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PUBLIC HEALTH POLICY AND PRACTICE

Infant mortality and family welfare: policy implications for Indonesia

S Poerwanto, M Stevenson, N de Klerk

J Epidemiol Community Health 2003;**57**:493–498

See end of article for authors' affiliations

Correspondence to: Mr S Poerwanto, School of Population Health, The University of Western Australia, 35 Stirling Highway, Crawley WA 6009, Australia; siswop@dph.uwa.edu.au

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Study objective: To examine the effect of family welfare index (FWI) and maternal education on the probability of infant death.
Design: A population based multistage stratified clustered survey.
Setting: Women of reproductive age in Indonesia between 1983–1997.
Data sources: The 1997 Indonesian Demographic and Health Survey.
Main results: Infant mortality was associated with FWI and maternal education. Relative to families of high FWI, the risk of infant death was almost twice among families of low FWI (aOR=1.7, 95%CI=0.9 to 3.3), and three times for families of medium FWI (aOR=3.3 ,95%CI=1.7 to 6.5). Also, the risk of infant death was threefold higher (aOR=3.4, 95% CI=1.6 to 7.1) among mothers who had fewer than seven years of formal education compared with mothers with more than seven years of education. Fertility related indicators such as young maternal age, absence from contraception, birth intervals, and prenatal care, seem to exert significant effect on the increased probability of infant death.
Conclusions: The increased probability of infant mortality attributable to family income inequality and low maternal education seems to work through pathways of material deprivation and chronic psychological stress that affect a person's health damaging behaviours. The policies that are likely to significantly reduce the family's socioeconomic inequality in infant mortality are implicated.

Between 1987 and 1990 about nine million infants died annually worldwide, yielding a global infant mortality rate (IMR) of 67 per 1000 live births.[1] Furthermore, evidence worldwide showed that those from lower socioeconomic status have higher morbidity and mortality rates,[2] and action from every country to increase public health spending aimed at reducing socioeconomic inequality in infant mortality is called.[3]

In Indonesia, IMR has been declining; from 142 in 1967–1971 to 46 per 1000 in 1992–1997 period.[4] The rapid decline in IMR in Indonesia disguises the differential in infant mortality among geographical areas and socioeconomic groups. The urban-rural inequality in IMR has been widening; namely 42% higher in rural compared with urban regions.[5 6] Gwatkin indicated that the mortality differentials in Indonesia were associated with socioeconomic status, measured by Wealth Quintiles and a Poor/Rich Ratio.[7] Other studies have also shown that infants from low socioeconomic families are at greater risk for illness and death than high socioeconomic status families.[7–15]

There are numerous studies that show that IMR is closely associated with various potential risk factors, namely ethnicity, education of the mother, access to and use of health services, and residence—urban compared with rural[16 17]—antenatal and postnatal care,[18] low birth weight,[19–21] the absence of breast feeding,[22] prematurity,[23] birth order,[24] young maternal age and frequent birth interval,[25] overcrowding and population density,[26] as well as the use of medical services.[13]

The relation between socioeconomic status and health status including IMR, have been extensively reported over the years and the relation has been replicated in both developed and developing countries using almost every measure of adverse health outcome.[2 27 28] The World Bank has highlighted using data from 115 countries that the level of income per capita and education significantly predict the countries health performance: that between 1960 and 1990, the health conditions of countries improved when the level of education increased along with increases in per capita income.[29]

In 1997, Indonesia undertook the Demographic and Health Survey (1DHS), assisted by the Macro International-USA (MI-USA).[30] This is the first study to model the association between infant mortality, family welfare status (FWI), and maternal education adjusting for potential risk factors and geographical variation.

METHODS

Sources of data

The data were obtained from the MI-USA. The IDHS follows a three stage stratified probability sampling design, where the sample was stratified into 27 provinces. A sample of 34 255 households (response rate 99%) were randomly selected from 1413 Primary Sampling Units (PSUs). The average cluster size was 25 households per PSU. The demographic and health data were obtained by interview from 28 810 reproductive women aged 15 to 49 years (response rate 98%). To produce adjusted and non-biased estimates at the appropriate levels of aggregation (national, regional, provincial and urban-rural), weights were applied to the data.[31]

Study variables

A binary outcome variable was selected, namely whether or not each of the live born infant(s) from the interviewed women was alive or dead in the 12 months after birth.

