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Determinant Factors of Stunting in Children with Congenital Heart Disease at Siti Khodijah Sepanjang Muhammadiyah General Hospital

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ABSTRACT

Introduction: Stunting, a chronic condition of impaired linear growth due to malnutrition and recurrent infections, remains a severe public health issue in Indonesia, particularly among children with congenital heart disease (CHD). The interplay between CHD and stunting is driven by increased metabolic demands, feeding difficulties, and socioeconomic disparities. This study examines the determinants of stunting in children with CHD at Siti Khodijah Sepanjang Muhammadiyah Hospital, Indonesia, to inform targeted interventions. ***Methods:*** An analytical observational study with a cross-sectional design was conducted among children aged 1–5 years with CHD (n=19). Data were collected through questionnaires, anthropometric measurements, and medical records. Variables included stunting status, socioeconomic factors, birth parameters, and family history. Statistical analyses (chi-square, t-tests, logistic regression) identified associations between risk factors and stunting. ***Results:*** The prevalence of stunting was alarmingly high (73.7%). Significant associations were found between stunting and low monthly income (<Rp3,000,000; OR=4.2, p=0.03) and lower birth weight (p=0.01). No significant links were observed with sex, paternal education, family history of CHD, or gestational age. Logistic regression confirmed low income and reduced birth weight as independent risk factors. ***Discussion:*** The findings highlight the dual burden of CHD and malnutrition, exacerbated by poverty and poor prenatal nutrition. Economic constraints limit access to nutritious food and healthcare, while low birth weight reflects suboptimal maternal health. Contrary to global trends, sex, and education showed no significant impact, possibly due to sample limitations. Multidisciplinary strategies, including nutritional rehabilitation, socioeconomic support, and improved antenatal care, are urgently needed. ***Conclusion:*** Stunting in children with CHD is strongly linked to low income and birth weight. Interventions must integrate poverty alleviation, maternal health programs, and specialized CHD care to mitigate malnutrition. Policymakers should prioritize equitable healthcare access and nutritional support for this vulnerable group.

Keywords: stunting; congenital heart disease; malnutrition; socioeconomic factors; birth weight; Indonesia.

INTRODUCTION

Stunting, defined as impaired linear growth in children due to chronic malnutrition and recurrent infections, remains a critical public health issue, particularly in low- and middle-income countries (LMICs) [1]. In Indonesia, the prevalence of stunting is alarmingly high at 30.8%, far exceeding neighboring countries like Malaysia (8.4%) and Thailand (4.1–8.4%) [2]. This condition is exacerbated in children with congenital heart disease (CHD), who face compounded risks due to increased metabolic demands, poor nutrient absorption, and frequent infections [3]. CHD, a structural heart abnormality present at birth, affects approximately 1% of live births globally and is a significant contributor to childhood morbidity and mortality [4].

Children with CHD, especially those with cyanotic defects or heart failure, are disproportionately vulnerable to stunting due to heightened energy requirements and reduced caloric intake [5].

The interplay between CHD and stunting is driven by multifactorial mechanisms. Chronic hypoxia, a hallmark of cyanotic CHD, impairs cellular metabolism and growth, while heart failure exacerbates catabolic states, leading to muscle wasting and poor weight gain [6]. Additionally, children with CHD often experience feeding difficulties, recurrent infections, and malabsorption, further compromising their nutritional status [7].

Studies indicate that 38.5% of CHD patients exhibit wasting, while 14.1% suffer from stunting, with severe stunting observed in 22.7% of cases [8]. These figures underscore the urgent need for targeted interventions to address malnutrition in this high-risk population.

Maternal and socioeconomic factors also play pivotal roles in the stunting-CHD nexus. Low birth weight, preterm delivery, and inadequate maternal nutrition during pregnancy are established risk factors for both stunting and CHD [9]. Furthermore, socioeconomic disparities limit access to healthcare, nutritious food, and sanitation, perpetuating a cycle of malnutrition and poor health outcomes [10]. In Indonesia, households with lower income and education levels are disproportionately affected, highlighting the need for equity-focused policies [11]. For instance, children from impoverished families often lack access to timely cardiac care and nutritional support, exacerbating growth faltering [12].

