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Gender differences and risk factor of infant mortality in Indonesia

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ABSTRACT

The Infant Mortality Rate is also closely related to the Human Development Index, which measures a country's social and economic development. The decline in IMR based on certain genders is thought to be related to discrimination in the treatment of female babies, unequal nutritional needs of female babies, and utilization of health service facilities. The study aims to investigate the relationship between risk factors and infant mortality with gender stratification. This analytical and observational study with a cross-sectional approach based on secondary data from the 2012 and 2017 Indonesian Demographic and Health Survey (IDHS). The research sample was women of childbearing age 15-49 years who had given birth. The total sample was 3694 babies in 2012 and 3413 babies in 2017. The data analysis used was Logistic Regression. The sampling technique used was two-stage stratified random sampling. Sequentially from the 2012 and 2017 IDHS, variables that influence infant mortality based on female and male gender are maternal age (0.23 95% CI 0.14-0.37; 3.17 95% CI 1.94-5.17), parity (0.49 95% CI 0.33-0.72; 2.53 95% CI 1.75-3.68), place of birth (0.47 95% CI 0.33-0.67; 0.61 95% CI 0.41-0.89), and body weight (2.67 95%CI 1.75-4.08; 3.31 95% CI 2.12-5.17) baby. Baby girls with small birth weights are at risk of dying compared to baby boys. Meanwhile, male babies born to old mothers are at greater risk of death compared to female babies. Antenatal care was an essential key to reducing various risks of infant death based on gender. It plays a crucial role in ensuring healthier outcomes for both male and female infants through early detection and targeted interventions.

1. Introduction

The infant mortality rate (MMR) reflects the quality of a country or region's health system. The Infant Mortality Rate is also closely related to the Human Development Index, which measures a country's social and economic development [1]. A high infant mortality rate can indicate severe problems in the health system [2]. The decline in IMR based on certain genders is thought to be related to discrimination in the treatment of female babies, unbalanced nutritional needs of female babies, and utilization of health service facilities and resources in certain groups. Sustainable Development Goals (SDGs) target reducing IMR to 12 deaths per 1000 Live Births by 2030 [3]. However, this target is still challenging for several developing countries such as Indonesia. Based on reports from the 2017 Indonesian Demographic and Health Survey (SDKI), IMR in Indonesia reached 32 deaths per 1000 KH and 24 deaths per 1000 KH. Although IMR shows a decline from the previous period, this figure is still far from the target set by the SDGs in 2030.4 The decline also shows inequalities in mortality rates between population subgroups in low- and middle-income

countries [5-8]. Baby boys were found to be in more significant morbidity and mortality compared to female babies [9-12].

The Indonesian Demographic and Health Survey (2017) reports that the mortality rate for male babies is higher than for female babies. Other researchers say that male babies have a higher risk of death compared to female babies. These risk factors are associated with socio-economic factors, maternal reproductive health, pregnancy and delivery facilities, and infant mortality in Indonesia [4,13,14]. However, this study did not look at the relationship between risk factors and infant mortality by considering the baby's gender. Various allegations regarding the exact cause of infant death based on gender are still unanswered and are still the subject of debate, so further research is needed to answer this question. Additionally, health challenges must be addressed to reduce infant mortality further. The Indonesian government must continue to make various efforts to reduce IMR through various maternal and child healthcare programs [15-17]. This study aimed to investigate the relationship between risk factors and infant mortality with gender stratification.

2. Method

Analytical and observational research with a cross-sectional approach, namely collecting data on a population at a particular time, is used in this research. The research population was women aged 15-49 years of childbearing age and spread across 34 provinces in Indonesia. The research sample is part of the population with inclusion criteria, namely women of childbearing age who have given birth to a baby in the last five years before 2012 and 2017 with the status of the previous born baby. Meanwhile, the exclusion criteria are babies born as twins. The sampling technique used was two-stage stratified random sampling [4-5]. The total sample was 3694 babies in 2012 and 3413 babies in 2017. The data collection method was carried out using secondary data originating from the Indonesian Health Demographic Survey from The United States Agency International Development (USAID) in 2012 and 2017, using an internationally validated questionnaire. The selection of secondary data for 2012 and 2017 was based on the fact that these data were from the last two survey periods.

