

Women's Empowerment Facilitates Complete Immunization in Indonesian Children: A Cross-sectional Study

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Objectives: The primary objective of this study was to examine the effect of women's empowerment on the immunization of Indonesian children. The secondary objective was to examine the effect of wealth as a factor modifying this association.

Methods: We utilized data from the 2017 Indonesian Demographic and Health Survey (IDHS). The subjects were married women with children aged 12-23 months (n=3532). Complete immunization was defined using the 2017 IDHS definition. Multiple components of women's empowerment were measured: enabling resources, decision-making involvement, and attitude toward intimate partner violence. The primary analysis was conducted using binomial logistic regression. Model 1 represented only the indicators of women's empowerment and model 2 controlled for socio-demographic variables. Subgroup analyses were conducted for each wealth group.

Results: The primary analysis using model 1 identified several empowerment indicators that facilitated complete immunization. The analysis using model 2 found that maternal education and involvement in decision-making processes facilitated complete immunization in children. Subgroup analyses identified that wealth had a modifying effect. The indicators of women's empowerment were strong determinants of complete immunization in lower wealth quintiles but insignificant in middle-income and higher-income quintiles.

Conclusions: To our knowledge, this study is the first to explore women's empowerment as a determinant of child immunization in Indonesia. The results indicate that women's empowerment must be considered in Indonesia's child immunization program. Women's empowerment was not found to be a determinant in higher wealth quintiles, which led us to rethink the conceptual framework of the effect of women's empowerment on health outcomes.

Key words: Immunization, Women, Empowerment, Children, Indonesia

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INTRODUCTION

The Indonesian government has committed to achieving universal basic immunization coverage for infants and children. Complete basic immunization in Indonesia was defined as receiving 1 dose of a hepatitis B vaccine, 1 dose of the Bacillus Calmette-Guérin (BCG) vaccine, 3 doses of the diphtheria-pertussis-tetanus-hepatitis B-*Haemophilus influenzae* type B (DPT-HBV-HiB) vaccine, and 4 doses of the polio vaccine [1]. Despite

this, the incidence of vaccine-preventable diseases is increasing. A recent report from 2020 on the immunization program in Indonesia showed an increase in reported cases of diphtheria and a stagnating rate of measles [2]. In addition, an internal Ministry of Health report from 2020 found a stagnating rate of complete immunization, with a recent declining trend. Internal Ministry of Health research found that only 59.2% of infants aged 12-23 months received complete immunization in 2013. This rate declined to 57.9% in 2018 [3]. These findings were echoed by previous Indonesian Demographic and Health Survey (IDHS) findings. Despite the upward trend in age-appropriate basic immunization coverage among children aged 12-23 months from 2007 to 2012 [4,5], the rate of coverage began to trend downward by 2017 [6]. Another finding from a study of individuals from the North Sumatra region of Indonesia found that being unvaccinated was a risk factor for measles at the time of a measles outbreak that affected the region [7].

Indonesia remains a largely patriarchal society, and mothers are typically expected to be responsible for childcare. In this context, women's empowerment has been identified as a determinant of healthcare usage by women and, by extension, their children. Multiple studies in various settings have found that women's empowerment facilitated maternal healthcare utilization [8,9]. Similar findings have also been observed in Indonesia [10].

Gender-based approaches for determining child health have been explored in previous studies. Using these approaches, the abstract idea of women's empowerment can be operationalized into several categories [11]. The first category is enabling resources, such as education and wealth, which intersect with general socioeconomic status. Accordingly, previous studies using Indonesian data identified these factors as the primary determinants of immunization coverage in children [12,13]. Another category is agency in decision-making. Maternal agency has been known to play an important role as a bridge between available enabling resources and health outcomes such as child immunization [11].

The concept of women's agency is a multifaceted component of women's empowerment related to women's inclusion in decision-making processes concerning various issues in the family, from economic decisions to decisions about where to live and health decisions [14,15]. A 2016 review on the role of women's empowerment and its multifaceted component found that, although 67% of included studies showed a positive correlation between empowerment and child immunization, this

association varied depending on the country [11]. In addition, a single-country study in Kenya found that this association was further modified according to the wealth of the family [16].

The role of women's empowerment in child immunization has not been explored in Indonesia. To our knowledge, no study has explored the role of women's empowerment as a determinant of child immunization in Indonesia, even though Indonesia contributes a significant number of incompletely vaccinated children globally [11]. This lack of studies is likely due to the insufficient interdisciplinarity of Indonesian health policies, including those related to its immunization program [17]. Interdisciplinary approaches are increasingly important as Indonesia strives to achieve the Sustainable Development Goal of reducing child mortality. Thus, this study was conducted with the objective of elucidating the role of women's empowerment as a determinant of complete immunization in Indonesian children.

