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Birth Interval and Twins Birth on Maternal Mortality in Indonesia: Cross-Sectional Study

Putri Royan Diva, Lukman Fauzi✉

Department of Public Health Science , Faculty of Medicine, Universitas Negeri Semarang, Indonesia

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Abstract

Maternal mortality is a global-scaled health problem to indicate how good a health system is in a region. Indonesia reached 305 per 100.000 live birth as per 2017. That rate is still far from SDGs 2030 which suggests that every country has accomplished 70 per 100.000 livebirth. There are factor risks that caused maternal mortality. Those factors can be divided into individual character-related factors, socioeconomy-related factors, and healthcare-related factors. This study is an analytical study using cross-sectional design data from the DHS program 2017. Data were analyzed using bivariate analysis and multivariate analysis to fiigure out which variables that associate with maternal mortality. Preceding birth interval, succeeding birth interval, and twin birth status are the three main factor risks that associate with maternal mortality. It is recommended that Indonesian family needs to participate in family planning, including birth control in order to control the factor risks of maternal mortality.

INTRODUCTION

Maternal mortality has become an important indicator of to value of a health system. It enacts maternal mortality to become a global health system indicator to value reproductive health to attain Sustainable Development Goals 2030 (SDGs 2030) specifically to reduce global maternal mortality rate (MMR) to 70 deaths per 100.000 livebirths and no country exceeded twice the number (Bauserman, Thorsten, et al., 2020). Maternal mortality is death that occurs during pregnancy, childbirth process, and postpartum (Hoyert, 2021). The death referred to in the mentioned definition is death caused by complications, psychological related problems, and any other health problems and disorders during pregnancy. Additionally, the International Classification of Disease has stated that maternal mortality happens within 42 days after the end of the gestational period regardless of the duration of pregnancy (Hoyert, 2021; Tikkanen, 2020). Maternal mortality can be caused by a complication that occurs during pregnancy, childbirth process, and postpartum including intervention, laxity, or insufficient care (Bauserman, Thorsten, et al., 2020; Tikkanen, 2020).

Maternal mortality is still a global health problem, both for High-Income Countries (HICs) as well as Low and Middle-Income Countries (LMICs). Globally, MMR decreased from 1990 to 2016. In 1990, MMR attained 385 deaths per 100.000 live births. It decreased by 44% to 216 deaths per 100.000 live births (Okonofua & Balogun, 2021). In Indonesia, MMR reached 305 per 100.000 live births in 2021 (Kementerian Kesehatan RI, 2023). According to the Ministry of Health of the Republic of Indonesia, Indonesia gained 6.856 maternal deaths in 2021. It showed an escalation from 4.197 in 2019. This needs to be apprehension for the government and the community to involve in controlling the risk factors of

✉ Correspondence Address:
E-mail: lukman.ikm@mail.unnes.ac.id

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maternal mortality (Kementerian Pemberdayaan Perempuan dan Perlindungan Anak RI, 2022). Indonesian MMR is still elevated to be compared with other SEA countries such as Filipina (114), Vietnam (54), Malaysia (40), Brunei (23), and Thailand (20) (Utomo et al., 2021).

Some factors caused maternal mortality. Those factors can be classified into maternal-related factors, socio-economical factors, and health service factors. Maternal-related factors include birth intervals, contraception usage, breastfeeding duration, maternal age, and fertility preference. (Aryanty et al., 2021; Ashraf et al., 2021; Bauserman, Nowak, et al., 2020). The result of previous researches indicate too young or too old mothers, too short or too long birth intervals, and high parity have contributed to maternal mortality (Bauserman, Thorsten, et al., 2020; Diana et al., 2020) Guatemala, India (Nagpur and Belagavi. These risk factors could lead to risky deliveries that can be prevented by using contraception. Contraception usage can prevent risky pregnancies and reduce risky abortions caused by unwanted pregnancies (Aryanty et al., 2021).