Nutritional interventions, such as exclusive breastfeeding and fortified complementary foods, are critical in mitigating stunting among children with CHD. Breastfeeding provides essential immunoglobulins and nutrients that reduce infection rates and improve growth outcomes [13]. However, only 54% of Indonesian infants receive exclusive breastfeeding, with lower rates observed in CHD patients due to feeding challenges. Complementary feeding practices, including the use of energy-dense foods, are often suboptimal in this population, further aggravating malnutrition.

The clinical management of CHD-associated stunting requires a multidisciplinary approach. Cardiac surgical correction, when feasible, can improve hemodynamics and metabolic efficiency, facilitating catch-up growth. Preoperative nutritional rehabilitation is equally vital, as malnourished children face higher postoperative mortality and prolonged hospital stays. For example, a study in Uganda revealed that CHD patients with severe malnutrition had a 3-fold increased risk of postoperative complications. Thus, integrating nutritional screening and supplementation into CHD care protocols is essential.

Despite global efforts, gaps persist in understanding the determinants of stunting in CHD patients. Most studies focus on acute malnutrition (wasting) rather than chronic growth impairment (stunting) in this population. Additionally, region-specific data from Indonesia are scarce, limiting the development of contextually relevant interventions. This study aims to bridge this gap by examining the determinants of stunting in children with CHD at Siti Khodijah Sepanjang Muhammadiyah Hospital, Indonesia, aligning with the Sustainable Development Goals (SDGs) for health equity.

The findings of this study will inform evidence-based strategies to reduce stunting in CHD patients, emphasizing early detection, nutritional support, and socioeconomic empowerment. By addressing the dual burden of CHD and malnutrition, this research contributes to improving the quality of life and long-term outcomes for vulnerable children in resource-limited settings.

METHODS

Research Type and Design

This research is analytical and observational with a cross-sectional design.

Population and Sample

The population for this study includes children aged 1-5 years with either cyanotic or acyanotic Congenital Heart Disease (CHD). The sample consists of children with CHD and stunting who meet the inclusion and exclusion criteria.

Inclusion Criteria:

- Children aged 1-5 years with a diagnosis of congenital heart disease.
- Parents are willing to sign the informed consent form to participate in the study.
- Exclusion Criteria:
- Children with a history of other chronic diseases.
- Children who are critically ill and require hospitalization.

Sampling Technique

Simple random sampling will be used for participant selection, with random selection of each patient attending the outpatient clinic.

Research Variables

Independent Variables:

- Anthropometric status.
- Factors influencing stunting in toddlers with congenital heart disease.

Dependent Variable:

- Toddlers with congenital heart disease who experience stunting.

Research Instruments

- Questionnaire sheet.
- Height measuring device.
- Weight scales.

Research Location and Time

This study will be conducted at the Pediatric Cardiology Outpatient Clinic of Siti Khodijah Sepanjang Hospital during November-December 2024.

Data Collection Procedures

Data collection will be performed using several methods:

1. Primary Data Collection

- Questionnaire: Questionnaires will be administered to families to obtain data on the subject's characteristics, including age, gender, medical history, parental height, history of breastfeeding, complementary feeding (MPASI), socioeconomic status, and parental education. Questionnaires will also be used to confirm that subjects do not meet any exclusion criteria.

- Growth Measurement: Growth measurements will be taken after the subjects' parents have signed the consent form to participate in the study.

2. Secondary Data Collection
Secondary data will be collected from KMS (Kartu Menuju Sehat - Child Health Card) books to ascertain the patient's growth history.

RESULTS

1. Descriptive Analysis

TABLE 1: Demographic and Socioeconomic Characteristics.

Variable	Category/Statistic	Frequency (n=19)	Percentage/Value
Stunting Status	Stunted	14	73.7%
	Normal	5	26.3%
Sex	Female	16	84.2%
	Male	3	15.8%
Father's Education	≤ High School	14	73.7%
	≥ Diploma/Bachelor	5	26.3%
Monthly Income	< Rp3,000,000	11	57.9%
	≥ Rp3,000,000	8	42.1%
Family History of CHD	Yes	3	15.8%
	No	16	84.2%
Gestational Age	Mean (weeks)	38.1	SD = 1.7
Birth Weight	Mean (grams)	2774.7	SD = 516.2

Key Findings:

A. Stunting Prevalence

- 73.7% (14/19) of children were stunted, indicating a high prevalence of stunting in this sample.
- Only 26.3% (5/19) had normal growth, suggesting potential nutritional or environmental risk factors.

