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Influence of maternal and neonatal continuum of care on the risk of intergenerational cycle of stunting: a cross-sectional study

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ABSTRACT

Objectives This study aimed to analyse the influence of the continuum of care during pregnancy and neonatal periods on the risk of intergenerational cycle of stunting.

Design This study was a cross-sectional study, with data analysed from the 2018 Basic Health Research in Indonesia.

Settings Basic Health Research 2018 was conducted throughout 513 cities/regencies in 34 provinces in Indonesia. The households were selected through two-stage sampling methods. First, census blocks (CB) were selected using probability proportional to size methods in each urban/rural stratum from each city/regency. Ten households were then selected from each CB using systematic sampling methods. All family members of the selected households were measured and interviewed.

Participants This study analyses 31 603 children aged 0–24 months.

Outcomes measures The dependent variable was the risk of the intergenerational cycle of stunting. Mothers who had a height less than 150.1 cm (short stature mothers) and had children (≤ 24 months of age) with length-for-age Z-score less than −2 Standard Deviation (SD) of the WHO Child Growth Standard (stunted children) were defined as at risk of the intergenerational cycle of stunting.

Results Mothers with incomplete maternal and neonatal care visits were 30% more likely to be at risk on the intergenerational cycle of stunting (OR (95% CI): 1.3 (1.00 to 1.63)) after adjusting for economic status.

Conclusion The continuum of maternal and neonatal healthcare visits could potentially break the intergenerational cycle of stunting, especially in populations where stunted mothers are prevalent.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study uses national survey data with a substantial sample size to improve the research statistical power in making conclusive findings.
⇒ Information and data regarding mothers' economic status in the past were unavailable; however, mothers' educational attainment can be a proxy for economic status in the past.
⇒ The antenatal care guidelines in Indonesia are slightly different from the WHO recommendation, leading to a lower prevalence of mothers receiving antenatal care according to the WHO recommendations.

INTRODUCTION

Stunting refers to children's growth and developmental impairments as a result of chronic suboptimal nutrition, recurrent infections and insufficient psychosocial stimulation. Children whose height for age is below the WHO child growth standard median by more than two SD are classified as stunted.[1] Stunting has declined gradually in recent decades; however, more efforts are needed to pursue the sustainable development goal (SDG) of reducing stunted children by 50% by 2030. In 2020, globally, around one-fifth of children under 5 years old were stunted and potentially failed to reach their linear growth and cognitive potential.[2]

Since human stature is heritable, genetic endowment should predominately determine the association between maternal height and offspring growth.[3] However, metabolic programming, epigenetics and selection, and other environmental influences, including the intergenerational transmission of poverty, were additional significant factors. Those recurrent exposures and environments encountered by one generation that impact the next generation's growth showed an intergenerational effect on growth and undernutrition, including stunting.[4]

Stunting conditions can be cyclical.[5] Studies showed that mothers with short stature had a higher probability of having stunted offspring.[6–11] Short-stature mothers are more likely to deliver small for gestational age infants,[12] who are susceptible to stunted growth in early life as well.[13] A cohort study identified that the mother's height and birth weight were two dominant risk factors for stunting during the first 2 years.[7] Mothers

with a height of less than 150 cm were 2.5 times more likely to have stunted children/offspring in early life, in comparison with mothers with a height above 160 cm.[14] Furthermore, the stunting condition of the offspring in early childhood is also associated with reduced height in adulthood, which in turn influences their economic capabilities.[15] Short-stature mothers who had stunted children in early life show a risk of the intergenerational cycle of stunting.

The stunting reduction programme becomes more challenging in the population where short-stature women/mothers are prevalent. The high prevalence of short-stature mothers in Indonesia[7 16 17] indicates a higher probability of the risk of the intergenerational cycle of stunting. Maternal height was an unalterable risk factor; therefore, stunting prevention can be done by modifying risk factors during pregnancy and the neonatal period.

Several countries have experienced a major reduction in stunting prevalence over a 15–20 years period. Nepal and Ethiopia effectively reduced the prevalence of stunting, which had decreased from around 60%–70% in 1996 to nearly 50% in 2005 and reached 35%–40% in 2016. Analysis of findings from existing literature and case studies in those exemplar countries showed that improvements in maternal nutrition and maternal and neonatal care have resulted in a substantial increase in childbirth length and have had an impact on the increasing of length-for-age Z-score (LAZ) mean during toddler period.[18]

Antenatal care is the primary and essential health platform for providing maternal nutrition interventions during pregnancy and preparing the mother to breast feed.[19 20] Postnatal/neonatal care services are also critical for improving child health in early life.[21] Improvement in maternal nutrition during pregnancy, as well as newborn health and child growth in early life, could be achieved with continuity of maternal and neonatal delivery services.