Socio-economy factors underlie social inequalities that lead to health disparity. Social inequalities include spousal occupation that determines maternal prosperity to decrease the maternal mortality rate (Crear-Perry et al., 2021; Saputri et al., 2020). As the householder, the role of a husband is to make the decision that could affect the mother's decision in accessing health facilities (Saputri et al., 2020). Socio-economy factors that cause maternal mortality can arise due to health disparity where there are differences among the community in the ability to access health facilities (Hamal et al., 2020). Limitations in accessing health facilities can risen the risk of delays and mistreatment in seeking care in the early stage of pregnancy. Additionally, it can hinder the process of building trust between the mother and healthcare providers. This can lead to ignorance of mothers about their medical condition hence it can pose a risk of comorbid during the perinatal period (Crear-Perry et al., 2021). Culture and tradition influence the decision to choose a birth attendant. There is a community that still have hereditary beliefs in choosing traditional birth attendant. With limited knowledge and training, traditional birth attendants perform labor with inadequate tools. Besides traditional birth attendants, another risk factor that can still be found is the choice of place of delivery. The reason why mothers choose their own home as a place of delivery is so that they can still do household chores. It can cause a delay in seeking help if a postpartum complication occurs (Takaeb, 2020).

The comparison of maternal mortality caused by preventable risk factors with the ones that are inescapable shows 3 to 5 deaths (Tikkanen, 2020). One of the preventable risk factors is birth intervals. In Indonesia, short birth intervals show a percentage of up to 15% (Ningrum et al., 2022)the birth interval between two births is at least 33 months. This study is the first to discuss the short birth interval (SBI. One of the inescapable risk factors is twins birth. Mothers with twins' birth escalate the risk of maternal mortality due to the influence of other risk factors. (Bucher-koenen et al., 2020; Chinn et al., 2020). According to the result of previous research, there are risk factors that associate with maternal mortality. Nevertheless, there is yet concluded information regarding risk factors associated with maternal mortality. Previous studies have not involved variables that are included as outlying determinants, specifically birth intervals and twins' birth. This research aims to acknowledge variables that are significantly associated with maternal mortality in Indonesia, including birth intervals and twin birth.

METHOD

The author uses a cross-sectional study design as it is more applicable to conducting analytical quantitative research utilizing secondary data from the Demographic Health Survey program. The research is conducted in Indonesia from September 2022 to December 2022. The author obtains the data from the official database of the Demographic Health Survey program 2017 www.measuredhs.com. The author uses the data from 2017 because it is the latest data from the DHS program as its update is once 5 years. The permission for data utilization is given after the author explains the aim of the research. The author uses an individual record (IR) and divides the variables into independent and dependent ones. The DHS is a regionally representative household survey covering the data based on population, health status, health facilities, maternal-related condition, and socio-economy of women aged 15-49 years. Based on the available data set, there are 11,884 women aged 15-49 years. The sampling method used is stratified two-stage sampling. The first stage was performed by sorting out the number of census blocks using a systematic proportional to size (PPS) with the size of the number of households registered as a result of the SP2010 listing. Systematic stratification was conducted according to urban and rural areas by sorting the census blocks based on the Wealth Index

category from the SP2010 results. The second stage was performed by selecting 35 accustomed households in each selected census block systematically. After initiating the inclusion and exclusion criteria, there are 10,875 women included in the inclusion criteria. The author measured the sample size based on the cross-sectional design and 5,891 subjects were obtained. Of the 5,891 subjects, there were 395 maternal mortality and 5496 living mothers. Sampling was obtained by random sampling. The process of sampling data from the research population to the research subject can be seen in Figure 1.

The accessible population included in this study are women aged 15-49 years. Regarding the maternal death variable, the samples included in the inclusion criteria are mothers who died during pregnancy, childbirth process, and postpartum caused by obstetric or gynecologic-related conditions. Exclusion criteria include mothers who died not due to obstetricand gynecologic causes. The dependent variable in this study is maternal death status. Maternal status data is classified into two, deceased mother and living mother. To ensure that the maternal deaths contained in the data are relevant to the definition of maternal mortality according to the ICD-10, the process of sorting out research subjects according to the inclusion criteria was seen from the mothers' age of first-time sexual intercourse. Data without this variable are not categorized as maternal deaths. Independent variables in this study are classified into two groups including individual characteristics, socio-economy status, pregnancy and childbirth-related conditions, and individual-related conditions regarding decision-making in handling labor. Individual characteristic variables include the type of regency, marital status, age at first marriage, and age at first time sexual intercourse. Socio-economy status variables include spousal occupancy. Pregnancy and childbirth-related condition variables include birth intervals, parity, parity in the last five years, and contraception usage. The individual-related condition regarding decision-making in handling labor includes birth attendant, place of giving birth, and duration of breastfeeding.