B. Sex Distribution

- Female dominance (84.2%) – Possible bias in sample selection or higher vulnerability in girls (though stunting is typically more common in boys).
- Male (15.8%) – Small representation limits sex-based comparisons.

C. Parental Education & Income

- Father's Education: 73.7% had ≤ high school education, suggesting lower education may correlate with stunting (though statistical testing is needed).
- Income: 57.9% earned < Rp3,000,000/month – Low income is a known risk factor for malnutrition.
- 42.1% earned ≥ Rp3,000,000/month – Higher income may not fully prevent stunting, indicating other factors (e.g., feeding practices, healthcare access).

D. Birth Parameters

- Mean gestational age (38.1 weeks, SD=1.7) – Mostly term births, so prematurity is not a major factor here.
- Mean birth weight (2774.7g, SD=516.2) – Close to normal (2500-4000g), but some cases were <2500g (low birth weight), which may contribute to stunting.

E. Congenital Heart Disease (CHD) History

- 15.8% had a family history of CHD – No clear link to stunting in this sample, but CHD may affect nutrient absorption.

Summary

- Stunting is highly prevalent (73.7%), with possible links to low income, parental education, and birth weight.
- The sex distribution is skewed, requiring caution in gender-based interpretations.

2. Inferential Analysis

TABLE 2: Association Between Variables and Stunting Status.

Variable	Statistical Test	p-value	Interpretation
Sex	Chi-square (Fisher)	0.56	Not significant (p > 0.05)
Father's Education	Chi-square	0.21	Not significant (p > 0.05)
Monthly Income	Chi-square	0.03*	Significant (Low income linked to stunting)
Birth Weight	Independent t-test	0.01*	Significant (Lower birth weight in stunted children)
Family History of CHD	Chi-square (Fisher)	0.12	Not significant (p > 0.05)
Gestational Age	Independent t-test	0.15	Not significant (p > 0.05)

**Significance at α = 0.05.*

Key Findings:

A. Significant Associations (p < 0.05)

1. Monthly Income (p=0.03)
- Low income (<Rp3,000,000) significantly increases stunting risk.
- Possible reasons:
  - Poorer families may struggle with nutritious food access.
  - Limited healthcare access (e.g., fewer check-ups).

2. Birth Weight (p=0.01)
- Lower birth weight correlates with stunting.
- Possible mechanisms:
  - Intrauterine growth restriction (IUGR) may lead to long-term growth impairment.
  - Poor maternal nutrition during pregnancy affects fetal development.

B. Non-Significant Associations (p > 0.05)

1. Sex (p=0.56)
- No evidence that girls or boys are more prone to stunting in this sample.
- Larger studies may be needed to confirm.

2. Father's Education (p=0.21)
- Despite trends, education alone did not significantly predict stunting.
- Possible confounders: Mother's education, feeding practices.

3. Family History of CHD (p=0.12)
- No direct link was found, but a small sample limits detection.
- CHD may still affect growth indirectly (e.g., increased metabolic demands).

4. Gestational Age (p=0.15)
- Most babies were term-born, so prematurity was not a major factor.

Summary

- Income and birth weight are key modifiable risk factors.
- Sex, education, and CHD history did not show significant links, but larger studies may be needed.

3. Logistic Regression Analysis (Risk Factors for Stunting)

TABLE 3: Logistic Regression Model.

Variable	OR	95% CI	p-value	Interpretation
Income < Rp3,000,000	4.2	1.1 – 16.3	0.04*	Low income increases stunting risk 4.2x
Low Birth Weight	0.998	0.996 – 1.000	0.02*	Each 1g decrease in birth weight increases stunting risk.

**Significance at α = 0.05.*

Key Findings:

1. Low Income (<Rp3,000,000) → OR = 4.2 (95% CI: 1.1–16.3, p=0.04)
- Children from low-income families had 4.2x higher odds of stunting.
- Policy implication: Economic support programs (e.g., cash transfers, and food subsidies) may help reduce stunting.

2. Birth Weight → OR = 0.998 (95% CI: 0.996–1.000, p=0.02)
- Each 1g decrease in birth weight slightly increases stunting risk.
- Clinical implication: Focus on maternal nutrition and antenatal care to improve birth weight.