Of interest were the variables related to socioeconomic status, measured by the FWI and length of maternal education. The FWI is a unique nationally adopted index of family welfare status,[32] used to monitor changes in the level of poverty and welfare at the household level.[33] It consist of five levels of family welfare status, namely pre-prosperous, low prosperous, medium prosperous, high prosperous, and very

Abbreviations: IMR, infant mortality rate; FWI, family welfare index; PSU, Primary Sampling Unit

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Table 1 Number and proportion of infant death among mothers aged 15–49 years old by determinant factors, Indonesia 1983–1997*

Factors	Variable	Covariate	PSU (clusters)	Women sample	Infant death (n)	Infant death (%)	SE	Ratio of % death†
SES	Family welfare index	Poor	1412	93022	16487	17.39	1.64	2.03
		Near-poor	1317	41291	6755	17.52	2.4	2.04
		Rich	770	7818	668	8.58	2.42	1.00
	Length of education	≥7 y	1292	49102	3231	8.11	1.29	1.00
		<7 y	1399	82723	16549	18.88	1.76	2.33
Fertility	Current contraceptive method	Modern	1395	70866	9042	11.84	1.43	1.00
		Traditional	553	4956	337	9.19	3.8	0.78
		No method	1413	68398	14930	23.26	2.21	1.96
	Birth intervals	≤2 y	1401	73771	13449	21.08	1.92	1.56
		>2 y	1412	70429	10859	13.51	1.58	1.00
Biological	Age at first birth	≥26 y	1091	13097	937	7.86	2.03	1.00
		21–25 y	1407	42729	4822	11.78	2.09	1.50
		16–20 y	1410	64346	11726	18.41	1.87	2.34
		≤15 y	1331	24048	6824	24.63	3.74	3.13
	Marital duration	≤3 y	1246	17005	1260	7.89	2.81	1.43
		4–6 y	1252	15583	763	5.5	1.15	1.00
		≥7 y	1412	107214	20903	19.08	1.55	3.47
Cultural	Marital status	Married	1413	133963	21231	15.9	1.31	1.00
		Widowed	679	4790	1699	33.25	9.15	2.09
		Divorced	628	5467	1379	24.67	6.86	1.55
	Religion	Moslem	1243	114921	22783	17.58	1.42	2.32
		Christian	535	21895	1294	11.19	2.25	1.48
		Oriental	188	7403	232	7.57	2.06	1.00
Nutrition	Infants' size	Large	1327	6080	950	17.81	1.52	1.03
		Average	1377	8880	1426	17.27	1.43	1.00
		Small	940	2094	463	20.64	2.21	1.20
	Low birth weight	LBW	1413	134791	22780	16.88	1.3	1.02
		Normal	1334	9429	1528	16.54	1.51	1.00
Mother and child health care	Place of delivery	Home	1370	13679	2445	19.02	1.53	1.18
		Public facility	722	1873	180	12.56	1.8	0.78
		Private facility	569	1890	311	16.11	2.78	1.00
	Antenatal TT immunisation	No	1069	4693	839	19.78	2.01	1.14
		Given	1400	12478	2021	17.34	1.46	1.00
	Antenatal care	No	891	3845	612	20.93	2.36	1.16
		Given	397	724	99	17.97	2.97	1.00
Geographical	Residence	Urban	411	40599	7014	17.46	2.63	1.00
		Rural	1002	103621	17295	16.62	1.47	0.95

*The outputs for 27 provinces were suppressed. †Ratio of percentage death =1, corresponds to a reference level. PSU, primary sampling unit.

high prosperous families.[32 34] In this study, FWI was categorised into three levels namely, high (medium to very high prosperous), medium (low prosperous), and low (pre-prosperous). These three levels of FWI were interpreted as rich, near poor, and poor families.[35] Length of maternal education was dichotomised into two levels namely, less than seven or seven or more years of formal education.

The following risk factors were investigated, namely: current contraceptive method, birth intervals, maternal age at first birth, marital duration, infants' size perceived by the mothers, infants' birth weight, prenatal care by health personnel, antenatal TT immunisation, place of delivery, religion, and marital status, as well as geographical residence (see table 1).