Univariate analysis is conducted to acknowledge the description of the percentage of each variable. Then, bivariate analysis is conducted to perceive the association between each independent variable as the risk factors for maternal mortality. Furthermore, multivariate analysis with logistic regression is conducted to perceive which independent variables that show a significant association with maternal mortality despite the influence of other independent variables. The limitation of this study is there are incomplete data on certain variables such as maternal age at first marriage, maternal age at first-time sexual intercourse, parity, duration of breastfeeding, birth attendant, place of delivery, and spousal occupancy.

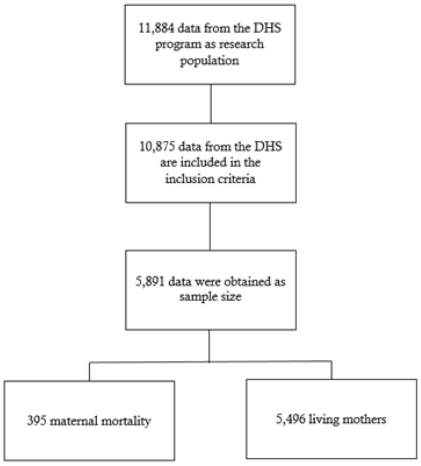

Figure 1. Flowchart of research subject

RESULT AND DISCUSSION

The descriptive analysis is conducted to analyze each variable. According to Table 1, of all 5,891 subjects, there are 395 deceased mothers included in maternal mortality (6.7%). Table 1 shows that mothers who live in rural areas (37.9%) have less percentage than mothers who live in urban areas. Most of the mothers included in the research subjects are married (72%) and had first-time sexual intercourse (54.7%) at risky age. Mothers who are not married or are widow has less percentage (7.6%) than married ones. Regarding risk factors about mothers' obstetrical condition risk factors, there are still mothers who expect pregnancy (37.6%), although the number is not as many as those who are infertile. Risky birth intervals, preceding (37.6%) or succeeding (13.3%) has fewer percentage than recommended birth intervals. Besides, high parity has a lower percentage (28.5%) than recommended parity. Mothers who give birth to twins (1.5%) has less percentage than a single birth. Mothers who never breastfeed (22.9%) have less percentage than those who regularly breasfeed. In relation to the maternal decision of seeking healthcare, mothers with traditional birth attendant (57.7%) show more percentage than the ones who choose skilled birth attendant. Mothers who choose a place of delivery other than a health facility (70.2%) have more percentage than those who choose health facility.

The bivariate analysis is conducted to ack-

Table 1. Univariate analysis result.

Variable	n	%
Mother's status		
Deceased	395	6.7
Alive	5496	93.3
Type of residence		
Rural area	2334	37.9
Urban area	3657	62.1
Marriage status		
Unmarried or divorced	447	7.6
Married and live with a spouse	5444	92.4
Mother's age at first marriage		
At risk age (<20 dan >35)	3735	72
At safe age (21-35)	1456	28
Mother's age at first time sexual intercourse		
At risk age (<20 dan >35)	3220	54.7
At safe age (21-35)	2664	45.3
Fertility preference		
Still expecting pregnancy	2046	37.6
Infertile	3398	62.4
Preceding birth interval		
Risky birth spacing (<36 and >59 months)	2046	37.6
Safe birth spacing (36-59 months)	3398	62.4
Succeeding birth interval		
Risky birth spacing (<20 months)	755	21.9
Safe birth spacing (≥20 months and last born)	2699	78.1
Parity		
High parity (>5)	1672	28.5
Good parity (1-4)	4212	71.5
Parity in the last 5 years		
High parity (>2)	721	12.2
Good parity (1-2)	5170	87.8
Giving birth to twins		
Yes	51	1.47
No	3412	98.53
Birth attendants		
Traditional birth attendant	1838	57.7
Skilled birth attendant	1346	42.3
Place of giving birth		
Not in health facilities	2238	70.2
In health facility	950	29.8
Duration of breastfeeding		
Never	692	22.9
Regularly	2336	77.1
Contraception usage		
No	2780	47.1
Yes	3111	52.9
Spousal occupancy		
No occupancy	2322	39.4
Have occupancy	3568	60.6

