Care (ANC) visit, complication and region. Moreover, the mother's age at delivery comprised of less than 20 years (coded as 0), 20-34 years (coded as 1) and more than 34

(coded as 3). The education attainment was coded 0 for "no education"; 1 for "primary level"; 2 for "secondary level"; and 3 for "higher education level". The mother's and couple's occupation were coded as 0 for "not work" and 1 for "working" (such as government officer, engineering/technical, administrative job, hospitality job, clerical, sales, agricultural sectors, industrial sectors, other).

The family wealth refers to household wealth index which was calculated by the possession of long-live goods in the households, such as a motorcycle or car, television and radio, refrigerator, saving and land. A principal component analysis is used to produce common factors for household, then these factors were scored. These scores were then used to classify households in welfare categories. Detailed ways of calculation can be seen in IDHS 2012 report [14]. The family wealth was five levels, namely poorest (coded as 1), poor (coded as 2), middle (coded as 3), rich (coded as 4) and richest (coded as 5) [14]. The desired pregnancy was considered as pregnancy desired at the time which coded as 1, wanted later coded as 2, or unwanted at any time as 3. The antenatal care visit referred to the number antenatal care visit during pregnancy. The women complication refers to complication during pregnancy and childbirth which referred to present or not present maternal complication either during pregnancy or at delivery. It was coded 1 for those who have experienced complication and 0 for otherwise [14]. The Indonesia was grouped into 7 regions, namely Sumatra (1), Java and Bali (2), Nusa Tenggara (3) Kalimantan (4), Sulawesi (5), Maluku (6), and Papua [17].

The multilevel logistic model was implemented to predict the probability of the occurrence of LBW by taking into account the effect of family wealth levels and the region effects. The region and family wealth level were considered as the multilevel parameterdue to different geographical regions of the Indonesia, while the family wealth level may be related to the purchasing power of mother and dietary patterns which results in pregnancy and weight of baby [15, 16]. The hypothesis was considered statistically significant if p-values were less than 0.05. The model was done by employing Stata software.

3. RESULTS

The 15,126 mothers out of 47,533 respondents were selected. In Table **1**, the frequency distribution of selected variables were presented. It was found that majority of the respondents (71.0%) were aged 20-34 years and 53.5% of them had completed secondary level. The result was similar to husband education which found to be 54.7%. By mother occupation, almost 50 percent of the respondents were unemployed (45.2%) while almost all of husbands had job (98.2%). Furthermore, the economic status of mother was categorized as the poorest (28.6%). In terms of antenatal care visit, 94.5 percent of the mothers visited antenatal care. The majority (84.9%) wanted pregnancy again. Regarding the obstetric complications, it was found 12.5% had complication during pregnancy. Moreover, the respondents were primarily from Sumatra (29.3%) and Java-Bali (26.8%). Importantly, it was found that the incidence of LBW babies was 10.2 percent.

Table 1. Frequency distribution (n= 15,126).

–	Birth Weight Infant			
	>=2,500g	<2,500g	Total	N
Mother's age at most recent delivery	–	–	–	–
<20	3.4	5.1	3.6	545
20-34	71.1	70.4	71.0	10,739
>=35	25.5	24.6	25.4	3,842
Mother education	–	–	–	–
No education	2.9	1.7	2.8	424
Primary	30.1	36.9	30.7	4,644
Secondary	53.8	50.4	53.5	8,092
Higher	13.2	11.1	13	1,966
Husband education	–	–	–	–
No education	2.4	2.2	2.4	363
Primary	30.2	34	30.6	4,629
Secondary	54.9	53.4	54.7	8,274
Higher	12.5	10.5	12.3	1,860
Mother occupation	–	–	–	–
Do not work	44.9	47.5	45.2	6,837
Work	55.1	52.5	54.8	8,289

(Table 1) contd.....

–	Birth Weight Infant			
	>=2,500g	**<2,500g**	**Total**	**N**
Husband occupation	–	–	–	–
Do not work	1.8	1.7	1.8	272
Work	98.2	98.3	98.2	14,854
Wealthy	–	–	–	–
Poorest	28.21	32.2	28.6	4,329
Poorer	20.14	21.4	20.3	3,066
Middle	18.39	18.8	18.4	2,790
Richer	17.57	15.5	17.5	2,624
Richest	15.69	12.1	15.32	2,317
ANC visit	–	–	–	–
No	5.7	3.6	5.5	832
Yes	94.3	96.4	94.5	14,294
Wanted pregnancy	–	–	–	–
Then	84.8	85.9	84.9	12,842
Later	7.3	6.7	7.2	1,089
No more	7.9	7.4	7.9	1,195
Obstetric complications	–	–	–	–
No	88.2	81.6	87.5	13,235
Yes	11.8	18.4	12.5	1,891
Region	–	–	–	–
Sumatra	29.9	24.8	29.3	4,431
Java and Bali	26.8	26.9	26.8	4,054
Nusa Tenggara	5.7	8.8	6.0	908
Kalimantan	10.7	12.8	10.9	1,649
Sulawesi	16.4	18.9	16.7	2,526
Maluku	5.7	3.6	5.5	832
Papua	4.9	4.3	4.8	726
N	89.8	10.2	100.0	–
–	(13,575)	(1,563)	(15,138)	–