A continuum-of-care approach has been promoted to improve the health of the mother, newborn and child. The continuum of care is divided within the dimensions of time and place (level of care). The time dimension involves the health services received by a woman and the child, from prepregnancy to early childhood. The place or level of care dimension connects family-community level, outreach-outpatient services and clinical care.[22] Prior continuum-of-care studies primarily concentrated on healthcare during the pregnancy and neonatal period.[23 24]

Understanding the effect of the continuum of care during the pregnancy and neonatal periods could provide valuable information for policy-making, particularly in initiatives focused on maternal nutrition and stunting reduction programmes, especially in the population with a high prevalence of short-stature mothers. Moreover, it could be beneficial in preventing the intergenerational cycle of stunting. This study aimed to analyse the effect of the continuum of care during pregnancy and neonatal periods on the risk of the intergenerational cycle of stunting.

METHODS AND MATERIALS

Study design and participants

This study constitutes a further analysis of national survey data in Indonesia, specifically the 2018 Basic Health Research. The survey is conducted every 5 years and aims to assess achievement in health development, focused on the indicators assigned by Sustainable Development Programs (SDGs), Indonesia's National Medium Term Development Plan, Indonesia's Ministry of Health Strategic Plans, Minimum Service Standards and Community Health Development Index.

The Basic Health Research 2018 was conducted throughout 513 cities/regencies in 34 provinces in Indonesia. The target sample visited was 300 000 households selected through two-stage sampling methods. First, 30 000 census blocks (CB) were selected using probability proportional to size methods in each urban/rural stratum from each city/regency. Ten households were then selected from each CB using systematic sampling methods. All family members of the selected households were interviewed. Anthropometry and blood pressure were also measured. Primary data management and analysis were managed by the Data Management Laboratory, National Institutes of Health Research and Development.

This study analysed 31 603 children born within 5 years before data collection (January 2013–July 2018). The inclusion criterion was children aged 0–24 months, and the mother and child data were linked. Children with incomplete data/information on length measurement (n=2219), mothers' height (n=1391), antenatal care, post partum and newborn care (n=2864) were excluded from the analysis.

Outcome variables

The dependent variable was the risk of the intergenerational cycle of stunting. Mothers who had a height less than 150.1 cm (short-stature mothers) and had children (≤ 24 months of age) with LAZ less than −2 SD of the WHO Child Growth Standard (stunted children) were defined as at risk of the intergenerational cycle of stunting. The LAZs were calculated using WHO Anthro software.[25] The mother height and child length were measured using a multifunction stadiometer, designed for the survey, to the nearest 0.1 cm by two trained enumerators.

Independent variables and potential confounders

The main independent variable was the continuum utilisation of maternal and neonatal healthcare. It was defined as a continuum if the mothers had a minimum of eight contacts on antenatal care during pregnancy (minimum of one contact in the first trimester, two contacts in the second trimester and five contacts in the third trimester)[26]; delivery assisted by health professional (obstetrician, doctor, midwife and nurse) at health facility or home; had a minimum of three contacts on maternal postpartum care (one contact in 6–72 hours; one contact in 4–28 days and one contact in 29–42 days after delivery); and minimum three contacts on neonatal care (one

contact in 6–48 hours; one contact in 3–7 days and one contact in 8–28 days after delivery).

The potential confounding variables were socioeconomic variables, that is, parents' education and occupation, place of residence and economic status. Information on parents' education, occupation and economic status was collected through interviews using a structured questionnaire. Parents' education was categorised into high school or above and less than high school. The place of residence was categorised into urban and rural. The economic status was assessed based on total expenditure per capita. It was divided into five equal groups, referred to as quintiles, with the lowest expenditure (poorest) as quintile one and the highest (richest/wealthiest) as quintile 5.