nowledge the association between maternal mortality and each independent variable. Based on Table 2, there is an association between maternal mortality with the type of residence. Mothers who live in urban areas tend to have a 1.414 times higher risk of maternal mortality than mothers who live in rural areas ($p < 0.001$; PR 1.414; 95% CI 1.337-1.763). It is in accordance with the result of a previous study that shows maternal mortality in urban areas can occur because of urbanization (Chen et al., 2021). Additionally, it could happen because the Three Delays Model includes delay in the decision to seek care, delay in reaching care, and delay in receiving adequate health care. Delays in the decision to seek care could occur because of economic status, education level, and mother empowerment. Those affect mothers' ability to seek information about maternal health and utilize those to access maternal healthcare services. The majority of mothers who experience a delay in seeking care come to healthcare centers with an unwell medical condition such as organ dysfunction (Indarti et al., 2021).

Maternal age at first marriage is corresponding with the incidence of maternal mortality. Mothers who marry at risky age have a tendency to bear maternal mortality 1.882 higher than mothers who marry at the suggested age ($p < 0.001$; 95% CI 1.417-2.449). Furthermore, there is an association between maternal age at first-time sexual intercourse and maternal mortality. Mothers who had sexual intercourse for the first time at risky age tend to be 1.727 times higher than mothers who had it at safe age ($p < 0.001$; 95% CI 1.391-2.143). Underage marriage and underage sex lead to obstetric and gynecological problems, sexually transmitted diseases, and mental health disorders because they are too young to understand the concept of safe sex (Salam & Aktar, 2020; Wibowo et al., 2021). Women who marry early are inclined to have risky pregnancies and deliveries. They do not complete antenatal care (Cameron et al., 2022).

The preceding birth interval (PBI) is the difference between the birth date of a child and the birth date of a previous child in months. The risky PBI is less than 36 months and more than 59 months, while the safe PBI is between 36 months and 59 months. Mothers who have risky PBI have a tendency to bear maternal mortality 1.734 times higher than those who have safe PBI ($p < 0.001$; 95% CI 1.335-2.252). The succeeding birth interval is the difference between the birth date of a child and the birth date of the following child in months. The risky SBI is less than 20 months, while the safe SBI is more than 20 months and last born. Mothers who have risky SBI are inclined to bear maternal mortality by 4.306 times higher than those who have safe SBI ($p < 0.001$; 95% CI 3.423-4.418). The previous studies disclose that perilous birth intervals can lead to complications such as premature membrane rupture, abruption of the placentas, and placenta previa. More studies have resulted that risky birth spacing can cause obstetric and gynecological problems such as pre-eclampsia, eclampsia, hemorrhage, and fatal malposition (Bauserman, Nowak, et al., 2020; Pimentel et al., 2020). A safe SBI can prepare mothers to be more prepared because they already have recovered from the previous delivery (Pimentel et al., 2020).

Parity is the amount of times a woman has given birth to a live birth in any gestation, regardless of the viability of the child. It has an association with maternal mortality. Mothers with high parity tend to bear maternal mortality 1.845 times higher than those with good parity ($p < 0.001$; 95% CI 1.497-2.273). Good parity is 2-3 children (Komariah & Nugroho, 2020). Furthermore, mothers with high parity in the last five years have a higher risk to bear maternal mortality 1.542 times higher than those with good parity in the last five years ($p < 0.005$; 95% CI 1.173-2.028). Mothers with high parity have a higher risk to suffer from perilous pregnancies and risky deliveries due to cervical cancer and preterm birth (Koullali et al., 2020; Tekalegn et al., 2022). High parity could have resulted in cervical damage. The cervix is an important organ in maintaining pregnancy so its damage can lead to preterm birth (Koullali et al., 2020).

Moreover, mothers who choose traditional birth attendant (TBA) have a tendency to bear maternal mortality 2.274 times higher than mothers who choose skilled birth attendant (SBA) ($p < 0.001$; 95% CI 1.610-3.211). Mothers' decision in choosing TBA can be affected by various factors including socio-economy factors and geographical areas where they live (Nasution et al., 2020). Furthermore, culture and tradition can influence mothers in choosing birth attendant. Previous studies have disclosed that birth attendants trusted by a family based on ancestral beliefs use traditional tools such as bamboo fiber to cut the umbilical cord and guava leaves to clean the baby. The behavior of people who avoid modern health services arises because of the belief that it is prohibited by their ancestors (Takaeb, 2020).