METHODS

Data Source, Population, and Samples

Our study utilized data from the 2017 IDHS. The 2017 IDHS is a nationally representative survey. Data collection was conducted by Indonesian agencies, including the National Body for Population and Family Planning (*Badan Nasional Kependudukan dan Keluarga Berencana*, or BKKBN), the Central Body for Statistics, and the Ministry of Health with technical assistance from International Classification of Functioning, Disability and Health (ICF) International. Multi-stage random sampling was used for data collection, with 1970 census blocks used as sampling units. Census block selection was stratified for urban and rural areas using a probability that was proportional to the population size, and 25 households were randomly selected from each census block [6].

Primary data collection for the 2017 IDHS included men and women aged 15-49 years old. Women with children were also asked questions about the health status of their youngest child below 5 years of age, including about vaccination history [6]. For the purposes of this study, we used data on these children and limited eligibility only to those with children aged 12-23 months. We also excluded data points with incomplete or missing data for any of the variables of interest. Out of 34 086 women respondents, there were 17 848 records of children under 5 years of age. A total of 3532 children with complete records were included in the final analysis.

Variables

The primary variable of interest in this study was complete immunization status. In Indonesia, complete immunization status was defined as having received all of the following: 1 dose of the BCG vaccine protecting against tuberculosis; 4 doses of the hepatitis B vaccine (including 1 at birth); 3 doses of the DPT vaccine, which protects against diphtheria, pertussis, and tetanus; 3 doses of the *Haemophilus influenzae* type B vaccine; 4 doses of the polio vaccine; and 1 dose of the measles vaccine [1,3].

For the women's empowerment variables, we adopted the framework developed by Phan to operationalize women's empowerment using Demographic and Health Survey (DHS) datasets from Southeast Asian countries [14]. We also built on the works of several previous studies that similarly evaluated the role of women's empowerment on health outcomes using IDHS data [10,18]. Our framework used several items from DHS instruments to measure the 3 components of women's empowerment: enabling resources, economic empowerment and involvement in decision-making, and attitude toward intimate partner violence (IPV).

The availability of enabling resources referred to the ability of the respondent to attain an education and participate in the workforce. Education level was classified into 3 categories: below secondary education, secondary education, and higher education. Participation in the workforce was determined according to the participant's participation in paid (either in cash or in kind) employment within the 12 months prior to data collection. Economic empowerment was determined according to the respondent's property (a house or land) ownership. Mothers were classified as having high economic empowerment if they were the sole owner of a property, having medium empowerment if they had joint ownership of a property with their husbands/partners or someone else, and having no economic empowerment if they did not own property.

Involvement in decision-making can be further classified into involvement in financial decisions, health decisions, and social decisions. Involvement in children's health decisions was based on 1 question: "Who makes the final decision on whether or not your child should be taken for medical treatment?" Involvement in social decisions was based on 1 question: "Who usually makes decisions about visits to your family or relatives?" Possible answers for both questions were the mothers themselves (high empowerment), the mothers and their husbands or at least 1 other person (medium empowerment), or some-

one else (low empowerment). Involvement in financial decisions was determined using 2 questions from the DHS instrument: "Who usually decides how the money you earn will be used?" and "Who usually makes decisions about making major household purchases?" The 2 questions were made into a composite variable and answers were considered to indicate high empowerment if the respondent answered that she could make the decision herself for both questions and low empowerment if she was not involved in both decisions. Any other combinations of answers were considered to indicate medium empowerment.

Attitude toward IPV was indicated by respondents' responses to whether they believed husbands beating their wives was acceptable under the following 2 conditions: if she goes out without telling him and if she argues with him. Respondents were classified as having low acceptance of IPV if they believed it was not acceptable in either scenario and high acceptance of IPV if they believed it was acceptable in both scenarios. They were classified as having moderate acceptance of IPV if they believed it was acceptable in only 1 of the scenarios. These items were selected from a set of 5 questions for evaluating vulnerability to IPV because they had the strongest relationship to women's decisions to have their children immunized.

We also collected socio-demographic data points of the respondents, especially those related to women's empowerment and child immunization, based on prior studies [12,13]. These variables included the region of residence, area of residence, mothers' age, birth order of the child, age difference with the husband, the education level of the husband, and household wealth quintile.

Statistical Analysis

Univariate analysis was conducted to show the data distribution based on the dependent and independent variables presented as weighted percentages (weighted %). Significance tests were conducted using bivariate and multivariate logistic regression for the complex samples and adjusted for sample stratification and clustering. Primary analysis was conducted using multivariate binomial logistic regression. We conducted the regression using 2 hypothetical models. Model 1 only included the women's empowerment indicators, while model 2 controlled the women's empowerment indicators by including socio-demographic variables. Subgroup analyses for each wealth quintile were also conducted to analyze the modifying effect of wealth on the association between women's empowerment

and child immunization. All analyses were conducted using SPSS version 23.0 (IBM Corp., Armonk, NY, USA).

