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Risk Factors for Maternal Mortality in Indonesia: Systematic-Review

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ABSTRACT

Background: Seventeen Sustainment Development Goals are a joint agreement from countries around the world. Maternal mortality is included in Sustainment Development Goals3, whereby in 2030, the number is expected to decrease significantly. A systematic study has yet to be conducted in Indonesia to assess the factors involved in maternal mortality. This review focuses on the question, what are the risk factors, and which ones exert the most significant influence on maternal mortality in Indonesia?

Methods: This systematic review was conducted using the Preferred Reporting Items Checklist for Systematic Review and Meta-Analysis Protocol) involving studies published between 2000 and 2021 through Embase, Scopus, Web of Science, Cochrane library, Medline, ScienceDirect, Google scholar, and Wiley Online Library, in English version. Study quality was assessed using the National Institutes of Health controlled intervention study. The risk of study bias was also assessed using The Risk of Bias in Non-randomized Studies - of Exposure tool.

Results: There are 334,105 publications were discovered at initial search. Ten articles were finally eligible for further analysis. Risk factors included in the modifiable category including Prior medical history (40% of ten studies; OR range 3.322 – 20.143), pregnancy complications (40% of ten studies; OR range 2.31 – 9.75), delivery complications (30% of ten studies; OR range 5.08 – 8.5), puerperal complications (20% of ten studies; OR 4.19 – 4.382), parity (30% of ten studies; OR 0.25 – 33.949), Birth space (20% of ten studies; OR 0.49 – 5.806), Nutritional status (20% of ten studies; OR 1.37 – 13.256), delayed referral (30% of ten studies; OR 4.01 – 7.135), living area (30% of ten studies; OR 0.989 – 7.41), number of doctors (10% of ten studies; OR 0.99), triage response time (10% of ten studies; OR 1.88), Obst. resident response time (10% of ten studies; OR 1.02), and ICU waiting time

(10% of ten studies; OR 1.01). Meanwhile, the most striking non-modifiable risk factor is the mother's age (40% of ten studies; OR 0.27 – 2.792).

Conclusion. The study describes some of the modifiable risk factors that can be used in the country's health policies to improve the quality-of-care activities.

Keywords: Risk factors, pregnant women, maternal deaths, systematic review, Indonesia

INTRODUCTION

In 2017, around 295,000 maternal deaths occurred globally, reflecting a Maternal Mortality Ratio (MMR) of 211 per 100,000 live births in 185 countries [1]. The global MMR between 2000 and 2017 fell by an average of 2.9% per year, with the global number of maternal deaths in 2017 estimated to be 35% lower than in 2000 [2]. MMR is significantly higher in low- and middle-income countries (LMICs), with sub-Saharan Africa and southern Asia accounting for 86% of all maternal deaths [2,3]. Evidence suggests that several high-income countries (HIC) are also experiencing increases in MMR, mostly among vulnerable populations [4].

Maternal death has significant negative social and economic consequences on society, and on the health and life of families, especially in newborns, especially in conditions of socioeconomic deprivation [5–7]. The MMR is a significant public health indicator that reflects both the quality of healthcare services and the status and interests of women in their society [2]. The priority given to reducing maternal mortality is shown by its choice as one of the seventeen Sustainment Development Goals (SDGs) [8]. There is evidence that the risk of maternal mortality is closely related to pregnancy and childbirth and the low quality of health services, which needs serious attention [9]. However, little is known about time trends in the immediate postpartum 42-day period to identify when more adequate follow-up is needed to reduce mortality. A systematic review of causes of maternal death up to 2012 identified that 73% of maternal deaths were caused by direct obstetric causes, such as bleeding, hypertensive disorders, and sepsis [10]. In general, 40% to 45% of maternal deaths occur between the onset of labour and the 24 hours immediately after birth [11]. Much of this evidence focuses on LMICs where the risk of death for women during the postpartum period is significantly higher [1].

In LMICs, coverage for essential health care interventions for women (e.g., skilled birth care providers) has increased, with a global emphasis on the SDGs and support for the Every Woman Every Child (EWEC) initiative [12]. However, global estimates show lower coverage for interventions targeting the postpartum period, with a further reduction in coverage of postpartum visits for women compared to newborns [12]. Understanding when and why death and severe morbidity postpartum can influence policies and recommendations to promote high-quality health care coverage. The current WHO recommendation is for postpartum care to be provided within the first 24 hours after birth in a health facility or within 24 hours if the delivery is at home, followed by a minimum of three postpartum contacts that occur within 48 to 72 hours, between days 7 and 14, and 6 weeks after birth [1].