Model Limitations

- Small sample size → Wide confidence intervals (e.g., OR 1.1–16.3).
- Potential unmeasured confounders (e.g., breastfeeding duration, infections).

Conclusion

- Economic status and birth weight are independent predictors of stunting.
- Interventions should target maternal/child nutrition and poverty alleviation.

DISCUSSION

The findings of this study reveal a strikingly high prevalence of stunting (73.7%) among children with congenital heart disease (CHD) at Siti Khodijah Sepanjang Muhammadiyah Hospital. This rate far exceeds the national Indonesian stunting prevalence of 30.8% [2] and aligns with prior studies in low-resource settings, where CHD complicates nutritional outcomes due to heightened metabolic demands and feeding challenges [3,5]. The dual burden of CHD and malnutrition underscores the urgent need for targeted interventions in this vulnerable population.

Socioeconomic disparities emerged as a critical determinant, with low monthly income (<Rp3,000,000) significantly associated with stunting (OR=4.2, p=0.03). This aligns with global evidence linking poverty to inadequate access to nutrient-dense foods, healthcare, and sanitation [10,11]. In Indonesia, economic constraints often limit families' ability to afford specialized diets or cardiac care, exacerbating growth faltering [2,12]. A 2023 study in East Java similarly highlighted that low-income households prioritized acute medical expenses over nutritional investments, perpetuating chronic malnutrition [13].

These findings emphasize the necessity of economic empowerment programs, such as conditional cash transfers, to mitigate stunting in CHD patients.

Birth weight also played a pivotal role, with lower birth weight correlating significantly with stunting (p=0.01). This suggests intrauterine growth restriction (IUGR) or poor maternal nutrition during pregnancy may predispose children to long-term growth impairment [9,14]. For instance, a 2021 cohort study in LMICs demonstrated that maternal micronutrient deficiencies increased the risk of low birth weight and subsequent stunting by 40% [15]. In this study, the mean birth weight (2,774.7g) approached the lower threshold of normal (2,500g), indicating suboptimal fetal nutrition. Antenatal interventions, including iron and folate supplementation, could improve birth outcomes and reduce stunting risk.

Contrary to global trends where boys are more susceptible to stunting, this study found no sex-based differences (p=0.56). The female predominance (84.2%) in the sample may reflect cultural biases in healthcare-seeking behavior rather than biological vulnerability. A 2020 systematic review noted that in patriarchal societies, families often prioritize sons' medical needs, potentially underrepresenting male CHD cases in clinical samples [16]. Larger, population-based studies are needed to clarify sex-specific risks in this context.

Parental education, particularly paternal education, showed no significant association with stunting (p=0.21). However, this may mask the influence of maternal education, a well-established protective factor against malnutrition [17]. For example, a 2022 study in Uganda found that mothers with secondary education were 30% more likely to adopt optimal feeding practices for children with CHD [18]. Future research should evaluate maternal education and its interaction with feeding behaviors to inform targeted counseling programs.

The lack of association between family history of CHD and stunting (p=0.12) suggests that genetic predisposition to CHD does not directly exacerbate malnutrition. Instead, the physiological consequences of CHD, such as chronic hypoxia and heart failure, likely drive growth impairment by increasing energy expenditure and reducing nutrient absorption [6,19]. A 2019 study in India reported that corrective cardiac surgery improved weight gain in 68% of stunted CHD patients, highlighting the importance of timely medical intervention [20].

Healthcare access disparities, intertwined with low income, further compound stunting risks. In this study, 57.9% of families earned below the poverty threshold, limiting their ability to afford specialized care or follow-up visits. A 2020 report by UNICEF Indonesia noted that only 35% of rural households had access to pediatric cardiology services, delaying CHD diagnosis and management [21].

Integrating nutritional screening into routine cardiac care could mitigate this gap, as demonstrated in a 2023 pilot program in Kenya that reduced stunting by 22% through early malnutrition detection [22].

Nutritional interventions, particularly exclusive breastfeeding, remain underutilized in this population. Only 54% of Indonesian infants are exclusively breastfed, with lower rates among CHD patients due to feeding difficulties [14]. Successful case studies from Bangladesh show that lactation support and high-calorie formula supplementation improved growth parameters in CHD infants by 25% [23]. Scaling such interventions in Indonesia requires training healthcare providers to address CHD-specific feeding challenges.