Additionally, the place of delivery is associated with maternal mortality. Mothers who give birth not in a health facility are inclined to bear maternal mortality 2.187 times higher than those

Table 2. Bivariate analysis result.

Variable	Maternal status				PR (CI 95%)	p-value
	Deceased		Alive			
	n	%	n	%		
Type of residence						
Rural area	274	69.4	3383	61.6	1.414 (1.337-1.763)	0.002
Urban area	121	30.6	2113	38.4		
Marital status						
Not married	52	13.2	395	7.2	1.958 (1.437-2.667)	<0.001
Married and live with a spouse	343	86.8	5101	92.8		
Maternal age at first marriage						
At risky age (<20 and >35)	284	82.3	3451	71.2	1.882 (1.417-2.499)	<0.001
At safe age (21-35)	61	17.7	1395	28.8		
Maternal age at first-time sexual intercourse						
At risky age (<20 and >35)	264	66.8	2956	53.9	1.727 (1.391-2.143)	<0.001
At safe age (21-35)	131	33.2	2533	46.1		
Fertility preference						
Still expecting pregnancy	124	36.2	1922	37.7	0.937 (0.746-1.176)	0.572
Infertil	219	63.8	3179	62.3		
Preceding birth interval						
Risky birth spacing (<36 and >59 months)	92	31.5	663	21	1.734 (1.335-2.252)	<0.001
Safe birth spacing (36-59 months)	200	68.5	2499	79		
Succeeding birth interval						
Risky birth spacing (<20 months)	136	35.5	485	11.3	4.306 (3.423-4.418)	<0.001
Safe birth spacing (≥20 months and last born)	247	64.5	3793	88.7		
Giving birth to twins						
Giving birth to twins	9	3.1	42	1.3	2.360 (1.137-4.898)	0.18
Giving birth to single	284	96.9	3128	98.7		
Parity						
High parity (>5)	163	41.3	1516	27.6	1.845 (1.497-2.273)	<0.001
Good parity (1-4)	232	58.7	3980	72.4		
Parity in the last 5 years						
High parity (>2)	68	17.2	653	119	1.542 (1.173-2.028)	0.002
Goog parity (1-2)	327	82.8	4843	99.1		
Birth attendant						
Traditional birth attendant	134	74.9	1704	56.7	2.274 (1.610-3.211)	<0.001
Skilled birth attendant	45	25.1	1301	43.3		
Place of delivery						
Not in a health facility	149	83.2	2089	69.4	2.187 (1.466-3.262)	<0.001
In a health facility	30	16.8	920	50.6		
Duration of breastfeeding						
Never	38	229	654	22.9	1.002 (0.691-1.445)	0.990
Regularly	128	77.1	2208	77.1		
Contraception usage						
No	233	59	2547	46.3	1.665 (1.353-2.049)	<0.001
Yes	162	41	2949	53.7		
Spousal occupancy status						
Have no job	185	46.8	2137	38.9	1.384 (1.128-1.699)	0.002
Have job	210	53.2	3358	61.1		

Table 3. Multivariate analysis table

Variables	B	Wald	p-value	aOR (CI 95%)
Preceding birth interval (<36 and >59 months)	0.636	7.749	0.005	1.888 (1.209-2.950)
Succeeding birth interval (<20 months)	1.900	65.491	<0.001	6.684 (4.219-10.589)
Giving birth to twins	1.894	9.734	0.002	6.646 (2.203-21.832)

who give birth in a health facility (p < 0.001; 95% CI 1.466-3.262). Limitations in accessing health facilities lead to delays and neglect in seeking care in the early stage of pregnancy. It can cause ignorance among the mothers towards their own health condition and risen the risk of comorbidities during the perinatal period (Crear-Perry et al., 2021). The reasons the mothers choose their own home as a place of delivery is that they still can do house chores (Takaeb, 2020).