This study aims to systematically examine the risk factors for maternal mortality in Indonesia. This review contributes to the body of knowledge on maternal mortality, especially in the Indonesian context. This review also may inform policymakers and healthcare practitioners in Indonesia about the current state of maternal mortality, its causes, and potential interventions. Preliminary results from our review indicate that no previous systematic review has been conducted on the determinants or causes of maternal death in Indonesia. Previous review studies presented in a proceeding focused on social and cultural factors that are determinants of maternal mortality in Indonesia, where the perceptions of mothers and families are the focus of the results of the review found [13].

The implication of this review for nurses including to serve better understanding the common causes of maternal mortality which may help nurses better prepare for obstetric emergencies. This includes recognizing when immediate action is needed and responding effectively to save lives.

The review's findings can emphasize the importance of ongoing education and training for nurses in maternal healthcare. It can lead to the development of targeted training programs focusing on maternal health and emergency response.

This review focuses on the question, what are the risk factors for maternal mortality in Indonesia?

MATERIALS AND METHODS

We conducted a systematic review following the preferred reporting items for systematic reviews and meta-analyses, the PRISMA statement version 2020 [14].

Searching strategy

Databases used in collecting relevant literature include Embase (accessed January 2023), Sciencedirect (accessed January 2023), Cochrane library (Central) (accessed March 2023), Medline (accessed April 2023), Scopus (accessed June 2023), Web of Science (accessed June 2023), Google scholar (accessed June 2023), and the Wiley Online Library (accessed June 2023). In addition, we also conducted a hand-searching through the bibliography of relevant studies.

Our search was limited to English-language studies. In supporting a more focused literature search, the PICOS statement includes maternal deaths that occur in healthcare facilities and without intervention as in experimental studies because they focus on observational studies. Studies comparing maternal outcomes with live births were also included in this review.

The defined keywords adhere to the Mesh term for health research. The keywords being used are varied because they are tailored to the search engine. The keywords focus on factors related to maternal death including pregnancy, childbirth, delivery of health care, facilities AND maternal mortality OR maternal death.

Eligibility Criteria

For the inclusion criteria, we included observational studies. Eligible studies should meet the following criteria:

- Population: pregnant women, or anyone else who can give accurate information.
- Intervention: with or without any intervention which related to the factors of maternal mortality in Indonesia.
- Comparison: results. The study must explain the analysis results regarding the relationship between existing factors and maternal mortality, regardless of whether it is significant.
- Written in English and published in peer-reviewed journals.

The exclusion criteria including all studies that reported incomplete information regarding the factors and the association, duplicate publications, systematic reviews, commentaries, and letters to editors that did not provide primary data. The pooled studies were then grouped by category including maternal characteristics, history of pregnancy and childbirth, and family characteristics.

Outcome Measures

The outcome of each study was assessed for its significance level based on the p-value, or the magnitude of the risk through the OR value. We also looked at the frequency of the most common factor in the studies reviewed. Additionally, we also examined the postpartum period, focusing on maternal deaths, to ascertain the most prevalent time of mortality.

Selection Process

Two authors (NN, ER) independently screened each record (title/abstract), and if there is confusion regarding the information in the abstract, then the author reads further in the

main text. This screening process uses the benefits of Mendeley software. Disagreement between the two authors resolved through discussion the first author (DNL). Screening is done by adjusting the title, objectives, and conclusions. The screening focus was based on the inclusion criteria of this systematic review.

Data Extraction and synthesis

Two independent authors (NN, ER) conducted the extraction. The extraction items consist of First author/year, country, study design (observational design), sample size, age, determinants, and outcomes. Discrepancies among those two authors are resolved by consensus after consulting with first author (DNL) when failed to meet an agreement. The first author will recheck the extraction results to ensure completeness.

Quality of evidence

Methodologically, two authors independently assessed the article quality using tools from the National Institutes of Health (NIH) on controlled intervention studies [15]. The first author will be the final decider of the quality of the included studies. There is an assessment sheet for assessing the methodology and compliance with the inclusion criteria of this study. Scores <30% of the criteria were classified as "poor", scores between 30 and 70% were classified as "moderate", and scores >70% were classified as "good" study quality. We agreed to include articles that fall into the "fair" and "good" categories.

Risk of bias

Using The Risk Of Bias In Non-randomized Studies - of Exposure (ROBINS-E) tool [16]. Each bias domain in ROBINS-E is addressed using signaling questions to gather important information about the study and the analysis being assessed. Many signaling

questions have answer choices of ‘Yes’, ‘Maybe yes’, ‘Probably no’, ‘No’ and ‘No information’. For these, ‘Yes’ and ‘Maybe yes’ have the same implications for risk of bias and ‘No’. ‘No’ and ‘Probably not’ have the same implications for the risk of bias; the distinction enables the user to distinguish between situations in which definitive information is available from situations in which judgments are made. Other signaling questions have different response options specific to the question, which can be used to distinguish between different risks of bias.

RESULTS

The Identified Outcomes

A systematic electronic search identified that 95,948 publications were discovered through backward searching of relevant papers. The full-text screening was conducted on 746 articles. A total of 654 articles failed to meet eligibility criteria at the full-text screening stage, and only 10 articles were finally eligible for further analysis. The search results follow the PRISMA 2020 flow diagram (Figure 1).