The association between birth weight and the risk of the intergenerational cycle of stunting and between birth length and the risk of the intergenerational cycle of stunting was also examined. The birth weight and birth length information was taken from maternal and child health books, growth monitoring cards and other legal documents. The limitation of the data is that they were obtained from different sources; however, according to Indonesia's essential neonatal healthcare guidelines, birth weight and length should be measured by the health workers when the newborn achieves a stable condition within the first 24 hours after birth.[27] The birth weight and birth length were categorised into two groups: less than −2 SD and −2 SD and above the WHO Child Growth Standard.

Data analysis

All analyses in this study considered the complex sample design/analysis. Descriptive statistics were conducted to summarise the distribution of dependent variables, main independent variables and other factors/potential confounders. The distribution of all variables was presented in weighted percentages. Cross tabulations were also generated to examine the distribution of the main independent variable and confounders by the risk of the intergenerational cycle of stunting.

This study uses binary logistic regression analysis and focuses on the main independent variable. Initially, a simple logistic regression analysis was performed to assess the association between the main independent variable and each potential confounder to the risk of the intergenerational cycle of stunting. Unadjusted ORs and 95% CIs were calculated. In the next stage, the multiple logistic regression analysis included the main independent variable and other factors/potential confounders with p values <0.25 (full model). Multiple logistic regression was employed to examine the role of the maternal and neonatal continuum of care on the risk of the intergenerational cycle of stunting, adjusted by potential confounders (parents' education, parents' occupation, place of residence and economic status). Modifier effect/interaction tests were also conducted to determine whether the effect of the continuum of care on the risk of intergenerational stunting is modified by other factors. The confounder tests were then performed. The potential confounders were sequentially eliminated from the full model using a backward method. If the OR of the main independent changed >10% after adjustment, the variables were considered confounders and retained in the model. Variables with a p value ≤0.05 were included in the final model. Adjusted ORs and 95% CIs were also calculated. All data management and analysis were carried out using SPSS V.21.

Statistical limitations in this study were missing data for mother's occupation (n=22 (< 0.001%)), father's occupation (n=5422 (17%)) and economic status (n=516 (1.6%)). Due to the relatively small amount of missing data, the data remained without any imputation or deletion.

RESULTS

The findings showed that around one-third of mothers in Indonesia had a height less than 150.1 cm (short stature), and around 13% of mothers were short statured and had stunted children or were at risk of the intergenerational cycle of stunting (figure 1). According to WHO recommendations, less than 20% of mothers perform antenatal care visits, and less than 10% perform a continuum of maternal and neonatal care (table 1).

Children with antenatal visit history below the WHO recommendation, having incomplete neonatal care visit, residing in rural areas, aged between 12 and 24 months, having parents with educational attainment below secondary level, coming from households with lower total expenditure per capita and having birth weight or birth length below −2 SD WHO Child Growth Standard were more likely to be at risk of intergenerational cycle of stunting (table 1).

No interaction was observed between the main independent variable and other factors/potential confounding factors. Based on the confounder test, the place of residence, parent's education and father's occupation variables were excluded from the full model. The full model and final model are presented in table 2. Mothers with incomplete maternal and neonatal care were 30% more likely to be at risk of the intergenerational cycle of stunting adjusted by economic status (table 2).

DISCUSSION

WHO recommendations on antenatal care have been formulated to be adaptable and flexible, allowing countries with varying settings, disease burdens, social and economic circumstances and health system structures to adopt and execute the recommendations. WHO recommends at least eight contacts during pregnancy, emphasising the importance of person-centred healthcare, the well-being of women and families and achieving positive outcomes during the perinatal and maternal periods.[26] However, antenatal care is recommended in Indonesia to include a minimum of six contacts during pregnancy. This factor explains the relatively low percentage of mothers