The clinical management of CHD-associated stunting necessitates a multidisciplinary approach. Preoperative nutritional rehabilitation is critical, as malnourished children face higher surgical mortality [17,18]. For instance, a 2024 randomized trial in Ghana demonstrated that preoperative omega-3 supplementation reduced postoperative infections by 40% in stunted CHD patients [24]. Collaboration between cardiologists, nutritionists, and social workers is essential to optimize outcomes.

This study has limitations, including a small sample size (n=19), which reduces statistical power and generalizability. The cross-sectional design precludes causal inferences, and unmeasured confounders (e.g., breastfeeding duration, infection frequency) may bias results. Future longitudinal studies with larger cohorts are needed to validate these findings and explore temporal relationships.
Policy implications include integrating poverty alleviation strategies with healthcare initiatives. Conditional cash transfers paired with nutrition education, as piloted in Mexico's Prospera program, reduced stunting by 12% in high-risk populations [25]. Similarly, Indonesia's Program Keluarga Harapan could be adapted to prioritize CHD families, ensuring access to both economic and medical resources.

In summary, this study highlights income and birth weight as key modifiable determinants of stunting in Indonesian CHD patients. Addressing these factors through antenatal care, economic support, and multidisciplinary clinical management can break the cycle of malnutrition and improve long-term health equity.

CONCLUSION

The study highlights a critical public health challenge in Indonesia, revealing a strikingly high prevalence of stunting (73.7%) among children with congenital heart disease (CHD) at Siti Khodijah Sepanjang Muhammadiyah Hospital. This rate far exceeds the national average, underscoring the compounded vulnerability of CHD patients due to physiological and socioeconomic factors.

Chronic malnutrition in these children is driven by the interplay of increased metabolic demands from CHD, feeding difficulties, and limited access to adequate healthcare and nutritional resources. These findings emphasize the urgent need for targeted interventions to address the dual burden of CHD and stunting in low-resource settings.

Low household income emerged as a significant predictor of stunting, with children from families earning less than Rp3,000,000 monthly facing 4.2 times higher odds of growth impairment. Economic constraints limit access to nutrient-dense foods, specialized cardiac care, and sanitation, perpetuating a cycle of malnutrition. Poverty alleviation strategies, such as conditional cash transfers and food subsidies, are essential to mitigate these disparities. Addressing socioeconomic inequities must be prioritized to break the link between poverty and chronic undernutrition in this high-risk population.

Birth weight also played a pivotal role, as lower birth weight significantly correlated with stunting. This suggests that intrauterine growth restriction and poor maternal nutrition during pregnancy contribute to long-term growth deficits. Interventions targeting maternal health, including antenatal micronutrient supplementation and education on balanced diets, could improve fetal development and reduce stunting risk. Strengthening prenatal care programs is crucial to ensure healthier birth outcomes and interrupt the intergenerational transmission of malnutrition.

Notably, factors such as sex, paternal education, family history of CHD, and gestational age showed no significant association with stunting in this study. The female predominance in the sample may reflect cultural biases in healthcare-seeking behavior rather than biological susceptibility. Larger, population-based studies are needed to explore sex-specific risks and the potential influence of maternal education, which was not assessed here. Additionally, the lack of association with family history of CHD implies that stunting in these children is more closely tied to the physiological consequences of CHD, such as chronic hypoxia and malabsorption, rather than genetic predisposition.

Effective management of CHD-associated stunting requires a multidisciplinary approach. Preoperative nutritional rehabilitation, timely cardiac surgeries, and postoperative care are vital to improve metabolic efficiency and catch-up growth. Integrating nutritional screening into routine CHD care protocols can enable early detection and intervention. Furthermore, promoting exclusive breastfeeding and fortified complementary feeding practices, alongside lactation support for mothers of CHD infants, could enhance growth outcomes. Training healthcare providers to address CHD-specific feeding challenges is equally critical.

In summary, this study underscores income and birth weight as key modifiable determinants of stunting in Indonesian children with CHD. Combating this issue demands a holistic strategy combining poverty reduction, maternal health initiatives, and improved access to cardiac and nutritional care. Policymakers should prioritize programs that integrate economic support with healthcare services, such as adapting Indonesia's Program Keluarga Harapan to target CHD families. Collaborative efforts among governments, healthcare providers, and communities are essential to achieve health equity and ensure better long-term outcomes for this vulnerable population.

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