3.1. Risk Factor for Low Birth Weight Infant

Table **2** shows the multilevel logistic analysis yielded that the mother's age at delivery, mother's education, antenatal care and pregnancy complication were significantly influence the occurrence of low birth weight at significant levels of 0.01. On the other hand, the husband education, mother occupation, husband occupation and the desired pregnancy did not affect the low birth weight at significant levels of 0.01. The multilevel logistics model was elaborated after considering the random effect of region and family wealth which has probability value of chi-square as 0.000 which is lower than significant levels of 0.01; it means that the multilevel model was significantly different to the normal logistic model. In other words, delivery-baby age, mother's education, antenatal care and pregnancy complication significantly influence to the low birth weight across regions where the respondents live and the family wealth levels.

Table 2. The multilevel logistic analysis of low birth weight infants (n= 15,126).

Characteristics	Difference between LBW and Normal	Odds Ratio	Standard Error	p>z	(95% conf. interval)	
Mother delivery-baby age (ref: < 20 years old)		–	–	–	–	–
20-34	0.007	0.723	0.093	0.009	0.562	0.929
>35	–	0.699	0.096	0.009	0.534	0.915
Mother education (ref. no education)	0.001	–	–	–	–	–
Primary	–	2.154	0.474	0.000	1.399	3.315
Secondary	–	1.782	0.397	0.011	1.151	2.758
Higher	–	1.752	0.423	0.020	1.091	2.813
Husband education (ref. no education)	0.007	–	–	–	–	–
Primary	–	1.053	0.206	0.794	0.717	1.546

(Table 2) contd.....

Characteristics	Difference between LBW and Normal	Odds Ratio	Standard Error	p>z	(95% conf. interval)	
Secondary	–	1.034	0.205	0.865	0.702	1.524
Higher	–	0.982	0.217	0.934	0.637	1.513
Mother occupation (ref. not work)	0.056	0.917	0.051	0.118	0.823	1.022
Husband occupation (ref. not work)	0.839	1.048	0.221	0.823	0.693	1.585
Wanted pregnancy (ref. wanted then)	0.475					
Later		0.879	0.095	0.234	0.711	1.087
No more		0.905	0.097	0.351	0.734	1.116
ANC visit (ref. not visit)	0.001	0.976	0.008	0.003	0.960	0.991
Complication (ref. no complication)	0.000	1.731	0.124	0.000	1.505	1.992
Random Effect Parameter						
Region		0.210	0.078		0.101	0.434
Wealth		0.109	0.054		0.041	0.289
Constanta			0.092	0.032	0.000	0.047
Wald chi2(df)	100.19					
Probability > Chi2	0.000					
LR test *vs*. logistic regression:	chi2(2)=39.37		Prob>chi2=0.000			

*=Significant at 0.05; **=Significant at 0.01; ref. =reference.

Regarding to the mother's age at delivery at Table **2**, mothers who delivered their baby at the age between 20 to 34 year (adjusted odds ratio 0.723, 95% CI 0.562-0.929. *p=0.009*) were less likely 0.723 as compared to those who delivered at age under 20 years old (adjusted odds ratio 0.699, 95% CI 0.534-0.915. *p=0.000*). Furthermore, those who have primary school education were more likely 2.154 times (adjusted odds ratio 2.154, 95% CI 1.399-3.315. *p=0.004*) higher to have chance to give low birth weight infant, while others level of education did not have any affect toward the occurrence of low birth weight. The ANC control has significantly positive impact on the low birth weight. Those who make ANC visit less likely 0.976 to deliver a low birth weight infant as compared to those who did not make ANC visit (adjusted odds ratio 0.976, 95% CI 0.960-0.991. *p=0.008*). Importantly, mothers with pregnancy complication have a chance to give low birth weight infant by 1.731 then those who did not experience complication (adjusted odds ratio 1.731, 95% CI 1.473-1.948. *p=0.000*).