Contraception usage is associated with the incidence of maternal mortality. Mothers who do not use contraception have a high risk to bear maternal mortality 1.665 more than mothers who use contraception (p < 0.001; 95% CI 1.353-2.049). Contraception usage influences mothers' parity. Mothers who do not use contraception will most likely have high parity. It can lead to perilous pregnancies and risky deliveries (Aryanty et al., 2021; Koullali et al., 2020). The application of contraception usage in a region is proven to reduce maternal mortality rate (Utomo et al., 2021). Additionally, spousal occupancy is associated with maternal mortality. Mothers with unemployed husbands are inclined to bear maternal 1.384 times higher than mothers with employed husbands (p < 0.005; 95% CI 1.128-1.699). Previous study have discovered that employed husbands have more knowledge and experience in making the decision (Saputri et al., 2020).

Some variables that do not show a significant association with maternal mortality are fertility preference, twins' birth, and duration of breastfeeding. Educated mothers understand how fertility preference and reproductive health affect pregnancies and deliveries. Nevertheless, fertility preference requires agreement between both parties so that mothers' fertility preference alone does not lead to maternal mortality (Ashraf et al., 2021). Additionally, giving birth to twins does not associate with maternal mortality because there are other risk factors that have more influence such as maternal age, stress, and socio-economy status (Bucher-koenen et al., 2020). Breastfeeding can decrease the risk of maternal mortality, but there are other risk factors that give bigger impacts (North et al., 2022).

Furthermore, multivariate analysis has resulted that the variables that associate maternal mortality after being influenced by other variables are PBI, SBI, and giving birth to twins. Previous studies have resulted in that mothers with too short or too long birth intervals have a higher risk to bear maternal mortality than mothers with good birth intervals (between 20 and 36 months) (Bauserman, Nowak, et al., 2020). Mothers with risky PBI are inclined to bear maternal mortality 1.888 times higher than mothers with good birth intervals (aOR 1.888; 95% CI 1.209-2.950). Specifically, mothers with risky SBI (less than 20 months) have a 6.646 higher risk than mothers with safe PBI (aOR 6.646; 95% CI 4.219-10.589). Too short a birth interval lead to anemia, postpartum hemorrhage, gestational diabetes, pre-eclampsia, and eclampsia (Garg et al., 2021; Liu et al., 2021). Moreover, mothers with too long birth intervals may experience premature membrane rupture, sepsis, and medical conditions requiring mechanical ventilation (Lin et al., 2020; Liu et al., 2021). In Indonesia, the percentage of perilous birth spacing affects the percentage of maternal and neonatal health (Ningrum et al., 2022).

Mothers who give birth to twins tend to bear maternal mortality 6.684 times higher than those who give birth to a single child (aOR 6.646; 95% CI 4,2019-10,589). The previous studies disclose that neglected and mistreated mothers who give birth to twin children have a higher risk to bear maternal mortality two to four times higher (Anwar et al., 2023). They are more vulnerable to maternal mortality due to heart or lung disease. Additionally, stress risen the risk of maternal mortality in mothers who give birth to twin children (Bucher-koenen et al., 2020). In Indonesia, risky twin pregnancies may be influenced by socio-economy status. Apart from the risk of maternal mortality, neglected and mistreated twin pregnancies may affect the health of the children (Wulandari et al., 2022).

CONCLUSION

Based on the result of the research, variables that are significantly associated with maternal mortality are preceeding birth interval, succeeding birth interval, and twin children birth. PBI and SBI are modifiable and preventable risk factors. Thus needs to be apprehension for both government and the community to be more con-

cerned about controlling birth intervals. On the other hand, twin children's birth is an unmodifiable factor risk. The risk of bearing maternal mortality because of giving birth to twins can be reduced by raising awareness and knowledge among mothers and families about the sign and symptoms of risky twin pregnancies and deliveries.

The author suggests that the intervention that should be carried out is to increase public awareness of the importance of safe birth intervals. It can be done by joining a family planning program. This intervention involves the mother as the primary target, the spouse and family as the secondary target, and the stakeholder as the tertiary target. The public should increase awareness about the signs and symptoms of risky pregnancies and deliveries so that there is no delay in seeking help and care. The efforts that can be done to increase awareness are through education by utilizing recognizable media in public and educator or health cadre at the neighborhood level. Furthermore, besides raising maternal knowledge about risky signs and symptoms, the intervention that can be done regarding the twin birth risk factor is to strengthen health facilities in every regency to ensure the adequation of health facilities and healthcare providers.

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