Ethics Statement

This study analyzed a publicly accessible, depersonalized dataset. Ethical reviews are waived for such studies at our center. However, the methodologies of 2017 IDHS considered the respondents' privacy and rights. Each respondent provided written informed consent for participation in the study. The data collection process for the 2017 IDHS itself was reviewed

and approved by ICF International's Institutional Review Board and the Ministry of Health [19].

RESULTS

Our analysis included 3532 respondents with children aged 12-23 months old, as shown in Table 1. The sample was distributed across various major islands in Indonesia. After adjusting for the sampling weights, the Java-Bali region contributed the most respondents with a weighted percentage of

Table 1. Socio-demographic characteristics and women's empowerment indicators of the respondents (n=3532)

Characteristics	n (weighted %)	Characteristics	n (weighted %)
Socio-demographic indicators		Wealth quintile	
Region of residence		First quintile	975 (20.2)
Java-Bali	1090 (56.9)	Second quintile	683 (20.3)
Sumatra	911 (22.2)	Third quintile	638 (18.9)
Lesser Sunda Islands	314 (4.9)	Fourth quintile	643 (21.3)
Kalimantan	301 (5.8)	Fifth quintile	593 (19.3)
Sulawesi	546 (7.3)	Women's empowerment indicators	
Maluku	260 (1.4)	Education level	
Papua	110 (2.0)	Below secondary education	860 (25.0)
Area of residence		Secondary education	1994 (58.7)
Urban	1737 (48.8)	Higher education	678 (16.4)
Rural	1795 (51.2)	Employment status	
Age (y)		Unemployed	2240 (64.4)
15-24	759 (21.4)	Employed	1292 (35.6)
25-29	931 (25.6)	Property ownership	
30-34	917 (26.4)	No property owned	1431 (42.9)
35-39	661 (19.4)	Joint property owner	1399 (37.1)
40-44	231 (6.1)	Sole property owner	702 (20.1)
45-49	33 (1.0)	Involvement in household spending decisions	
Birth order of child		Low	239 (7.0)
1	1051 (31.6)	Medium	2902 (82.8)
2	1156 (34.9)	High	391 (10.3)
3	715 (19.8)	Involvement in social decisions	
≥4	610 (13.7)	Low	497 (15.3)
Age difference with husband		Medium	2481 (68.2)
≤ Age of the subject	676 (19.1)	High	554 (16.5)
1-5 y older	1731 (48.5)	Involvement in child's medical treatment decisions	
6-10 y older	813 (23.8)	Low	485 (14.1)
>10 y older	312 (8.6)	Medium	1781 (46.5)
Education level of husband		High	1266 (39.4)
Below secondary education	954 (27.4)	Acceptance of intimate partner violence	
Secondary education	2028 (58.7)	Low	2643 (78.4)
Higher education	550 (13.9)	Medium	670 (17.1)
		High	219 (4.5)

56.9%. Sumatra had the next-highest number of participants, contributing a weighted percentage of 22.2% of the total respondents. Other regions contributed less than 10% of the respondents. Despite this, the respondents were evenly distributed between urban and rural areas, with 48.8% of respondents being from urban areas and 51.2% being from rural areas. Predictably, the age distribution skewed toward young mothers, with nearly three-fourths of respondents being below 35 years of age.

A medium level of empowerment was the most common degree of women's empowerment. Over half of the mothers had a secondary education level, although only 35.6% of participants participated in paid employment in the previous 12 months. Less than 15% of the mothers had low involvement in the decision-making processes of their households, and 50% to 80% of respondents cited making joint decisions with their partner or another person. The women were found to have the highest degree of empowerment concerning medical care decisions for their children, with 46.5% being moderately empowered and 39.4% being highly empowered. A total of 17.1% of respondents had moderate acceptance of IPV and 4.5% had high acceptance of IPV.

Table 2 shows the immunization status of the respondents' children according to the acceptance rate for each vaccination

Table 2. Immunization history of the children of respondents

Immunization types	Immunized
BCG	3085 (89.3)
Polio 0	3100 (89.2)
Polio 1	3026 (87.4)
Polio 2	2822 (81.7)
Polio 3	2466 (71.4)
DPT 1	3020 (87.2)
DPT 2	2852 (82.8)
DPT 3	2593 (75.5)
HiB 1	3020 (87.2)
HiB 2	2852 (82.8)
HiB 3	2593 (75.5)
Hepatitis B 0	2856 (83.4)
Hepatitis B 1	3020 (87.2)
Hepatitis B 2	2852 (82.8)
Hepatitis B 3	2593 (75.5)
Measles 1	2693 (77.5)
Complete immunization	2048 (60.1)

Values are presented as number (weighted %). BCG, Bacillus Calmette-Guérin; DPT, diphtheria-pertussis-tetanus; HiB, *Haemophilus influenzae* type B.

dose. Overall, complete vaccination was achieved by 60.1% of children. Based on the data for each vaccination dose, vaccine acceptance was moderately high for early doses. Acceptance of the first and second doses of multiple-dose vaccinations typically exceeded 80%, with some nearing 90%. The highest acceptance rate was observed for the first polio dose (Polio 0), which is received at birth, at 89.2%.