General Characteristics

There are ten eligible studies that included in this review (Table 1). The studies are retrospective studies regarding maternal death history based on secondary data available in healthcare facilities. More than five million participants participated in the studies included in this review, where the overall age of pregnant women analyzed was in the range of 15 to 49 years. Most of the studies use a case-control approach to be able to compare how the influence of factors related to maternal mortality in the control group [17–22]. The data sources used by the studies in this review are varied, including medical records[11,17–22], National survey [23], Interview [19,20,24,25], verbal autopsy [19,24].

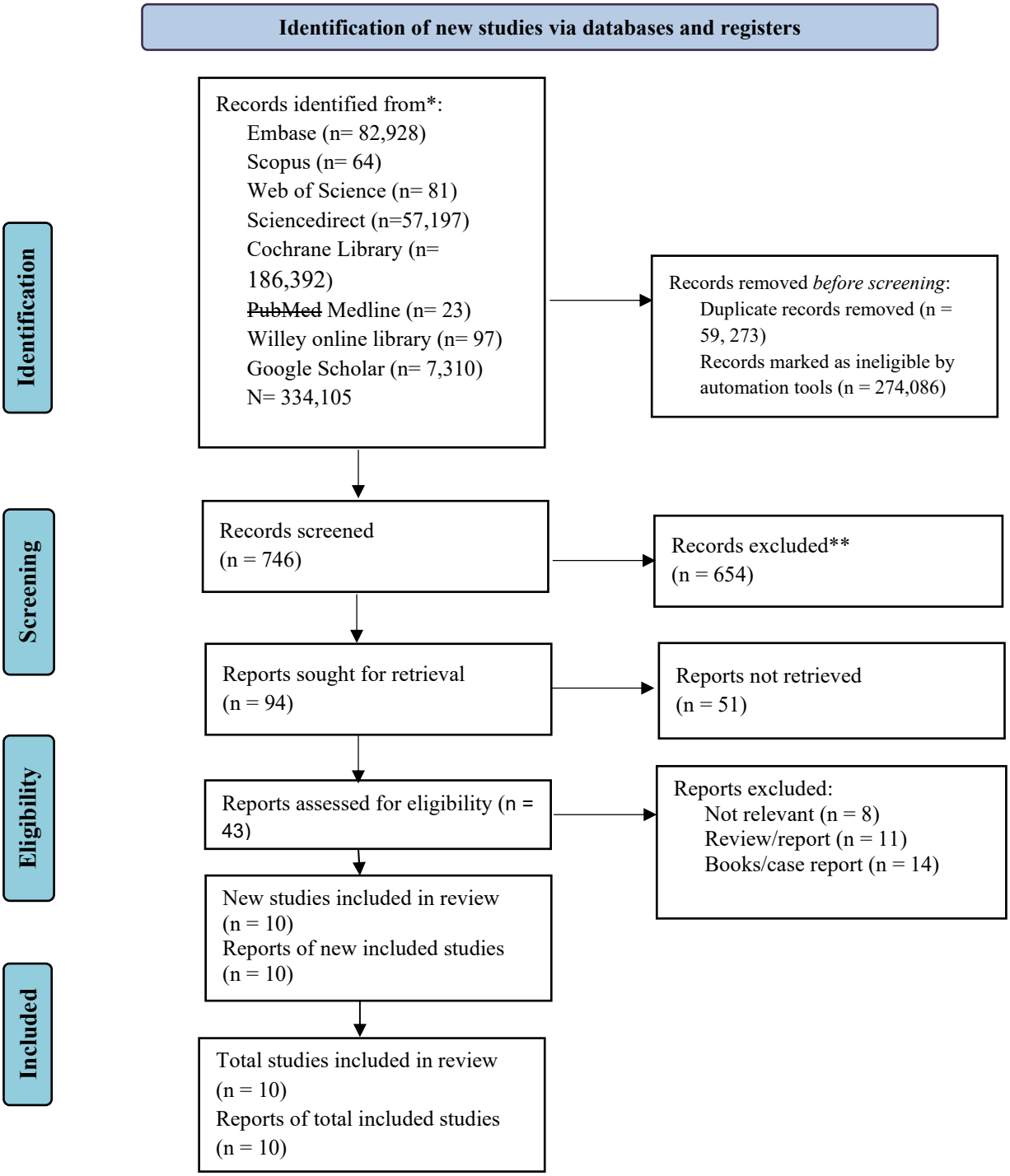

Figure 1. *PRISMA flow diagram for literature search*

Author, year	Aim	Study design	Participants and maternal mortality ratio	Evaluation methods	Factors of Maternal death	Main Finding
Astuti et al., 2017	To discover the factors affecting the occurrence of maternal deaths.	Cross sectional	52 case; 52 control Maternal mortality ratio: 773/100000	Medical Records	- Pregnancy complication - Delivery complications - Puerpural complications - Age - Parity - Medical history - ANC - Education - Living area	- Factors have Strong relationship with maternal death: Pregnancy complication (OR 6.638; p<0.001), delivery complication (OR 5.083; p<0.001), puerperal complication (OR 4.382; p<0.022), maternal age (OR 2.625; p<0.001), antenatal care (OR 5.444; p=0.007), and area of residence (OR 2.190; p=0.049) - Parity and education have no significant correlations to maternal deaths (p>0.05).
Bazar et al., 2012	To determine the determinant risk factors for maternal mortality	Retrospective	50 cases of maternal mortality and 150 physiological labor cases as control group. Maternal mortality ratio: 951/100000	Medical records	- Distant factor (maternal education and husband's occupation), - Intermediate factors (subject age, parity, residence, referral status, number of ANC visits, birth	- Factors have Strong relationship with maternal death: Maternal education levels (OR 8.96; p=0.001), Husband's occupation (OR 3.79; p=0.001), Residence (OR 7.41,

					spacing, first attendance, labor facility and prior medical history), - Near/outcome factors (type of delivery, complications of pregnancy, childbirth and puerperal)	p=0.001), Referral status (OR 4.01, p=0.001), Number of ANC visits (OR 2.98, p = 0.001), Prior medical history (OR 4.40, p=0.001)
Cameron et al., 2019	To identify key determinants of maternal mortality	Retrospective	5,866,791 women aged 15 to 49 years Maternal mortality ratio: 137/100000	National survey	- Socio-economic context: Economic status/wealth, Education level, Health, reproductive, demographic characteristics - Health service context: Family planning,	- Distance to a health centre is not associated with maternal death (OR 0.989, 0.943–1.038) - The number of doctors in the village is a strongly associated to maternal mortality (OR 0.990 95% CI 0.984–0.997)
Diana et al., 2020	To analyze maternal complications and the possible high-risk factors connected to maternal mortality.	Case-control	Family members Maternal mortality ratio: 91/1000	Interview and observation, maternal mortalities and antenatal records (KMS), verbal autopsy (OVM)	- Nutritional status, state of anemia, history of illness, age, ANC examination, delivery method, late referral, occupational status, and pregnancy complications	- Complication in pregnancy as the most dominant factor influencing maternal mortality