4. DISCUSSION

The rate of LBW in the present study was 10.2%, which is similar to the result in Pakistan, 10.6% [18] but different from World Health Organization (WHO) with the prevalence of LBW is 15.5% in developing countries [19, 20]. Multilevel logistic analysis showed that the mother's age at delivery, mother's education, lack of antenatal care and pregnancy complication were significantly associated with term low birth weight.

The finding presented mothers who delivered their baby at less than 20 years old give low birth weight infant higher than mother who delivery at age from 20 to 34 year. According to the study of Yilgwan, C (2009) the new born babies were significantly influenced by the age of mothers when they gave births. The incidence of LBW infants was high in adolescent mothers by 65.52% [21]. Moreover, Viengsaahone [22] reported that young women pregnant are found to have LBW significantly. The risk of LBW has varied according to the age of the mother. Similarly, Rizvi *et al*. (2007) reported the risk of LBW increases when the mother is very young [23]. Inconsistent with Mumbare *et al.* (2012) found no association between LBW and maternal age as significant risk factors [24].

Furthermore, the present study that found mothers with low education level or receive primary education tend to have a higher risk of LBW infants is higher than mothers with secondary education or higher. The inequalities the authors have been describing have consequences for individuals. Normally, persons ranking high in one dimension of inequality are likely to rank high in other dimensions. People tend to have similar ranks in various dimensions [8, 25]. Women with higher education may be more cautious about their weight during pregnancy as well as their baby weight. In addition, they have more access to information and are aware of the disadvantages of having a baby, such as tearing during childbirth or operative episiotomy. It has been observed that higher education can improve family socio-economic status and may have an adverse effect on delivering LBW infants. Mothers with a high level of education can make decisions about their reproductive health, including the healthcare system. These findings correspond to the results of some studies in developing countries which reported poor education related to high incidence of LBW [25, 26].

Results showed that inadequate ANC was significantly associated with LBW. Women who have had less than 4 antenatal visits are more likely to deliver LBW babies than women who have had more than four visits. Antenatal care is beneficial to the health of the pregnant woman. Good quality of prenatal care may reduce the incidence of LBW [23]. High quality ANC access should be emphasized because it is not only improves maternal health but also provides opportunities for counseling and risk assessment [21]. The result related to several researches which LBW will vary greatly depend on the ANC system and attendance levels [24, 27 - 29]. According to Tellapragada *et al.* (2016), reported mothers who did not receive any ANC or did not meet ANC visit recommendation had higher LBW infants than those who received ANC standard [26]. Similar to the study of Badshsh *et al.* (2008) [30] and Siugo-Abanihe and Oke (2011) [29] that the higher prevalence of LBW infants associated with the lower ANC visit.

The results showed that mothers with complications from pregnancy were more likely to give birth with LBW than those who did not have complications from pregnancy. According to many researchers found mothers with anemia have a higher incidence of LBW than mothers with anemia [20, 30, 31]. The study of Pakistan was also reported a strong relationship between maternal complications during pregnancy and infants born less than 2500 grams [32].

The policy of the Ministry of Health should focus on improving mother to complete the antenatal care recommendation so that healthcare professionals can identify risk factors or pre-complications. In addition, proper obstetric care and neonatal care are important in reducing the complications of pregnancy and improving the quality of life of the fetus.

5 . LIMITATIONS

This study has some limitations on the possibility of collecting data because the new born baby weights were collected from the secondary data. The IDHS 2012 reported that 63% of deliveries were at health facility (such as hospital, health center, clinic and private doctor/ midwife). In consequence, it should be more careful to implement this study for the policy. In addition, it had a plausibility that infants did not weight and record in the public health facilities, which may result in a lower prevalence of LBW in this study.

CONCLUSION

The results of the current study provide valuable information about the major risk factors associated with LBW babies from recent national surveys in Indonesia. Mother characteristics, such as the delivery age, education attainment, non-complete ANC and complication during pregnancy, significantly affect the birth-weight of infant. Improvements in these specific risk factors might have the positive effect in reducing the incidence of LBW. Antenatal care for pregnant mothers is a necessary service to improve pregnancy outcomes. Encouraging pregnant women to receive ANC services is a potential and feasible activity in reducing the incidence of LBW. However, interventions to improve the education level of mother and girl teenager are critical for reducing the occurrence of LBW. Health education for pregnant women should be strengthened to provide health education for pregnant women seeking care and to promote the demand for skilled care at every stage of childbirth. The healthy babies have the chance to survive and become wealth in the future. Different strategies based on the context of the area should be used, with appropriate community intervention, so policy makers can design effective plans to improve the overall health of mothers and children in the selected developing countries. The findings of this study provide insights to health professionals and policymakers on strategies and interventions to reduce the prevalence of LBW in the future.