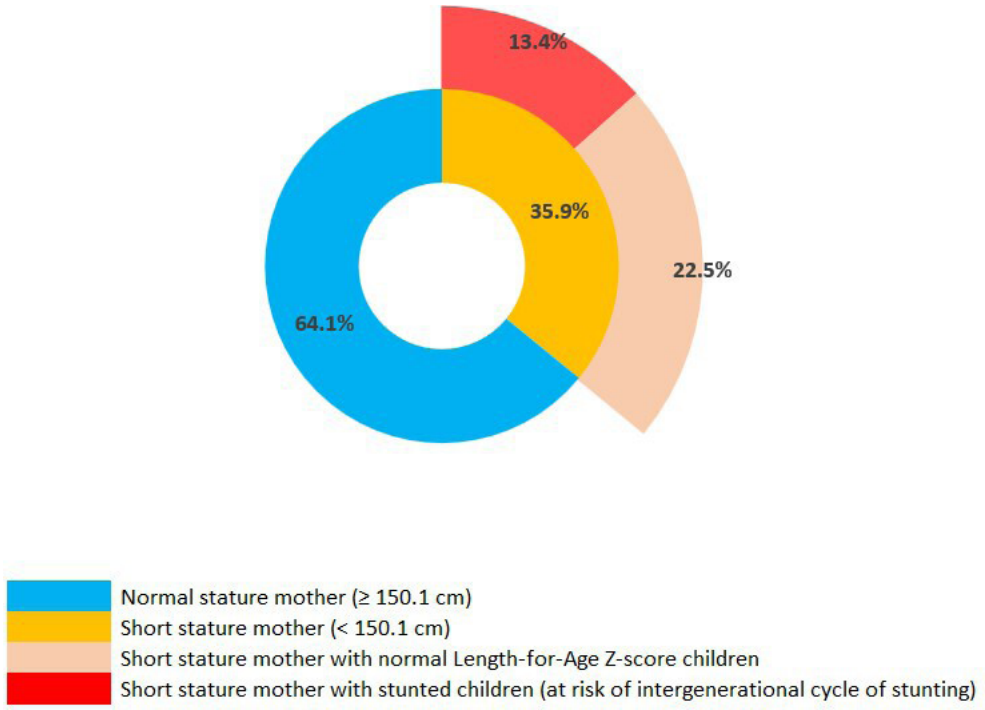

Figure 1 The proportion of short-stature mothers with stunted children.

who received prenatal health services and continuum of care in this study. Another study also showed that most women and children were missing the continuum of care in maternal and newborn health services. Only 7.9% of women and children completed the continuum of care in pregnancy, delivery and postdelivery visits.[24]

In this study, we found that more than half of mothers missed the opportunity to receive the antenatal care recommended by WHO. This implies that most mothers missed the opportunity to receive risk factors screening, counselling and nutrition education, maternal and fetal assessment, education about childbirth and newborn care and other preventive measures provided during antenatal care.[26] Missing the opportunity to receive antenatal care could increase the risk of low birth weight or stunting at birth and stunting in early childhood as well.

Maternal short stature was an unalterable risk factor for stunting in early childhood; however, stunting of the offspring can be prevented by modifying risk factors during pregnancy. Healthcare and preventive measures mothers accept during pregnancy will impact their child's health and growth. A study showed that the likelihood of stunting was found to be significantly higher in children whose mothers attended less than four antenatal care services during pregnancy.[28] Another study in Nepal found that administering antenatal iron and folic acid (IFA) supplementation demonstrated a significant reduction in the likelihood of stunting among children under 2 in Nepal. Children whose mothers used (IFA) supplements had a 14% lower adjusted relative risk of being stunted compared with children whose mothers did not use these supplements.[29] The consumption of iron tablets during pregnancy is linked to compromised linear growth of fetuses, primarily attributed to the presence of anaemia in expectant mothers. Maternal anaemia has the potential to result in low birth weight[30] and become a risk factor for stunting during the first 2 years.[31]

Mothers who use maternal and neonatal care will receive the *Mother and Child Health Handbook* (MCHH). The MCHH has been essential in promoting positive health outcomes for mothers and children. MCHH could help mothers and families monitor the mother's health and condition during pregnancy, as well as the child's growth and developmental milestones. Additionally, the MCHH encompasses educational content, including dietary recommendations during pregnancy and early child rearing, for promoting mother and child health.[32] Analysis of the Indonesian Family Life Survey 2014 showed that the ownership of MCHH was significantly associated with stunting among Indonesian children aged 0–23 months.[33]

Maternal and child health services should not solely focus on antenatal care. Providing newborns with essential healthcare and educating mothers on lactation management to ensure the quality of breastfeeding practice are crucial for preventing growth failure during the first 6 months of life when the most rapid growth occurs.[34] This also includes addressing growth issues for babies born with low birth weight or short length.