Ikhtiar& Yasir, 2015	To investigate the risk factors associated with maternal mortality	Retrospective	35 cases and 140 controls of women who reported to have given birth within	Interviews, maternal death records, pregnant women cohort registers,	Chronic energy deficiency, Status of anaemia, history of pregnancy complications	Women with high risk pregnancy have almost 10 times having maternal death compared to low risk

	determinants		the last 3 years Maternal mortality ratio: 10/1000	medical records and verbal autopsy documents		women (OR =9.750).
Iswati et al.,2020	To analyze the determinant of maternal mortality	Retrospective cohort study	Family of the death maternal 29 cases, 116 controls Maternal mortality ratio: 13/1000	Interview, Mother and child health records	Husband's education, house status, parity and pregnancy interval at significance of 5% and decision maker, husband's support and disease history	- Husband with lower-middle education, mother with upper-middle education has probability of 7.93 Times higher to die - Living in family-owned or rented house has 5,980 risk of death higher than those living in their own house - The higher the mother's parity, the higher is the maternal mortality probability (adj. OR= 33.949; P > 0.001) - The narrower the pregnancy interval (adj. OR= 5.806; P < 0.007). - Mothers making their own decision has maternal mortality risk of 0.343 or 2.915 higher - Mothers with supporting husband have 1/0.367 or 2.583 risk of mortality - Those with disease history have 3.322 risk of maternal mortality

Kusnadi et al., 2019	To reduce the MMR, especially in Karanganyar Regency, the risk factors that affect the maternal mortality must be known.	Case-control retrospective	57 study subjects Maternal mortality ratio: 18/1000	Interviews, observation	Pregnancy complications, labor complications, post-partum complications, delayed referral, delayed complication management, family income	- Factors have Strong relationship with maternal death: Pregnancy complications (OR= 6.98; p= 0.001), labor complication (OR= 7.59; p= 0.001), delayed labor (OR = 5.39; p= 0.021), and family income (OR= 4.29; p = 0.015)
Palimbo et al., 2019	To identify determinants of maternal mortality from 2016 to 2017 in Banjar regency	Case control	21 cases, 42 control Maternal mortality ratio: 21/1000	Medical records	Age, parity, childbirth, place of death/complications, Complication during pregnancy, child birth and postpartum, a period of death/complications	- Factors have relationship with maternal death: Age (OR=0.2; 0.09 – 0.8), parity (OR=0.2; 0.08 – 0.8), Labor provider (OR=0.2; 0.03 – 0.8), pregnancy complications (OR=2.3; 1.5 – 3.3)
Mawarti et al., 2017	To identify maternal care quality provided to mothers with life threatening conditions in an academic public tertiary hospital and the relationship of quality of care with maternal mortality	Retrospective cohort study	114 mothers, 29 cases of maternal deaths, with one inaccessible medical record, and 86 near misses as controls Maternal mortality ratio: 96/1000	Medical records	Subjects' characteristics and disease history, referral status, response time, vital sign, diagnoses, laboratory test results, treatment and intervention given, length of stay and pregnancy outcome.	- Factors have relationship with maternal death: Triage response time (OR 1.88); Obstetric resident response time (OR 1.02); surgery waiting time (OR 1.00) and ICU waiting time (OR 1.01) - The survived mothers were more likely to be referred from other health care facilities (OR 0.09). Caesarean section (OR