The theoretical framework used in the research is the theory of child survival in developing countries [19], which evolved into the following conceptual framework. Some factors in the dependent variable are socioeconomic and demographic, women's reproductive health, and infant factors. Socioeconomic and demographics included wealth index, region and residence type, and source of drinking water. Maternal age, literacy, marital status, parity, mother's desire for pregnancy, prenatal assistance, place of delivery, delivery assistance, Section Caesarea (SC), abortion history, and health insurance are included in women's reproductive health. Therefore, variables in infant factors are birth weight and birth interval. All variables are defined in categorical data. Data collected from IDHS was analyzed using descriptive and bivariate analysis. Descriptive analyses were performed comparing females and males by number and percentage. Odd ratio and 95% CI were obtained from the Logistic Regression stratified by gender.

3. Results and Discussion

3.1. Results

Univariate analysis to describe all variables with frequencies and percentages after stratification based on gender is presented in Table 1.

Table 1. Descriptive analysis factors of infant mortality stratified by gender (IDHS, 2012 and 2017).

Variables		IDHS 2012				IDHS 2017			
		Female		Male		Female		Male	
		n	%	n	%	n	%	n	%
		n = 1805		n= 1889		n = 1716		n = 1881	
Infant survival 0-11 months	Yes	1694	45.85	1736	47.01	1517	44.45	1658	48.58
	No	111	3.00	153	4.14	93	2.71	145	4.26
DISTAL FACTORS									
Wealth index	Poorest and poor	740	20.02	773	20.92	665	19.49	727	21.29
	Middle	315	8.53	411	11.12	316	9.27	367	10.76
	Richest and rich	750	20.30	706	19.11	628	18.40	710	20.79
Region	Papua Maluku	59	1.60	1163	30.04	56	1.63	69	2.03
	Sumatera	398	10.77	608	15.71	381	11.17	441	12.91
	Java Bali	1030	27.87	257	6.64	873	25.56	977	28.61
	Nusa Tenggara	88	2.38	84	2.26	79	2.31	77	2.26
	Kalimantan	92	2.49	130	3.52	101	2.94	104	3.05
	Sulawesi	138	3.73	138	3.73	121	3.55	136	3.98
Residence type	Urban	890	49.30	56	3.13	817	43.20	63	3.35
	Rural	804	44.56	54	3.02	920	48.70	90	4.75
Source of drinking water	Non improved source	1497	40.52	1638	44.36	684	20.03	774	22.66
	Improved source	308	8.34	251	6.78	926	27.16	030	30.18
INTERMEDIATE FACTORS									
Mother's age (y)	15-24	622	16.84	616	16.66	425	12.45	449	13.15
	25-34	867	23.47	906	24.54	849	24.86	932	27.32
	35-49	316	8.54	368	9.95	336	9.84	422	12.37
Mother's literacy	Cannot read at all	123	3.34	166	4.52	72	2.10	80	2.33
	Able to read	1672	45.49	1715	46.65	1536	45.12	1718	50.45
Marital status	Married	1751	47.39	1842	49.87	1562	45.75	1745	51.13
	Un-married	19	0.52	16	0.44	14	0.42	25	0.74
	Widowed and divorced	35	0.94	31	0.83	34	1.00	33	0.96
Parity	1 -3	1581	42.79	1597	43.25	1385	40.59	1550	45.41
	≥ 4	224	6.07	292	7.89	224	6.57	253	7.42
Mother's desire for pregnancy	Then	1546	42.13	1556	42.42	1300	38.45	1481	43.80
	Later	136	3.71	155	4.21	147	4.34	167	4.93
	No more	113	3.09	163	4.44	142	4.19	145	4.29
Prenatal assistance	Health professional	1731	47.22	1818	49.60	1623	45.55	1785	50.10
	Non-health professional	61	1.66	56	1.52	74	2.08	81	2.27
Place of delivery	Health facilities	1300	35.44	1294	35.28	1335	39.48	1502	44.40
	Non-health facilities	495	13.50	579	15.79	254	7.50	291	8.62
Delivery assistance	Health professional	1572	42.84	1632	44.49	1474	43.56	1657	48.96
	Non health professional	223	6.08	241	6.58	118	3.48	135	4.00
Caesarea Section	No	1542	42.17	1597	43.69	1280	37.87	1435	42.49
	Yes	250	6.83	268	7.32	307	9.07	357	10.57
History of abortion	No	1585	42.91	1613	43.66	1356	39.72	1562	45.75
	Yes	220	5.94	277	7.49	254	7.44	242	7.09
Health insurance	No	1131	29.24	1250	32.32	595	17.43	649	19.01
	Yes	712	18.41	775	20.04	1015	29.73	1155	33.83
PROXIMATE FACTORS									
Size at the birth	Average	1013	27.30	1043	28.11	915	27.57	943	28.42
	Very small and small	269	7.25	239	6.44	207	6.22	205	6.17
	Very large and large	489	13.18	658	17.73	444	13.37	606	18.25
Birth interval	<24 months (Ref)	148	6.06	166	6.80	122	5.30	117	5.08
	≥24 moths	987	40.42	1141	46.72	976	42.30	1092	47.33