ETHICAL APPROVAL AND CONSENT TO PARTICIPATE

The ethical clearance of this study was granted by the commission on health research ethics – Faculty of Public Health, Diponegoro University with the certificate of approval number 016/EC/FKM/2018, dated April 4, 2018.

HUMAN AND ANIMAL RIGHTS

No humans/animals were used for the studies that are bases of this research.

CONSENT FOR PUBLIATION

Not applicable.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest, financial or otherwise.

ACKNOWLEDGEMENTS

The author gives the highest gratitude to the Demographic and Health Survey Program which has granted to explore the data from Indonesia DHS 2012.

REFERENCES

[1] Siwawut P, Chandeying V. Birth risk indicators for maternal and neonatal health among three different age groups: Betong Hospital perspective. J Med Assoc Thai 2012; 95(10): 1239-43.
[PMID: 23193734]

[2] Sebayang SK, Dibley MJ, Kelly PJ, Shankar AV, Shankar AH. Determinants of low birthweight, small-for-gestational-age and preterm birth in Lombok, Indonesia: Analyses of the birthweight cohort of the SUMMIT trial. Trop Med Int Health 2012; 17(8): 938-50.
[http://dx.doi.org/10.1111/j.1365-3156.2012.03039.x] [PMID: 22943372]

[3] Hack M, Fanaroff AA. Outcomes of children of extremely low birthweight and gestational age in the 1990s. Semin Neonatol 2000; 5(2): 89-106.
[http://dx.doi.org/10.1053/siny.1999.0001] [PMID: 10859704]

[4] Kelly YJ, Nazroo JY, McMunn A, Boreham R, Marmot M. Birthweight and behavioural problems in children: A modifiable effect? Int J Epidemiol 2001; 30(1): 88-94.
[http://dx.doi.org/10.1093/ije/30.1.88] [PMID: 11171863]

[5] Ceesay SM, Prentice AM, Cole TJ, *et al.* Effects on birth weight and perinatal mortality of maternal dietary supplements in rural Gambia: 5 year randomised controlled trial. BMJ 1997; 315(7111): 786-90.
[http://dx.doi.org/10.1136/bmj.315.7111.786] [PMID: 9345173]

[6] Chan BC, Lao TT. Maternal height and length of gestation: Does this impact on preterm labour in Asian women? Aust N Z J Obstet Gynaecol 2009; 49(4): 388-92.
[http://dx.doi.org/10.1111/j.1479-828X.2009.01006.x] [PMID: 19694693]

[7] Requejo J, Bryce J, Lawn J. Countdown to 2015 Decade Report (2000–2010) with Country Profiles: Taking Stock of Maternal, Newborn and Child Survival. Washington, DC: World Health Organization and Unicef 2010.

[8] Black RE, Cousens S, Johnson HL, *et al.* Global, regional, and national causes of child mortality in 2008: A systematic analysis. Lancet 2010; 375(9730): 1969-87.
[http://dx.doi.org/10.1016/S0140-6736(10)60549-1] [PMID: 20466419]

[9] Panaretto K, Lee H, Mitchell M, *et al.* Risk factors for preterm, low birth weight and small for gestational age birth in urban Aboriginal and Torres Strait Islander women in Townsville. Aust N Z J Public Health 2006; 30(2): 163-70.
[http://dx.doi.org/10.1111/j.1467-842X.2006.tb00111.x] [PMID: 16681339]

[10] Forssas E, Gissler M, Sihvonen M, Hemminki E. Maternal predictors of perinatal mortality: The role of birthweight. Int J Epidemiol 1999; 28(3): 475-8.
[http://dx.doi.org/10.1093/ije/28.3.475] [PMID: 10405851]

[11] Walraven GE, Mkanje RJ, van Asten HA, van Roosmalen J, van Dongen PW, Dolmans WM. The aetiology of low birthweight in a rural area of Tanzania. Trop Med Int Health 1997; 2(6): 558-67.
[http://dx.doi.org/10.1046/j.1365-3156.1997.d01-323.x] [PMID: 9236823]

[12] BPS Human development index year 2006-2007 (Indeks pembangunan manusia, Indonesia). Jakarta: Central Bureau of Statistik Indonesia (BPS) 2008.

[13] Cai X, Wardlaw T, Brown DW. Global trends in exclusive breastfeeding. Int Breastfeed J 2012; 7(1): 12-6.
[http://dx.doi.org/10.1186/1746-4358-7-12] [PMID: 23020813]

[14] BKKBN, Kemenkes-MOH, International I Indonesia Demographic and Health Survey 2012. Jakarta, Indonesia: BPS, BKKBN, Kemenkes, and ICF International 2013.