						0.15). vaginal delivery (OR 3.47).
Baharud din et al., 2019	To determine the factors contributing to hospital based maternal deaths in Indonesia	Retrospective review	90 women who died in 11 hospitals from January to June 2014. Maternal mortality ratio: 19/1000	Medical records	Heath worker-oriented, administrative /supply, transport/referra l, and patient-oriented factors	- Factors identified: health worker-oriented factors including absence of the obstetrician/ gynecologist (88%); inappropriate clinical decision making (77%); and a lack of monitoring (76%). - transport/refer rals factor, not stabilized before referral

**ANC= Ante Natal Care; KMS= Kartu Menuju Sehat (Toddler health-record card); OVM= Otopsi Verbal Maternal (Maternal verbal autopsy); MMR= Maternal Mortality Rate; ICU= Intensive Care Unit; OR=Odds Ratio; CI= Confidence Interval*

Table 1. *Characteristics of the studies included.*

Study quality assessment

Based on the results of the study quality assessment, overall the included studies were in the study quality between Moderate to High. The result of RoB assessment presented in Table 2. There are three studies with only 12 "Yes" answer indicating a Moderate quality, and the rest is with 13 "Yes" means a high quality.

Criteria	Astuti et al., 2017	Bazar et al., 2012	Cameron et al., 2019	Diana et al., 2020	Ikhtiar &Yasir, 2015	Iswati et al., 2020	Kusnadi et al., 2019	Palimbo et al., 2019	Mawarti et al., 2017	Baharud din et al., 2019
1	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
2	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
3	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	Y	Y	Y	Y	NR	Y	Y	Y	Y	Y

5	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
6	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	NR	Y	Y	NR	Y	NR	Y	Y	NR	Y
8	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
9	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
10	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
11	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
12	Y	Y	NR	NR	Y	Y	Y	Y	NR	Y
13	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
14	Y	Y	Y	Y	NR	Y	Y	NR	Y	NR

*Y= yes; NR= Not reported

Table 2. *Summary of Study Quality Assessment*

Risk of Bias Assessment

Most of the studies included in this review are in the Some Concerns category (Baharuddin et al., 2019; Diana et al., 2020; Ikhtiar & Yasir, 2015; Iswati et al., 2020, Mawarti et al., 2017, [26]. There are four studies that are in the Low Risk of Bias category [17,18,22,23]. Following are the results of the Risk of Bias assessment using the ROBINS E Tool presented in the form of a Traffic Light plot (Figure 2).

Risk Factors of maternal mortality

Based on what was obtained in the studies collected, it is known that several factors are related to the incidence of maternal mortality in Indonesia, which are then categorized into Modifiable and Non-modifiable risk factors. Based on the compiled studies, it is evident that modifiable factors are the most significantly associated risk factors with maternal mortality rates in Indonesia (Table 3).