Table 1 shows that the number of baby girls is 1805, and the number of baby boys is 1889 (IDHS 2012). Meanwhile, there were 1716 female and 1881 male babies (IDHS 2017). In both IDHS periods was reported that the most significant percentage of babies whose status was stillborn was in the group of male babies. In the distal factors of 2012 IDHS, the highest rate of baby girls with wealthy status, baby boys who live in Papua and Maluku Provinces, baby girls who live in urban areas, and baby boys who do not have a source of protected clean water. Meanwhile, based on the

2017 IDHS, the highest percentages are baby boys who come from people experiencing poverty and inferior wealth index, baby boys who live in Java and Bali, baby girls who live in rural areas, and baby boys who come from families with access to protected drinking water sources.

Table 2. Bivariate analysis of risk factors of infant mortality stratified by gender (IDHS, 2017)

Variables		IDHS 2017					
		Female			Male		
		Survived	Did not survived	COR (95%CI)	Survived	Did not survived	COR (95%CI)
DISTAL FACTORS							
Wealth index	Poorest and poor	775	61	Ref	804	74	Ref
	Middle	281	13	0.59 (0.32-1.09)	329	21	0.69 (0.42-1.15)
	Richest and rich	557	29	0.66 (0.42-1.04)	602	51	0.92 (0.64-1.34)
Region	Papua Maluku	952	53	Ref	1046	78	Ref
	Sumatera						
	Java Bali						
	Nusa Tenggara						
	Kalimantan	495	34	1.23 (0.79-1.92)	521	49	1.26 (0.87-1.83)
	Sulawesi	166	16	1.73 (0.97-3.97)	168	19	1.52 (0.90-2.57)
Residence type	Urban	761	49	Ref	866	64	Ref
	Rural	852	54	0.98 (0.66-1.47)	869	82	1.28 (0.91-1.79)
Source of drinking water	Non improved source	763	48	Ref	820	70	Ref
	Improved source	850	55	1.03 (0.69-1.53)	915	76	0.97 (0.69-1.36)
INTERMEDIATE FACTORS							
Mother's age (y)	15-24	436	17	Ref	445	24	Ref
	25-34	860	47	1.40 (0.80-2.47)	921	59	1.19 (0.73-1.94)
	35-49	317	39	3.16 (1.75-5.68)**	369	63	3.17 (1.94-5.17)***
Mother's literacy	Cannot read at all	73	12	Ref	82	13	Ref
	Able to read	1538	91	0.36 (0.19-20.69)	1646	133	0.51 (0.28-0.94)*
Marital status	Married	1543	98	Ref	1660	139	Ref
	Un-married	39	1	0.40 (0.06-2.97)	45	2	0.53 (0.13-2.21)
	Widowed and divorce	31	4	2.03 (0.70-5.87)	30	5	21.99 (0.76-5.21)
Parity	1 -3	1344	70	Ref	1461	99	Ref
	≥ 4	269	33	2.36 (1.53-3.64)**	274	47	2.53 (1.75-3.68)***
Mother desire for pregnancy	Then	1320	73	Ref	1430	107	Ref
	Later	169	8	0.86 (0.41-1.81)	168	11	0.88 (0.46-1.66)
	No more	124	4	0.58 (0.21-1.62)	136	15	1.47 (0.84-2.60)
Prenatal assistance	Health professional	1635	96	1.63 (0.73-3.63)	1684	134	0.76 (0.33-1.77)
	Non health professional	56	5	Ref	53	3	Ref

Variables		IDHS 2017					
		Female			Male		
		Survived	Did not survived	COR (95%CI)	Survived	Did not survived	COR (95%CI)
Place of delivery	Health facilities	330	37	Ref	355	40	Ref
	Non-health facilities	1283	49	0.34 (0.22-0.53)***	1380	94	0.61 (0.41-0.89)**
Delivery assistance	Health professional	1635	96	1.63 (0.73-3.63)	1684	134	0.76 (0.33-1.77)
	Non health professional	56	5	Ref	53	3	Ref
Caesarea Section	No	1323	67	1.30 (0.77-2.20)	1399	113	074 (0.45-1.21)
	Yes	288	19	Ref	335	20	Ref
History of abortion	No	1368	87	1.03 (0.59-1.78)	1490	118	1.44 (0.94-2.23)
	Yes	245	16	Ref	245	28	Ref
Health insurance	No	559	38	0.91 (0.60-1.37)	571	48	1.00 (0.70-1.44)
	Yes	1054	65	Ref	1164	98	Ref
PROXIMATE FACTORS							
Size at the birth	Average	901	28	Ref	898	54	Ref
	Very small and small	209	30	4.62 (2.70-7.90)***	186	37	3.31 (2.12-5.17) ***
	Very large and large	483	13	0.87 (0.45-1.69)	619	31	0.83 (0.53-1.31)
Birth interval	<24 months (Ref)	130	11	Ref	109	17	Ref
	≥24 moths	963	64	0.79 (0.40-1.53)	1055	99	0.60 (0.35-1.04)