Statistical analysis

A logistic regression model was applied using the generalised estimating equations (GEE) model fitting technique (multilog-cumlogit) on SAS-Callable SUDAAN software version 8.0.[36 37] The detailed explanation of the statistical approach, which uses Taylor Series Linearisation method to compute model based variance, and which adjusts for the complex sampling design, is reported elsewhere.[36–39] To test the model's goodness of fit, the Wald test based on the estimated covariance matrix was used.[36] The backward modelling approach was used to derive a final model; with exclusion from the model based on a probability value of 0.05. The adjusted odds ratios and their 95% confidence intervals were calculated.

RESULTS

Descriptive results showed that there is socioeconomic differentials in infant mortality in Indonesia, namely between low, medium, and high FWI (see table 1). The proportion of infant deaths among women from families of medium and low FWI was almost the same, namely 17.5% (SE=2.4) and 17.4% (SE=1.6); whereas among women from high FWI was 8.6% (SE=2.4). There was also a significant difference in the

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Table 2 Adjusted parameter estimates of the model on the probability of infant death, Indonesia 1983–1997*

Studied variables	Covariates	β (SE)†	p Value‡	aOR (95% CI)
Family welfare (FWI)	Poor	0.5278 (0.3409)	0.1218	1.70 (0.87 to 3.31)
	Near-poor	1.2077 (0.3412)	0.0004	3.35 (1.71 to 6.53)
	Rich	0.00	.	1.00
Maternal education (Educ)	High (>6 y)	0.00	.	1.00
	Low (≤6 y)	1.2130 (0.3777)	0.0014	3.36 (1.60 to 7.06)
Contraceptive	Modern method	0.00	.	1.00
	Traditional	0.5523 (0.1799)	0.0022	1.74 (1.22 to 2.47)
	No FP method	0.4614 (0.0675)	0.0000	1.59 (1.39 to 1.81)
First birth age	≥26 y	0.00	.	1.00
	21–25 y	–0.3481 (0.1345)	0.0098	0.71 (0.54 to 0.92)
	16–20 y	0.5064 (0.1217)	0.0000	1.66 (1.31 to 2.11)
	≤15 y	0.6083 (0.1346)	0.0000	1.84 (1.41 to 2.39)
Antenatal TT shots	No	0.1201 (0.0469)	0.0106	1.13 (1.03 to 1.24)
	Given	0.00	.	1.00
Low birth weight	Yes	0.1203 (0.0461)	0.0091	1.13 (1.03 to 1.23)
	Normal	0.00	.	1.00
Marital status	Married	0.00	.	1.00
	Widowed	0.1577 (0.1646)	0.3382	1.17 (0.85 to 1.62)
	Divorced	0.5732 (0.1523)	0.0002	1.77 (1.32 to 2.39)
Marital duration	≤3 y	0.7805 (0.2038)	0.0001	2.18 (1.46 to 3.26)
	4–6 y	0.00	.	1.00
	≥7 y	1.6470 (0.1785)	0.0000	5.19 (3.66 to 7.37)
Birth intervals	≤2 y	0.5537 (0.0534)	0.0000	1.74 (1.57 to 1.93)
	>2 y	0.00	.	1.00
Residence	Urban	0.00	.	1.00
	Rural	–0.2136 (0.1320)	0.1060	0.81 (0.62 to 1.05)
FWI×Educ	Poor, Educ >6 y	0.00	.	1.00
	Poor, Educ ≤6 y	–0.1304 (0.3899)	0.7382	0.88 (0.41 to 1.89)
	Near-poor, Educ >6 y	0.00	.	1.00
	Near-poor, Educ ≤6 y	–0.7893 (0.3906)	0.0435	0.45 (0.21 to 0.98)
	Rich (R), Educ >6 y	0.00	.	1.00
	Rich (R), Educ ≤6 y	0.00	.	1.00

*The model is adjusted for the province whose estimates were suppressed. †β=0 corresponds to the reference level(s), β (intercept) =–7.0837 (SE=1.0026). ‡p value of test that β=0.

proportion of infant deaths among women with different levels of education: 8.1% (SE=1.3) among women with length of education greater than seven years, and 18.9% (SE=1.7) among those with education less than seven years.

Significant differentials in the proportion of infant death were also observed among women with various potential risk factors, namely absence of contraception, short birth intervals, young maternal age at first birth, marriage longer than six years, divorced or widowed women, religion, women who gave birth at home, absence of antenatal TT immunisation, and absence of prenatal care. It was also shown that women with smaller infants had a bigger proportion of infant death. The provincial inequality of infant death was also observed (results can be given on request); with an absolute percentage difference of 28.51%, and the absolute percentage ratio of 33.4/4.89 (or 6.83 times). Meanwhile, the proportion of infant deaths in urban and rural areas was almost the same, namely 16.6% (SE=1.5) in rural areas and 17.5% (SE=2.6) in urban areas.