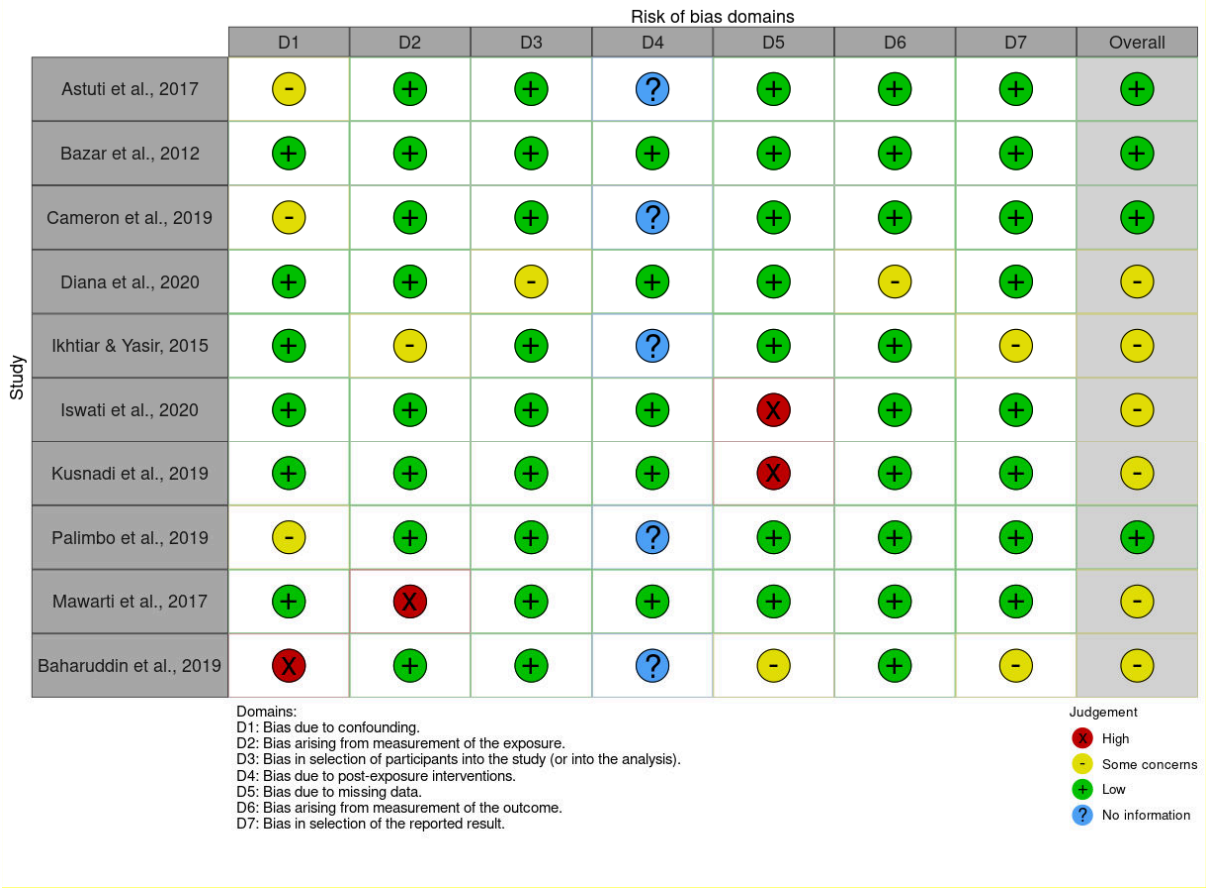

Figure 2. *Traffic-Light Plot for Risk of Bias Result.*

Author	Risk factor	Modifiable			Risk factor	Non-Modifiable		
		P value	OR	95% CI		P value	OR	95% CI
Astuti et al., 2017	Pregnancy compl.	<0.001	6.368	2.172 - 18.668	Maternal age	0.03	2.625	1.081-6.377
	Delivery compl.	<0.001	5.083	2.143 - 12.053				
	Puerpural compl.	0.022	4.382	1.145 - 4.382				
	Medical history	<0.001	19.828	4.356 - 90.258				
	Antenatal care	0.007	5.444	1.449 - 20.462				
	Area of residence	0.049	2.19	0.998 - 48.07				
Bazar et al., 2012	Maternal Educ.	0.001	8.96	3.78 - 21.23				
	Husband's occup.	0.001	3.79	1.94 - 7.40				
	Residence	0.001	7.41	3.66 - 15.01				
	Referral status	0.001	4.01	1.76 - 9.13				
	ANC Visit	0.001	2.98	1.53 - 5.80				

	Medical history	0.001	4.4	3.40 - 5.71				
	Compl. of pregn.	0.001	5.54	4.07 - 7.55				
	Compl. of delivery	0.001	8.5	5.63 - 12.82				
	Compl. of Puerpural	0.001	4.19	3.26 - 5.37				
Cameron et al., 2019	Dist. to health cent.	0.001	0.989	0.943 - 1.038				
	Numb. of doctors	0.001	0.99	0.984 - 0.997				
Diana et al., 2020	Anemia status	0.3	8	1.684 - 37.997	Age	0.207	2.792	1.022-7.630
	Late referral	0.279	7.135	1.490 - 34.175				
	Working status	0.401	7.615	2.575 - 22.525				
	Nutritional status	0.457	13.256	3.620 - 48.540				
	History of illness	0.545	20.143	5.495 - 73.337				
	ANC exam.	0.589	33.6	7.302 - 154.62				
	Method of delivery	0.257	6.316	1.305 - 30.562				
Ikhtiar dan Yasin, 2015	High-risk pregn.		9.750	3.624 - 26.230				
Iswati et al., 2020	Husband's educ.	0.01	0.126	0.026 - 0.614				
	House status	0.01	5.98	1.535 - 23.304				
	Decision making	0.07	0.343	0.108 - 1.093				
	Parity	0.001	33.949	3.876 -297.354				
	Pregn. interval	0.007	5.806	1.609 - 20.946				
	Husband's support	0.09	0.387	0.129 - 1.159				
	Disease history	0.075	3.322	0.885 - 12.473				
Kusnadi et al., 2019	Pregnancy Compl.	0.001	6.98	2.06 - 23.71	Age	0.306	0.51	0.14 - 1.86
	Labor compl.	0.001	7.59	2.19 - 26.28				
	birth space <2 y	0.244	0.49	0.15 - 1.64				
	Parity <4 times	0.178	0.25	0.023 - 2.16				
	Nutri. status	0.574	1.37	0.456 - 4.14				
	Late referral	0.021	5.39	1.17 - 24.75				
	ANC Visit ≥4 times	0.202	0.41	0.10 - 1.66				
	Family income	0.015	4.29	1.28 - 14.41				
Palimbo	Parity	0.03	0.26	0.08 - 0.8	Age	0.04	0.27	0.09 -0.8