We conducted a cross-tabulation analysis to examine the distribution of each independent variable for complete and incomplete immunization groups, and the results are shown in Table 3. Other than property ownership, all of the empowerment indicators were found to be associated with the complete immunization status of children based on the complex sample bivariate logistic regression. Wealth and maternal education

Table 3. Distribution of complete immunization of children based on independent variables

Variables	Complete immunization, n (weighted %)	p-value ¹	OR (95% CI)
Socio-demographic indicators			
Region of residence		<0.001	
Java-Bali	692 (63.7)		1.00 (reference)
Sumatra	447 (50.3)		0.58 (0.49, 0.68)**
Lesser Sunda Islands	224 (71.5)		1.43 (1.01, 2.03)*
Kalimantan	193 (64.3)		1.02 (0.75, 1.38)
Sulawesi	329 (60.2)		0.86 (0.66, 1.13)
Maluku	114 (43.8)		0.43 (0.24, 0.77)**
Papua	49 (42.0)		0.42 (0.26, 0.68)**
Area of residence		<0.001	
Urban	1070 (62.4)		1.00 (reference)
Rural	978 (58.0)		0.83 (0.72, 0.95)**
Age (y)		0.056	
15-24	407 (58.6)		1.00 (reference)
25-29	562 (60.2)		1.07 (0.87, 1.30)
30-34	569 (64.3)		1.27 (1.04, 1.56)*
35-39	370 (57.4)		0.95 (0.77, 1.17)
40-44	124 (56.7)		0.93 (0.68, 1.27)
45-49	16 (54.5)		0.83 (0.42, 1.67)
Birth order of child		<0.001	
1	642 (61.8)		1.00 (reference)
2	715 (65.7)		1.19 (1.00, 1.41)
3	404 (57.0)		0.82 (0.68, 1.00)
≥4	287 (46.8)		0.55 (0.44, 0.68)**
Age difference with husband		0.089	
≤ Age of the subject	385 (60.1)		1.00 (reference)
1-5 y older	1002 (59.4)		0.97 (0.81, 1.17)

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Table 3. Continued from the previous page

Variables	Complete immunization, n (weighted %)	p-value ¹	OR (95% CI)
6-10 y older	494 (63.4)		1.15 (0.93, 1.42)
> 10 y older	167 (55.4)		0.83 (0.63, 1.09)
Education level of the husband		<0.001	
Below secondary education	487 (51.2)		1.00 (reference)
Secondary education	1202 (62.7)		1.60 (1.37, 1.88)**
Higher education	359 (67.1)		1.95 (1.55, 2.46)**
Wealth quintile		<0.001	
First quintile	471 (48.7)		1.00 (reference)
Second quintile	375 (57.1)		1.40 (1.13, 1.73)**
Third quintile	388 (63.6)		1.84 (1.48, 2.29)**
Fourth quintile	422 (65.6)		2.00 (1.62, 2.48)**
Fifth quintile	392 (66.2)		2.07 (1.66, 2.58)**
Women's empowerment indicators			
Education level		<0.001	
Below secondary education	405 (48.3)		1.00 (reference)
Secondary education	1198 (63.2)		1.84 (1.57, 2.17)**
Higher education	445 (67.4)		2.21 (1.77, 2.76)**
Employment status		<0.075	
Unemployed	1246 (59.0)		1.00 (reference)
Employed	802 (62.1)		1.14 (0.99, 1.32)
Property ownership		0.725	
No property owned	836 (60.7)		1.00 (reference)
Joint property owner	800 (59.3)		0.94 (0.81, 1.10)
Sole property owner	412 (60.6)		1.00 (0.83, 1.20)
Involvement in household spending decisions		<0.001	
Low	110 (50.2)		1.00 (reference)
Medium	1721 (61.0)		1.55 (1.19, 2.02)**
High	217 (60.2)		1.50 (1.08, 2.09)*
Involvement in social decisions		<0.001	
Low	262 (51.0)		1.00 (reference)
Medium	1476 (62.3)		1.59 (1.31, 1.92)**
High	310 (59.7)		1.43 (1.12, 1.82)*
Involvement in child's medical treatment decisions		0.001	
Low	254 (53.2)		1.00 (reference)
Medium	1026 (59.6)		1.30 (1.06, 1.59)*
High	768 (63.2)		1.51 (1.22, 1.87)**
Acceptance of intimate partner violence		<0.001	
Low	1575 (61.5)		1.00 (reference)
Medium	371 (57.3)		0.84 (0.70, 1.01)
High	102 (48.4)		0.59 (0.43, 0.82)**

OR, odds ratio; CI, confidence interval.