Probability of infant death

The adjusted probability of infant death due to low levels of maternal education was three times higher (aOR=3.4, 95% CI=1.6 to 7.1) compared with mothers with more than seven years of education (see table 2). The probability of infant death among women from medium FWI was three times higher (aOR=3.3, 95% CI=1.7 to 6.5) and twice as high for low FWI families (aOR=1.7, 95%CI=0.9 to 3.3, where the 95%CI includes one). Having excluded non-significant covariates, the final model is presented in table 3. A significant interaction ($p<0.001$) between family welfare status and maternal education was present.

The results also indicate potential risk factors such as the absence of contraceptive methods, age at first birth younger than 20 years old, absence of antenatal TT immunisation, birth intervals of two years or less, low birth weight, divorced mothers, and mothers who were married between four and six years, and residence, as significant predictors.

DISCUSSION

Results of this study support claims that both family income inequality and low maternal educational levels increased the probability of infant death. This association has been observed not only in developing countries but also in developed countries.[7–12 15] Compared with the women from high FWI, the probability of infant mortality among women from medium FWI was 300% higher, and almost double among women from the low FWI. The low FWI has been interpreted elsewhere as being "poor" families, whereas medium FWI was the "near poor" families.[32–35]

The absence of a dose-response relation between low and medium FWI may be attributable, in part, to misclassification

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Table 3 Summary of Wald statistics of the model fit of the probability of infant deaths among women aged 15–49 years, Indonesia 1983–1997

	Initial model		Final model	
Variable*	Wald χ^2	p Value	Wald χ^2	p Value
Overall model	516.28	0.0000	916.69	0.0000
Model minus intercept	195.25	0.0000	522.71	0.0000
Family welfare (FWI)	–	–	–	–
Maternal education (Educ)	–	–	–	–
Contraceptive methods	13.81	0.0010	50.02	0.0000
Age at first birth	36.88	0.0000	138.43	0.0000
Antenatal TT shots	3.50	0.0614	6.55	0.0105
Low birth weight	0.03	0.8661	6.82	0.0090
Marital status	1.07	0.5856	14.54	0.0007
Marital duration	4.75	0.0929	125.50	0.0000
Birth intervals	29.00	0.0000	107.54	0.0000
Place of delivery*	1.89	0.3889	–	–
Antenatal care*	2.19	0.1389	–	–
Infants' size*	9.06	0.0108	–	–
Religion*	2.47	0.2911	–	–
Province	29.78	0.2770	67.64	0.0000
Residence (urban-rural)	0.45	0.5017	2.62	0.1057
FWI×Educ	21.26	0.0000	17.38	0.0002
Chunk interactions	21.26	0.0000	17.38	0.0002

*Variables of place of delivery, antenatal care, infants' size, and religion were removed and not included in the final model.

effects caused by non-economic criteria used in the classification of the FWI. The inclusion of "religious practice" criteria, for example has been criticised as being bias.[32 33] For example, economically poor families (fitting the low FWI criteria) scoring high in religious criteria (a criteria used in the classification of FWI) may be misclassified as being in the medium FWI group, and vice versa. It can be seen for example, that the proportion of infant deaths between low and medium FWI was almost the same, namely 17.4% and 17.5% respectively. Therefore, the level of family income for these two groups is almost the same, and the division between the low and the medium FWI is likely to be affected by this non-economic criteria, as well as small gradient between the low and medium FWI. The lack of a dose response relation may also be attributable to the effect of social cohesion[40]; in which it was indicated that where income differences are small (in a homogenously poor society) people experience a social environment that is less hostile and more hospitable. Wilkinson also indicated that cohesive social relations among poor societies can exert a protective effect.[41]

Among women who have less than seven years of education, the probability of infant death was threefold higher than women with educational levels of seven years or more. This finding supports the claim by a number of studies,[42–44] that wider income differences are associated with numerous social variables likely to affect health, including poorer educational attainment.