[15] Ayensu J, Annan RA, Edusei A, Badu E. Impact of maternal weight on pregnancy outcomes: A systematic review. Nutr Food Sci 2016; 46(4): 542-56.
[http://dx.doi.org/10.1108/NFS-11-2015-0146]

[16] Jonas O, Roder D, Chan A. The association of low socio-economic status in metropolitan Adelaide with maternal demographic and obstetric characteristics and pregnancy outcome. Eur J Epidemiol 1992; 8(5): 708-14.
[http://dx.doi.org/10.1007/BF00145388] [PMID: 1426171]

[17] ISO. ISO 3166-2:ID, Indonesian geographical regions. 2014.

[18] Khan A, Nasrullah FD, Jaleel R. Frequency and risk factors of low birth weight in term pregnancy. Pak J Med Sci 2016; 32(1): 138-42.
[PMID: 27022362]

[19] Sachdev H. Low birth weight in South Asia. Int J Diabetes Dev Ctries 2001; 21(1): 13-31.

[20] Yilgwan C, Abok I, Yinnang W, Vajime B. Prevalence and risk factors of low birth weight in Jos. Jos J Med 2009; 4(1): 13-5.

[21] Banerjee B, Pandey G, Dutt D, Sengupta B, Mondal M, Deb S. Teenage pregnancy: A socially inflicted health hazard. Indian J Community

Med 2009; 34(3): 227-31.
[http://dx.doi.org/10.4103/0970-0218.55289] [PMID: 20049301]

[22] Viengsakhone L, Yoshida Y, Harun-Or-Rashid M, Sakamoto J. Factors affecting low birth weight at four central hospitals in vientiane, Lao PDR. Nagoya J Med Sci 2010; 72(1-2): 51-8.
[PMID: 20229703]

[23] Rizvi SA, Hatcher J, Jehan I, Qureshi R. Maternal risk factors associated with low birth weight in Karachi: A case-control study. East Mediterr Health J 2007; 13(6): 1343-52.
[http://dx.doi.org/10.26719/2007.13.6.1343] [PMID: 18341184]

[24] Mumbare SS, Maindarkar G, Darade R, Yenge S, Tolani MK, Patole K. Maternal risk factors associated with term low birth weight neonates: A matched-pair case control study. Indian Pediatr 2012; 49(1): 25-8.
[http://dx.doi.org/10.1007/s13312-012-0010-z] [PMID: 21719926]

[25] Khatun S, Rahman M. Socio-economic determinants of low birth weight in Bangladesh: A multivariate approach. Bangladesh Med Res Counc Bull 2008; 34(3): 81-6.
[PMID: 19476252]

[26] Tellapragada C, Eshwara VK, Bhat P, *et al.* Risk factors for preterm birth and low birth weight among pregnant Indian women: A hospital-based prospective study. J Prev Med Public Health 2016; 49(3): 165-75.
[http://dx.doi.org/10.3961/jpmph.16.022] [PMID: 27255075]

[27] Kotelchuck M. The Adequacy of Prenatal Care Utilization Index: Its US distribution and association with low birthweight. Am J Public Health 1994; 84(9): 1486-9.
[http://dx.doi.org/10.2105/AJPH.84.9.1486] [PMID: 8092377]

[28] Dai LL, Mao YY, Luo XM, Shen YP. Prenatal care in combination with maternal educational level has a synergetic effect on the risk of neonatal low birth weight: New findings in a retrospective cohort study in Kunshan City, China. PLoS One 2014; 9(11): e113377.
[http://dx.doi.org/10.1371/journal.pone.0113377] [PMID: 25426715]

[29] siugo-Abanihe U, Oke O. Maternal and environmental factors influencing infant birth weight in Ibadan, Nigeria. Afr Popul Stud 2011; 25(2): 250-66.

[30] Badshah S, Mason L, McKelvie K, Payne R, Lisboa PJ. Risk factors for low birthweight in the public-hospitals at Peshawar, NWFP-Pakistan. BMC Public Health 2008; 8: 197-206.
[http://dx.doi.org/10.1186/1471-2458-8-197] [PMID: 18533023]

[31] Ahmad MO, Kalsoom U, Sughra U, Hadi U, Imran M. Effect of maternal anaemia on birth weight. J Ayub Med Coll Abbottabad 2011; 23(1): 77-9.
[PMID: 22830153]

[32] Khan MM. Effect of maternal anaemia on fetal parameters. J Ayub Med Coll Abbottabad 2001; 13(2): 38-41.
[PMID: 11732221]