¹Chi-square test.* $p < 0.05$, ** $p < 0.01$.

level were the factors most strongly associated with complete immunization. Children from households in the fourth and fifth wealth quintiles were more than twice as likely to have complete immunization compared to those in the first quintile (poorest). Similarly, children whose mothers had a high education level were more than twice as likely to be completely immunized compared to those whose mothers had below a secondary education level.

The multivariate regression modeling results are shown in Table 4. Binomial logistic regression using model 1 found several women's empowerment indicators to be independently associated with the complete immunization status in children. Maternal education was the factor most associated with complete immunization, in that children whose mothers had a high education level were nearly twice as likely to be completely immunized compared to children whose mothers had below a secondary education level. Maternal empowerment concerning social decisions and children's healthcare decisions was also associated with the complete immunization in children. In model 2, these associations persisted despite control-

Table 4. Multivariate analysis of factors associated with complete immunization of children

Variables	Model 1	Model 2
Women's empowerment indicators		
Education level		
Below secondary education	1.00 (reference)	1.00 (reference)
Secondary education	1.82 (1.54, 2.15)**	1.53 (1.26, 1.86)**
Higher education	2.08 (1.64, 2.63)**	1.58 (1.15, 2.15)**
Employment Status		
Unemployed	1.00 (reference)	1.00 (reference)
Employed	1.01 (0.87, 1.18)	0.97 (0.83, 1.14)
Property ownership		
No property owned	1.00 (reference)	1.00 (reference)
Joint property ownership	1.02 (0.87, 1.20)	1.05 (0.88, 1.25)
Sole property ownership	1.04 (0.86, 1.25)	1.07 (0.87, 1.31)
Involvement in household spending decisions		
Low	1.00 (reference)	1.00 (reference)
Medium	1.29 (0.97, 1.71)	1.23 (0.92, 1.65)
High	1.24 (0.87, 1.76)	1.25 (0.87, 1.81)
Involvement in social decisions		
Low	1.00 (reference)	1.00 (reference)
Medium	1.40 (1.14, 1.72)**	1.44 (1.17, 1.79)**
High	1.28 (0.99, 1.65)	1.28 (0.99, 1.66)
Involvement in child's medical treatment decisions		
Low	1.00 (reference)	1.00 (reference)

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Table 4. Continued from the previous page

Variables	Model 1	Model 2
Medium	1.14 (0.92, 1.42)	1.15 (0.92, 1.43)
High	1.40 (1.13, 1.75)**	1.41 (1.13, 1.77)**
Acceptance of intimate partner violence		
Low	1.00 (reference)	1.00 (reference)
Medium	0.90 (0.75, 1.08)	0.96 (0.79, 1.17)
High	0.67 (0.48, 0.94)*	0.73 (0.51, 1.04)
Socio-demographic indicators		
Region of residence		
Java-Bali	-	1.00 (reference)
Sumatra	-	0.61 (0.51, 0.74)**
Lesser Sunda Islands	-	2.00 (1.37, 2.94)**
Kalimantan	-	1.19 (0.86, 1.64)
Sulawesi	-	1.01 (0.75, 1.35)
Maluku	-	0.60 (0.32, 1.11)
Papua	-	0.60 (0.36, 1.03)
Area of residence		
Urban	-	1.00 (reference)
Rural	-	1.18 (0.99, 1.39)
Age (y)		
15-24	-	1.00 (reference)
25-29	-	1.12 (0.89, 1.40)
30-34	-	1.58 (1.22, 2.06)**
35-39	-	1.37 (1.02, 1.85)*
40-44	-	1.52 (1.02, 2.26)*
45-49	-	1.92 (0.89, 4.12)
Birth order of child		
1	-	1.00 (reference)
2	-	1.06 (0.86, 1.30)
3	-	0.73 (0.56, 0.95)*
≥4	-	0.51 (0.38, 0.70)**
Age difference with husband		
≤ Age of wife	-	1.00 (reference)
1-5 y older	-	1.12 (0.92, 1.40)
6-10 y older	-	1.37 (1.09, 1.73)**
>10 y older	-	1.03 (0.76, 1.39)
Education level of the husband		
Below secondary education	-	1.00 (reference)
Secondary education	-	1.25 (1.04, 1.52)*
Higher education	-	1.29 (0.94, 1.77)
Wealth quintile		
First quintile	-	1.00 (reference)
Second quintile	-	1.27 (1.01, 1.60)*
Third quintile	-	1.50 (1.17, 1.94)**
Fourth quintile	-	1.52 (1.17, 1.98)**
Fifth quintile	-	1.44 (1.06, 1.95)*

Values are presented as adjusted odds ratio (95% confidence interval).
* $p < 0.05$, ** $p < 0.01$.

ling for known socioeconomic determinants.