et al., 2019								
	Birth attendant	0.03	0.17	0.03 - 0.8				
	Complication	0.001	2.31	1.59 - 3.34				
Mawarti et al., 2017	triage response time		1.88	1.35 - 2.62				
	Obst. resident resp. time		1.02	1.00 - 1.04				
	surgery waiting time			1.00 - 1.01				
	ICU waiting time		1.01	1.00 - 1.01				

Table 3. *Risk Factors of Maternal mortality in Indonesia*

Risk factors included in the modifiable category including prior medical history (40% of ten studies; OR range 3.322 – 20.143), pregnancy complications (40% of ten studies; OR range 2.31 – 9.75), delivery complications (30% of ten studies; OR range 5.08 – 8.5), puerperal complications (20% of ten studies; OR 4.19 – 4.382), parity (30% of ten studies; OR 0.25 – 33.949), Birth space (20% of ten studies; OR 0.49 – 5.806), Nutritional status (20% of ten studies; OR 1.37 – 13.256), delayed referral (30% of ten studies; OR 4.01 – 7.135). Regarding facilities, several categories of modifiable risk factors include living area (30% of ten studies; OR 0.989 – 7.41), number of doctors (10% of ten studies; OR 0.99), triage response time (10% of ten studies; OR 1.88), Obst. resident response time (10% of ten studies; OR 1.02), and ICU waiting time (10% of ten studies; OR 1.01). Meanwhile, the most striking non-modifiable risk factor is maternal age (40% of ten studies; OR 0.27 – 2,792).

Place of the maternal mortality

Based on the ten studies included, most place of mothers death was in the health care facilities including hospitals (Astuti et al., 2017; Bazar, 2012; Noferi Kusnadi & Sulistyowati, 2019; Mawarti et al., 2017; Baharuddin et al., 2019), Public Health Center (Cameron et al.,

2019; Diana et al., 2020; Ikhtiar & Yasir, 2015; Palimbo et al., 2019), and Clinic [20].

Outcome Measures

Information regarding maternal mortality, including assessment of research outcomes using medical records (Astuti et al., 2017; Bazar, 2012; Ikhtiar & Yasir, 2015; Palimbo et al., 2019; Mawarti et al., 2017; Baharuddin et al., 2019), National survey (Cameron et al., 2019), interview and observation (Diana et al., 2020; Ikhtiar & Yasir, 2015; Iswati et al., 2020; Kusnadi & Sulistyowati, 2019), Maternal verbal autopsy (Diana et al. al., 2020; Ikhtiar & Yasir, 2015), and Mother-Toddler health-record card (Diana et al., 2020; Iswati et al., 2020).

DISCUSSION

Maternal mortality is the result of complications during and after pregnancy and childbirth. Most of these complications develop during pregnancy and can be prevented or treated. Other complications may exist before but worsen during pregnancy, especially if not treated as part of the woman's care. Not only that but maternal mortality can also be influenced by other factors that are indirectly related to the mother's physique.

This review has collected scientific evidence from published studies on maternal mortality in Indonesia in the last twenty years. In this review, various variations of factors associated with the incidence of maternal mortality were found. These various factors have been tried to be classified to make it easier to understand and as a guide to overcoming this problem systematically, especially for those who have authority.

Mother-related factors

After analyzing descriptively, the results of the studies collected, factors from within the mother are the most decisive factor related to the incidence of maternal mortality.

Variables included in this factor include age, level of knowledge and education, pregnancy complications, delivery complications, medical history, and nutritional status.

Obstetric complications, namely pregnancy, childbirth, and postpartum complications, are risk factors for maternal death [27]. Obstetric complications directly resulting in maternal death are as much as 75% of all maternal deaths. Medical intervention can prevent such deaths [25]. The main complications that cause almost 75% of all maternal deaths are heavy bleeding (mostly bleeding after delivery), infection (usually after delivery), high blood pressure during pregnancy (pre-eclampsia and eclampsia), complications from childbirth, and unsafe abortion [10].