Mothers and children's health and well-being are intricately interconnected and should be addressed through an integrated approach. Continuity of healthcare throughout the lifecycle is essential in promoting mother and child health, especially in the population where short-stature mothers are prevalent. It emphasises the importance of ensuring the availability and accessibility

Table 1 Risk of intergenerational cycle of stunting based on child characteristics, main independent variable and potential confounders

Variables	All		At risk			
	Weighted n	Weighted %	Weighted n	Weighted %	Unadjusted OR (95% CI)	P value
Maternal and neonatal continuum of care						
Continuum/complete	1612	5.1	161	10	1	
Incomplete	29.991	94.9	4079	13.6	1.41 (1.11 to 1.81)	0.006*
Antenatal care visit						
Appropriate with WHO recommendation	4740	15	498	10.5	1	
Below the WHO recommendation	26.863	85	3734	13.9	1.3 (1.19 to 1.62)	0.006*
Postpartum care visit complete	11.029	34.9	1401	12.7	1	
Incomplete	20.574	65.1	2839	13.8	1.09 (0.99 to 1.21)	0.078
Neonatal care visit						
Complete	13.936	44.1	1714	12.3	1	
Incomplete	17.667	55.9	2526	14.3	1.2 (1.08 to 1.31)	0.001*
Birth weight						
≥ –2 SD	29.960	94.8	3475	11.6	1	
< –2 SD	1643	5.2	338	20.6	1.98 (1.62 to 2.42)	< 0.001*
Birth length						
≥ –2 SD	28.696	90.8	3501	12.2	1	
< –2 SD	2907	9.2	631	21.7	1.97 (1.60 to 2.43)	< 0.001*
Gender						
Boys	15.960	50.5	2282	14.3	1	
Girls	15.643	49.5	1955	12.5	1.16 (1.06 to 1.28)	0.002*
Age (months)						
0–5	7300	23.1	694	9.5	1	
6–11	8091	25.6	769	9.5	1.00 (0.86 to 1.17)	0.982
12–24	16.212	51.3	2772	17.1	1.97 (1.73 to 2.25)	< 0.001*
Mother's education						
≥ High school	15.517	49.1	1614	10.4	1	
< High school	16.086	50.9	2622	16.3	1.66 (1.52 to 1.84)	<0.001*
Father's education						
≥ High school	16.054	50.8	1638	10.2	1	
< High school	15.549	49.2	2612	16.8	1.77 (1.59 to 1.97)	<0.001*
Mother's occupation						
Housewife	20.053	63.5	2707	13.5	1	
Working mother	11.528	36.5	1521	13.2	0.97 (0.88 to 1.07)	0.530
Father's occupation						
Fix income	6493	24.8	656	10.1	1	
Unfix income	19.086	72.9	2806	14.7	1.53 (1.32 to 1.77)	<0.001*
Unemployment	602	2.3	63	10.4	1.03 (0.69 to 1.54)	0.889
Place of residence						
Urban	16.939	53.6	1965	11.6	1	
Rural	14.664	46.4	2272	15.5	1.41 (1.28 to 1.55)	< 0.001*
Economic status						
Quintile 1 (poorest)	7088	22.8	1177	16.6	2.18 (1.83 to 2.59)	< 0.001*
Quintile 2	6435	20.7	1004	15.6	2.03 (1.69 to 2.42)	< 0.001*

Continued

Table 1 Continued

Variables	All		At risk		Unadjusted OR (95% CI)	P value
	Weighted n	Weighted %	Weighted n	Weighted %		
Quintile 3	6124	19.7	876	14.3	1.83 (1.52 to 2.22)	< 0.001*
Quintile 4	5596	18	616	11.0	1.35 (1.11 to 1.64)	< 0.001*
Quintile 5 (richest)	5844	18.8	491	8.4	1	
Birth weight						
≥ –2 SD	29.960	94.8	3475	11.6	1	
< –2 SD	1643	5.2	338	20.6	1.98 (1.62 to 2.42)	< 0.001*
Birth length						
≥ –2 SD	28.696	90.8	3501	12.2	1	
< –2 SD	2907	9.2	631	21.7	1.97 (1.60 to 2.43)	< 0.001*

*Significant p value ≤0.05.

of crucial health and reproductive services for women throughout various stages of their lives, including adolescence, pregnancy, delivery and beyond.[22]

The findings have several policy implications, particularly for stakeholders involved in the stunting reduction acceleration programme. This underscores the necessity for specific technical guidelines regarding antenatal care for pregnant women who are at a higher risk of delivering stunted babies, including anaemia, short-stature mothers or at risk of chronic energy deficiency. Improving the quality and frequency of antenatal care for pregnant women at a higher risk is beneficial. In addition, neonatal services require guidelines for providing healthcare for stunted newborn babies to catch their linear growth