The subgroup analyses for each wealth quintile, shown in Table 5, outline the modifying effect of wealth on the association between women's empowerment and the immunization status of children. The women's empowerment indicators were more strongly associated with immunization status in the lower wealth quintiles, especially in the second quintile. Maternal education was found to be associated with complete immunization in children from all wealth quintiles except the highest one, in which the effects of educational inequality may not be as pronounced as in the others. Acceptance of IPV and maternal empowerment concerning economic and health decisions were identified as determinants of complete child immunization in the lower wealth quintiles, whereas empowerment concerning social decisions was identified as a stronger determinant in the higher wealth quintiles.

DISCUSSION

Our analysis found that women's empowerment indicators were positively associated with the complete immunization of children even when controlled for known socioeconomic determinants in the multivariate analysis. The overall analysis found that the indicators most associated with immunization status were maternal education, maternal involvement in household financial decisions, and maternal involvement in children's healthcare decisions. Further subgroup analysis showed that wealth had a modifying effect, and these indicators were found to be most strongly associated with immunization status in children from lower wealth quintiles.

Our analysis is only the most recent in a long line of studies that support the theory that women's empowerment improves the health outcomes of children. Prior studies from Africa and South Asia have shown that various indicators of women's empowerment were associated with complete immunization in children, with different studies from different settings identifying different indicators as the strongest determinants [11]. One study from India also found that maternal involvement in medical decisions for their children was a determinant of childhood immunization [20]. In addition, a Nigerian study also identified maternal involvement in financial decisions as a determinant of childhood immunization [21]. Another study that analyzed data from several Asian countries found maternal involvement in financial and social decisions to be a determinant of children's vaccination status [22].

Table 5. Multivariate analysis of factors associated with complete immunization of children