COR Crude odds ratio; *p<0.05 **p<0.01 ***p<0.001; Indonesia Demographic and health Surveys (IDHS)

Table 2 presents the results of bivariate analysis based on 2012 and 2017 IDHS data, which shows that the variables influencing infant mortality based on female and male gender are maternal age, parity, place of birth, and baby's weight. The results that differentiate between the two survey periods are the literacy variables and abortion history.

Table 2 presents the results of bivariate analysis based on 2012 and 2017 IDHS data, which shows that the variables influencing infant mortality based on female and male gender are maternal age, parity, place of birth, and baby's weight.

3.2. Discussion

The results that differentiate between the two survey periods are the literacy variables and abortion history. Infant mortality is the opportunity for a child to die between birth and before the child celebrates his first birthday. Mosley and Chen (2003) stated that close determinants and baby factors influence infant mortality in developing countries [19]. Intermediate determinants include maternal reproductive health, pregnancy and childbirth care facilities, and distant determinants include socio-economics and demographics. Maternal age is one of the variables associated with infant mortality based on gender. Elderly mothers are less likely to suffer infant death compared to mothers aged less than 20 years or older than 35 years [20-22].

Babies born with the assistance of health workers and whose mothers carry out adequate Ante Natal Care (ANC) are less likely to die than babies born to non-health workers with inadequate ANC [23]. Place of birth has been proven to be associated with infant mortality, especially if delivery takes place in a health service facility [24]. Babies born by professional health workers are less likely to die [25]. A history of abortion or termination of pregnancy is the main cause of infant death [26]. Another study found that babies living in states with restrictive laws were more likely to die than

those living in states with no restrictive laws one or two restrictive laws [27]. Risk factors for infant mortality by sex stratification. Abate et al. (2020) reported that infant mortality was lower for very small women and smaller than average-size women compared to average-size men [28]. The increase in late neonatal mortality among girls is explained by a three-way environmental interaction between ethnicity, gender, and previous sibling composition [7].

Table 2 reports that based on the 2017 IDHS, variables related to infant mortality based on gender are maternal age, literacy, parity, place of delivery, and baby's weight. Previous studies also report that men and women are equally sensitive to the harmful effects of being smaller at birth on the risk of death during infancy and early childhood [29]. However, a study in the Netherlands reported no association between normal-large-weight male babies and perinatal and neonatal mortality compared to female babies. Male babies with small body weight have a higher risk of neonatal morbidity than female babies [30]. Smaller and larger babies have a higher chance of dying than average-sized babies. The causes are infections and other disorders. Older babies have a higher risk of birth injuries, respiratory problems due to birth asphyxia, and congenital anomalies [31, 32]. Babies born with a birth interval of less than 24 months have a higher risk of death than babies born with a birth interval of more than 24 months [24, 32]. The results of other studies report differences; research conducted in East Nusa Tenggara, Indonesia, found that birth spacing <24 months was not associated with infant mortality [31].

This research has the advantage that the questionnaire used to collect this data has met national validity and reliability tests. Meanwhile, the weakness of this research is that the data is only analyzed bivariate, so the influence of all independent variables on infant mortality could not be shown.

4. Conclusion

There was relationship between maternal age, parity, place of birth, and baby's weight. Baby girls with small body weight are at risk of dying compared to baby boys. Meanwhile, male babies born to old mothers are at greater risk of death compared to female babies. However, in general, it can be concluded that male babies have a greater risk of dying compared to female babies. We suspect that genetic factors and biological advantages influence female infant mortality. However, the risk of death can be reduced by increasing the number of health education programs given to pregnant women during Ante Natal Care (ANC) at health service facilities

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Author contributions

YW has designed and drafted this manuscript. YW and SN collected and analyzed the data. YW and INS have been involved in correcting the manuscript. All authors have read and approved the final manuscript.

Conflict of Interest

The author declares no potential conflict of interest.

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