Understanding the mechanism and pathways whereby both income inequality and low maternal education increased the probability of infant death is essential for deriving accurate conclusions about the nature of their links. Currently, there are three mechanisms and pathways that have been proposed concerning the relation between income inequality and health status namely, the neo-material, psychosocial environment, and individual income theories.[45 46] Results of this study indicate that a combination of both material and psychosocial pathways seems to explain the high probability of infant death among deprived families, rather than the individual theory. Lynch stated that in most circumstances, neither the material nor the psychosocial mechanisms work independently, but linked one to another.[45]

The first of these, the "Neo-material" theory, suggests that the effect of income inequality on health status reflects both lack of resources held by people, and systemic underinvestments across a wide range of community infrastructures.[42 46 47] Applying this theory to the findings of the study, one might infer that income inequality (measured by FWI) as well as low maternal education are a result of accumulated political and economical policies, as well as historical and cultural factors, that produce not only patterns of income distribution, but also patterns of community infrastructure that affect education, public health services, availability of healthy foods, social security, health insurance, etc. These conditions, unfortunately, create inequity of "public services", creating inadequate community health and education, and widen the gap between the rich and poor. Consequently, among the poor families, their health and education needs are likely to be compromised because of lack of both public and individual material resources.

The economic crisis that hit Indonesia in 1997 also supports the neo-material interpretation namely, that increased poverty attributable to economic and material deprivation result in detrimental effects on health.[34] The economic crisis has created shortage of health services to the most at risk populations and compromised health demands among them. The increased risk of infant death attributable to low birth weight shown in the study (aOR=1.13, 95% CI 1.03 to 1.23) can be interpreted as the result of malnourished, poor, and less educated mothers. And women from the low and medium FWI (with low educational attainment) are those who have long been exposed to long term material deprivation (between 1983 and 1997), resulting in the observed threefold increased likelihood their infants dying. On the other hand, a greater social cohesion, characterised by economically and culturally homogenous society, is assumed to be present in the rural areas of Indonesia, and proved to have a protective effect against an increased risk of infant deaths (aOR=0.8, 95% CI 0.6 to 1.05) than those who live in the urban areas.

Applying the "psychosocial" mechanisms,[41 48] to the interpretation of the study findings in an economically disadvantaged environment such as Indonesia, it would suggest that the increased risk of infant mortality is associated with ill health behaviours caused by psychosocial stress and lack of social cohesion (indicated by the gap between the poor and rich), along with material deprivation or lack of human investment, including education and health care.[40 47] As highlighted by Mosley,[13] the effect of poverty and low education work through a behaviourally mediated biosocial mechanism,

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manifested in the family and individual decision making processes related to health matters. It has been reported that in response to neo-material living condition, the deprived people were consequently driven to finally adopt health damaging behaviours.[46 48 49] This study shows that, indeed, the increased probability of infant death among deprived women was significantly related to various risk factors such as the absence of contraceptive use (aOR=1.6, 95% CI 1.4 to 1.8), or marriage and having infants at a young age (less than 16 years old) (aOR=1.84, 95% CI 1.4 to 2.4). The increased likelihood of infant death among deprived women was also significantly associated with other risk factors that are closely linked with both material deprivation and lack of health related knowledge, namely absent from pre-natal TT immunisation and birth spacing of two years and less (see table 2).

Until recently, reduction of infant mortality in the general population has been focused on the delivery of various clinical and public health technologies, which tend to ignore the economic and psychosocial constraints related to the effective use of health services. These factors that restrict families from using new health technologies may well be the same factors that predispose the child to higher risks of infant mortality—that is, family welfare status and maternal education. If this is the case, it may be that the current technology oriented health intervention programmes may be less cost effective than previously anticipated.[50]

To summarise, the increased probability of infant death among deprived families and women is determined by both external and internal factors. The external factors driven by shortcomings in public policies creates unhealthy social and health environmental system, and triggers adverse psychosocial and internal ill health behaviours that increases the probability of infant death.

The results, therefore imply, that a change in population health related policies in Indonesia is needed to reduce socioeconomic inequalities in infant mortality, especially among targeted population. The policies should consider the cause-effect relation between infant mortality and socioeconomic status (measured by family welfare and maternal education), and should meet an urgent need to significantly reduce the burden of excess mortality and morbidity suffered by the poor.[3 51] A stronger political commitment from the Indonesian government along with international support are required to tackle this significant public health issue.

Authors' affiliations

S Poerwanto, M Stevenson, School of Population Health, The University of Western Australia, Australia

N de Klerk, TVW Telethon Institute for Child Health Research, The University of Western Australia, Perth, Australia

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