Variables	Poorest	Poorer	Middle	Richer	Richest
Women's empowerment Indicators					
Education level					
Below secondary education	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Secondary education	1.38 (0.96, 2.00)	1.59 (1.04, 2.42)*	1.77 (1.12, 2.78)*	1.92 (1.16, 3.17)*	1.02 (0.39, 2.63)
Higher education	3.62 (1.35, 9.66)*	1.46 (0.65, 3.29)	1.51 (0.67, 3.39)	1.24 (0.62, 2.50)	1.30 (0.47, 3.61)
Employment status					
Unemployed	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Employed	0.81 (0.54, 1.19)	0.79 (0.54, 1.15)	1.09 (0.74, 1.60)	1.26 (0.89, 1.79)	1.15 (0.78, 1.67)
Property ownership					
No property owned	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Joint property owner	1.14 (0.77, 1.68)	1.34 (0.87, 2.08)	0.97 (0.64, 1.47)	0.84 (0.56, 1.25)	1.34 (0.88, 2.04)
Sole property owner	0.75 (0.47, 1.21)	1.72 (1.07, 2.77)*	1.04 (0.62, 1.73)	0.72 (0.46, 1.14)	1.93 (1.16, 3.21)*
Involvement in household spending decisions					
Low	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Medium	0.99 (0.53, 1.84)	2.95 (1.49, 5.83)**	1.34 (0.64, 2.84)	1.07 (0.54, 2.11)	0.80 (0.37, 1.75)
High	1.34 (0.62, 2.90)	3.46 (1.48, 8.08)**	0.94 (0.38, 2.32)	1.37 (0.55, 3.40)	0.53 (0.21, 1.35)
Involvement in social decisions					
Low	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Medium	1.47 (0.91, 2.37)	1.15 (0.69, 1.91)	1.48 (0.85, 2.57)	1.60 (1.01, 2.54)*	2.05 (1.20, 3.50)**
High	1.38 (0.79, 2.42)	1.00 (0.53, 3.03)	1.25 (0.66, 2.39)	1.04 (0.58, 1.87)	2.50 (1.26, 4.79)**
Involvement in children's medical treatment decisions					
Low	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Medium	0.94 (0.57, 1.56)	1.87 (1.11, 3.16)*	1.26 (0.75, 2.11)	0.94 (0.57, 1.56)	0.85 (0.48, 1.39)
High	1.53 (0.91, 2.57)	1.77 (1.04, 3.03)*	1.35 (0.80, 2.27)	1.13 (0.67, 1.89)	1.16 (0.65, 2.05)
Acceptance of intimate partner violence					
Low	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Medium	0.95 (0.64, 1.40)	1.31 (0.82, 2.08)	0.97 (0.61, 1.55)	0.77 (0.49, 1.22)	0.81 (0.48, 1.39)
High	0.51 (0.29, 0.92)*	0.76 (0.38, 1.54)	1.50 (0.44, 5.05)	1.09 (0.34, 3.48)	1.24 (0.26, 5.83)
Socio-demographic indicators					
Region of residence					
Java-Bali	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Sumatra	0.56 (0.35, 0.89)*	0.46 (0.30, 0.69)**	0.43 (0.27, 0.67)**	0.96 (0.62, 1.48)	0.58 (0.36, 0.93)*
Lesser Sunda Islands	2.11 (1.19, 3.74)*	2.72 (1.01, 7.29)*	0.70 (0.25, 2.01)	2.12 (0.45, 10.10)	4.40 (0.73, 26.37)
Kalimantan	1.64 (0.83, 3.20)	1.29 (0.59, 2.82)	0.64 (0.33, 1.25)	1.02 (0.48, 2.20)	1.28 (0.49, 3.36)
Sulawesi	0.88 (0.50, 1.53)	1.08 (0.58, 2.02)	1.31 (0.58, 2.92)	1.21 (0.55, 2.66)	0.90 (0.37, 2.20)
Maluku	0.56 (0.24, 1.31)	0.49 (0.11, 2.23)	0.24 (0.03, 2.00)	1.31 (0.10, 17.86)	1.95 (0.05, 72.37)
Papua	0.50 (0.23, 1.06)	0.74 (0.14, 3.83)	0.17 (0.02, 1.56)	2.16 (0.16, 28.73)	0.47 (0.07, 2.95)
Area of residence					
Urban	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Rural	1.11 (0.70, 1.76)	0.94 (0.64, 1.39)	1.23 (0.85, 1.77)	1.45 (1.01, 2.07)*	1.07 (0.66, 1.71)
Age (y)					
15-24	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
25-29	1.18 (0.71, 1.95)	0.83 (0.50, 1.39)	1.24 (0.72, 2.11)	0.85 (0.50, 1.47)	1.29 (0.68, 2.46)
30-34	1.59 (0.89, 2.83)	1.37 (0.75, 2.49)	1.85 (0.98, 3.50)	1.26 (0.68, 2.34)	1.61 (0.81, 3.20)
35-39	1.57 (0.81, 3.04)	1.26 (0.62, 2.57)	1.62 (0.77, 3.40)	1.22 (0.62, 2.38)	1.23 (0.56, 2.73)
40-44	3.28 (1.32, 8.16)*	2.51 (0.90, 7.00)	1.29 (0.52, 3.25)	1.04 (0.40, 2.72)	1.06 (0.43, 2.59)
45-49	0.72 (0.18, 2.91)	1.64 (0.21, 12.62)	17.01 (0.65, 448.49)	NA	0.71 (0.09, 5.56)

(Continued to the next page)

Table 5. Continued from the previous page

Variables	Poorest	Poorer	Middle	Richer	Richest
Birth order of child					
1	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
2	1.13 (0.69, 1.83)	1.34 (0.83, 2.17)	0.88 (0.53, 1.46)	0.95 (0.60, 1.50)	0.86 (0.53, 1.41)
3	1.10 (0.60, 2.03)	0.77 (0.42, 1.42)	0.89 (0.45, 1.77)	0.49 (0.27, 0.88)*	0.59 (0.33, 1.08)
≥4	0.97 (0.51, 1.87)	0.17 (0.08, 0.37)**	0.56 (0.26, 1.20)	0.57 (0.27, 1.22)	0.45 (0.21, 0.96)
Age difference with husband					
≤ Age of the subject	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
1-5 y older	1.14 (0.71, 1.83)	1.43 (0.86, 2.37)	1.79 (1.10, 2.91)*	0.90 (0.58, 1.39)	0.77 (0.49, 1.20)
6-10 y older	1.64 (0.96, 2.81)	1.38 (0.78, 2.43)	1.98 (1.14, 3.44)*	0.97 (0.59, 1.60)	1.49 (0.83, 2.68)
>10 y older	1.04 (0.53, 2.02)	1.08 (0.54, 2.17)	1.03 (0.50, 2.13)	0.93 (0.47, 1.85)	1.72 (0.70, 4.34)
Education level of the husband					
Below secondary education	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
Secondary education	1.08 (0.75, 1.56)	1.70 (1.14, 2.53)*	1.63 (1.05, 2.54)*	1.01 (0.62, 1.63)	0.80 (0.29, 2.19)
Higher education	2.43 (0.87, 6.80)	1.71 (0.63, 4.69)	0.97 (0.41, 2.30)	1.26 (0.62, 2.55)	0.70 (0.24, 2.03)

Values are presented as adjusted odds ratio (95% confidence interval).