In this review, it was found that complications in pregnancy were a frequent factor found in almost all the studies included in this review. Ikhtiar & Yasir stated that mothers who experience pregnancy complications would be ten times at risk of experiencing death compared to mothers who do not experience pregnancy complications [19].

The nutritional status of pregnant women is also a factor associated with maternal mortality. This condition is associated with a lack of nutritional intake during pregnancy, such as anaemia and chronic energy deficiency. Anaemia in pregnancy has been associated with higher rates of maternal mortality, perinatal mortality, premature birth, preeclampsia, low birth weight, small live birth for gestational age (SGA), and cesarean delivery [28–32].

Socio-economic-cultural factors

The factors that fall into this category based on the results of the studies included in this review include husband/family support, economic/family income status, occupational status, and referral status.

The role of the husband and family in the mother's pregnancy is crucial because it relates to the mother's desire to have a pregnancy check-up. In several studies conducted in countries

such as Asia and Africa, husbands and families hold full power to determine what pregnant women should do because, usually, this is related to some cultural or customary rules that apply in specific regions or tribes. Husband and family's knowledge about pregnancy and various types of problems is essential to increase as a counterweight in making a decision that might conflict with the beliefs they live by [33–36].Support from the husband while the mother is in the hospital can increase the mother's social support. Even though the role is unclear psychologically in influencing the birth process, it was reported that physical support and feelings could speed up the process of cervical opening, minimise complications, and add to the mother's sense of optimism [37].

Individual socioeconomic status has a robust protective effect [3,38]. According to Kusnadi and colleagues, a family income below the minimum standard has five times the risk of experiencing maternal death [26]. Lack of family income has implications for the lack of meeting family nutritional needs, costs for carrying out pregnancy checks, and costs for childbirth, including transportation costs [39,40].

Factors of health facilities and services

This category includes antenatal care, living area/residence, family planning, referral status, response time, diagnosis, laboratory test results, treatment and intervention were given, health worker-oriented, administrative/supply, transportation, and patient-oriented factors. Antenatal care (ANC) is highly recommended for pregnant women in places that carry it out according to their regions. Through ANC, various information and education related to pregnancy and childbirth preparation can be given to mothers as early as possible. Lack of knowledge about the danger signs of pregnancy often occurs due to a lack of ANC visits. Lack of ANC visits can cause harm to the mother and fetus, such as bleeding during pregnancy, because no signs of danger are detected [41].

A study in Mozambique stated that the delays in referrals for pregnant women were related to the management of the referral process, which was characterized by frequent fuel stocks running out and lack of ambulance maintenance or even no functioning in the District[42]. A study conducted by Bazar and colleagues stated that in Palembang, most of the deaths occurred within <48 hours after hospital admission, which indicates that most of the referrals were delayed or late referrals [17]. The high maternal mortality rate in Indonesia indicates the low quality of health services. It is considered impossible to reduce without an effective referral system, especially in cases with complications [43,44].

Studies in Tanzania show that more than a quarter of maternal deaths are caused by late referrals from lower care facilities to higher care facilities, long distances to facilities and poor infrastructure [45,46]. In practice, long distances to health facilities, poor communication and transportation infrastructure continue to complicate timely access to health services due to delays [38,47]. In addition, it shows a weak healthcare system that contributes to the poor management of this condition in regional and district-level hospitals. In addition, most health facilities in low- and middle-income countries cannot offer safe and effective care to women with obstetric complications due to limited resources [48,49].

CONCLUSION

Understanding the causes and contributing factors to maternal death is critical to developing interventions and funding to reduce maternal mortality. The results of this review study highlight the importance of paying attention to the causes of maternal death in Indonesia in higher proportion. In particular, maternal deaths due to pregnancy complications require special attention because these causes are responsible for half of all maternal deaths in Indonesia. This study also summarizes the results of an analysis that examines the relationship between maternal mortality and maternal characteristics as well as facilities and

health services in Indonesia and shows that factors within the mother (age, level of knowledge and education, complications of pregnancy, complications of childbirth, medical history, and nutritional status), Socio-economic-cultural factors (husband/family support, economic/family income status, occupational status, and referral status), and Factors of health facilities and services (Antenatal care, living area/residence, family planning, referral status, response time, diagnosis, laboratory test results, treatment and intervention given, health worker-oriented, administrative/supply, transportation, and patient-oriented factors) are related to maternal mortality. In addition to the need for a national study to determine the factors associated with maternal mortality, specific differences in the determinants of death between districts and provinces should be considered.

LIMITS AND STRENGTH

The studies collected were small and not of high quality, so caution should be exercised in using the results of this review. However, by analyzing the factors related to maternal mortality in Indonesia, this study can become a starting point to examine further the factors frequently emerging in most studies included in this review.

Registration

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Author's Contribution

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Conflict of Interest

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