Table 2 Associations of maternal neonatal continuum of care and the risk of intergenerational cycle of stunting

Variables	Full model		Final model	
	aOR (95% CI)	P value*	aOR (95% CI)†	P value*
Maternal and neonatal continuum of care				
Continuum/complete	1		1	
Incomplete	1.2 (0.92 to 1.57)	0.1	1.30 (1.00 to 1.63)	0.05*
Mother's education				
≥ High school	1			
< High school	1.26 (1.09 to 1.44)	0.001*	–	–
Father's education				
≥ High school	1			
< High school	1.3 (1.16 to 1.53)	0.001*	–	–
Father's occupation				
Fix income	1			
Unfix income	1.04 (0.88 to 1.23)	0.192	–	–
Unemployment	0.76 (0.51 to 1.14)	0.111	–	–
Place of residence				
Urban	1			
Rural	1.15 (0.9 to 1.28)	0.2	–	–
Economic status				
Quintile 5 (richest)	1		1	
Quintile 4	1.16 (0.94 to 1.43)	0.165	1.34 (1.11 to 1.63)	0.003*
Quintile 3	1.49 (1.20 to 1.86)	<0.001*	1.82 (1.51 to 2.19)	<0.001*
Quintile 2	1.54 (1.24 to 1.89)	<0.001*	2.01 (1.68 to 2.4)	<0.001*
Quintile 1 (poorest)	1.53 (1.25 to 1.88)	<0.001*	2.15 (1.81 to 2.56)	<0.001*

*Significant p value ≤0.05.
†Backward logistic regression.
aOR, adjusted OR.

during the initial 6 months when the highest linear growth rate occurs.[34]

This study also found that mothers with incomplete maternal and neonatal continuum of care were more likely to be at risk on the intergenerational cycle of stunting adjusted by economic status. The provision of maternal and neonatal care is also influenced by economic status. A study showed that a limited proportion of women in Sub-Saharan Africa and South Asia were provided with a complete range of services encompassing the continuum of care. Furthermore, it was observed that women with higher levels of wealth and education and those with greater decision-making autonomy exhibited a higher likelihood of receiving various components of care across the continuum. It is imperative to improve the accessibility of maternal and neonatal healthcare services for economically disadvantaged women who lack empowerment.[35]

Stunting could maintain a cyclical pattern as women who experienced stunting during their childhood often transfer stunting tendencies to their offspring, contributing to an intergenerational cycle of poverty and reduced human capital that is challenging to overcome.[5] Intergenerational transmission of poverty will determine the maternal early life environment, which will affect a child's birth length and postnatal length through the maternal constitution and nutrition during pregnancy.[4] Various studies across countries show that socioeconomics plays a critical role in influencing the prevalence of stunting. An analysis of 80 countries showed that those with more significant socioeconomic disparities tend to have a high prevalence of stunting.[5] A study in a province in Indonesia, East Nusa Tenggara, showed that socially, politically, economically and emotionally disadvantaged children are shorter than children from prosperous backgrounds.[36 37] This province is also recognised as one of the economically underprivileged regions in Indonesia, which may contribute to a comparatively lower average height of its population compared with other provinces in the country.

The limitation of this study was that the information and data regarding mothers' economic status in the past were unavailable; however, mothers' educational attainment can be a proxy for economic status in the past. An additional constraint is that the WHO recommends a minimum of eight contacts on antenatal care during pregnancy, whereas, in Indonesia, a minimum of six contacts is recommended. WHO recommendation/criteria lead to a lower prevalence of mothers receiving antenatal care in this study, as pregnant women and health workers generally adhere to the current guidelines in Indonesia.

CONCLUSION

The continuum of maternal and neonatal healthcare has a potential influence in breaking the intergenerational cycle of stunting, especially in populations where stunted mothers are prevalent. It emphasises the importance of ensuring the availability and accessibility of maternal and child healthcare throughout various stages, including pregnancy, delivery and beyond, for women and children at all economic levels.

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Patient consent for publication Not applicable.

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Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The data were available from the Health Policy and Development Board, Ministry of Health, Republic of Indonesia. The data can be accessed with certain requirements and procedures by sending a complete proposal and data access request letter to datin.bkpk@kemkes.go.id.

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