NA, not applicable.

* $p < 0.05$, ** $p < 0.01$.

An underexplored idea related to the effect of women's empowerment on child immunization is the modifying effect of resource availability. Even though they acknowledged the modifying effect of local culture and customs on the association between women's empowerment and health outcomes, most prior studies conceptualized a linear association between resources availability, agency, health behaviors, and health outcomes [11,23]. However, our results indicate that wealth modified the association between women's empowerment indicators and immunization, showing a stronger association for women from lower wealth quintiles. This finding differs from those of a recent study from Kenya that found evidence of a stronger association between women's empowerment and immunization among wealthier women [16]. It also differs from several other studies from Africa that found a stronger association between women's empowerment and improved maternal and child health outcomes among wealthier women [24,25].

To understand the underlying causes of these differences, the differences between the Indonesian population and its counterparts in these studies must be examined. Most of the countries analyzed in these studies (Kenya, Rwanda, Ethiopia, and Tanzania) were categorized as low-income countries or were at the lower end of the lower-middle-income group, whereas Indonesia was at the upper end of the latter group as of the time of data collection [26]. This means that a huge gap in resource availability exists between the lower wealth quintiles described in these prior studies compared to the lower

wealth quintiles described in our analysis.

This difference led us to re-examine the conceptual framework that connected resource availability, women's empowerment, and health outcomes [11,23]. The aforementioned African studies strengthened the evidence for a linear conceptual framework that indicates that a certain threshold for socioeconomic resource availability must be surpassed in order for women's empowerment to affect health outcomes [16,24,25]. Based on our data, we theorize that this is true for women with a limited amount of resource availability that forces them to use their agency to strategically allocate those resources. However, there may also be a threshold at which resources are readily available, and this has a weaker modifying effect on women's empowerment related to health-seeking behaviors. Instead, at this threshold, agency and empowerment are modified by more subjective factors such as experiences, media exposure, beliefs, and trust in institutions [27-29]. However, few studies have simultaneously evaluated the associations between women's empowerment and subjective factors related to childhood immunization. As such, further studies are needed to evaluate this hypothetical framework.

The results of our analysis have significant implications for Indonesia's immunization program. Socioeconomic status has been repeatedly identified as an independent determinant of child immunization [12,30]. Similarly, regional disparities in complete immunization have also been repeatedly identified [12,13]. These findings indicate an urgent need to increase

equal access to healthcare resources across diverse geographic and socioeconomic groups in Indonesia.

The effect of women's empowerment on immunization in children is an understudied phenomenon. This phenomenon has been repeatedly identified in other settings [11], although very few, if any, have examined it in Indonesia specifically. This indicates that the physical development of healthcare resources should coincide with social development within the surrounding population, including increasing women's empowerment and agency and improving health literacy. Programs to improve these factors have been conducted in India and were found to be successful. Education and empowerment among a small fraction of the women population in a single village were found to improve the immunization rate of children compared to that of another village acting as the control. The program also improved the immunization rate of children of women who did not participate in the program in the village where the program was conducted [31].

The primary limitation of this study was the limited design of the DHS data collection. The multistage cluster sampling method utilized by the DHS may have led to some degree of subjectivity in cluster selection and non-response, although this risk was mitigated by adjustments in our analysis methodologies. The DHS data also limited our operationalization of women's empowerment to power dynamics between women and their husbands as married couples sharing a household [16]. This operationalization did not include other aspects of women's empowerment, especially related to women's agency in the Can-Act-Resist framework, and their effects on child immunization and healthcare utilization in general [32]. Another limitation was the lack of uniformity of the women's empowerment indicators analyzed in this study compared to other similar studies based on DHS data. This lack of comparability has been cited as a general limitation for studies on this topic [11].

In conclusion, our analysis identified several women's empowerment indicators, especially those related to agency in decision-making, as determinants of complete child immunization. A modifying effect related to wealth was also observed, showing that women's empowerment indicators were not significantly associated with child immunization in higher wealth quintiles, which differs from the findings of previous studies on the subject. Our results indicate a need to re-examine the linear conceptual framework of resources, agency, and health outcomes used in similar studies. More directly, our results indicate a need for a more multidisciplinary approach to immu-

nization program policies in Indonesia. Social development through women's empowerment and agency should be pursued to improve the outcomes of the child immunization program.

CONFLICT OF INTEREST

The authors have no conflicts of interest associated with the material presented in this paper.

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AUTHOR CONTRIBUTIONS

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