



An Overview of the Double Burden of Malnutrition in Toddlers and Its Implications for Cardiovascular Disease Risk in Adulthood

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ABSTRACT

Masalah gizi ganda pada anak merupakan isu kesehatan masyarakat yang penting karena berdampak pada pertumbuhan dan perkembangan, serta berpotensi menimbulkan konsekuensi kesehatan jangka panjang. Kondisi malnutrition pada periode awal kehidupan dapat menyebabkan perubahan permanen pada struktur dan fungsi organ. Perubahan ini secara biologis berkaitan dengan peningkatan kerentanan terhadap penyakit tidak menular, termasuk penyakit kardiovaskular pada usia dewasa. Tujuan: Penelitian ini bertujuan untuk menggambarkan kondisi masalah gizi ganda pada balita dengan malnutrition serta membahas implikasi konseptualnya terhadap risiko penyakit kardiovaskular, termasuk Infark Miokard Akut (IMA), pada usia dewasa berdasarkan kajian literatur ilmiah. Metode: Penelitian ini menggunakan desain deskriptif potong lintang dengan melibatkan 107 balita di wilayah kerja UPTD Puskesmas Cilembang, Kota Tasikmalaya. Data yang dikumpulkan meliputi karakteristik balita dan orang tua, status kesehatan, serta asupan makanan. Analisis data dilakukan secara deskriptif untuk menggambarkan distribusi masalah gizi ganda. Hasil: Hasil penelitian menunjukkan bahwa sebagian besar balita mengalami kombinasi masalah gizi pendek dan malnutrition, yaitu sebesar 66 persen. Kondisi masalah gizi ganda ini berpotensi menghambat pertumbuhan dan perkembangan balita serta berkaitan dengan gangguan metabolik yang dapat berdampak pada kesehatan jangka panjang. Kesimpulan: Masalah gizi ganda pada balita dapat terjadi akibat berbagai faktor yang saling berkaitan dan berdampak pada pertumbuhan serta perkembangan. Berdasarkan tinjauan literatur, kondisi malnutrition pada awal kehidupan berpotensi menyebabkan perubahan biologis jangka panjang yang secara konseptual berkaitan dengan peningkatan risiko penyakit kardiovaskular, termasuk Infark Miokard Akut, pada usia dewasa.

ABSTRACT

The double burden of malnutrition in children is an important public health issue because it affects growth and development and may lead to long-term health consequences. Malnutrition during early life has the potential to cause permanent changes in organ structure and function, which are biologically associated with an increased vulnerability to non-communicable diseases, including cardiovascular disease, in adulthood.

Objective: This study aimed to describe the condition of the double burden of malnutrition among malnourished toddlers and to discuss its conceptual implications for the risk of cardiovascular disease, including Acute Myocardial Infarction (AMI), in adulthood based on the scientific literature. Methods: This study employed a descriptive cross-sectional design involving 107 toddlers in the service area of UPTD Puskesmas Cilembang, Tasikmalaya City. Data collected included characteristics of toddlers and parents, health status, and dietary intake. Data analysis was conducted descriptively to illustrate the distribution of the double burden of malnutrition. Results: The findings showed that most toddlers experienced a combination of stunting and undernutrition (66%). This double burden of malnutrition has the potential to hinder growth and development and is associated with metabolic disturbances that may affect long-term health. Conclusion: The double burden of malnutrition in toddlers can arise from multiple interrelated factors and has an impact on growth and development. Based on the literature review, malnutrition in early life may lead to long-term biological changes that are conceptually linked to an increased risk of cardiovascular disease, including Acute Myocardial Infarction, in adulthood.

INTRODUCTION

In recent years, attention to the double burden of malnutrition in children has increased significantly. Double Burden of Malnutrition (DBM) refers to a condition when two forms of nutritional problems, both undernutrition and overnutrition, occur simultaneously at the individual level (Inayatullah et al., 2022). In children, this condition can appear as overweight that occurs at the same time as stunting (Farah et al., 2021). Globally, in 2022 it is estimated that 22.3% (148.1 million) of children under the age of five are *stunted*, while more than 37 million (5.6%) are overweight (United Nations Children's Fund et al., 2023). In Indonesia, Riskesdas 2018 reported the prevalence of stunting in toddlers at 30.8% and the prevalence of overweight at 8% (Badan Penelitian dan Pengembangan Kesehatan, 2018).

Malnutrition is a serious challenge, especially in developing countries such as Indonesia, as it has an impact on long-term health, lowers productivity, increases the economic burden on families and the state, and increases the risk of death (Zhang et al., 2021). Malnutrition is defined as an imbalance in energy and nutrient intake that affects body size, composition, and function. WHO groups malnutrition into three main categories: undernutrition, overnutrition, and micronutrient deficiency (Khaliq et al., 2022). Stunting, wasting, and underweight are included in malnutrition, while overweight and obesity are forms of overnutrition. This condition is influenced by various factors, including food intake imbalances, infectious diseases, inadequate sanitation, and low parental parenting and education (Amadu et al., 2021).

Undernutrition can lead to decreased immunity, cognitive impairment, and stunted physical growth (Wardani & Renyoet, 2022), while overnutrition has the potential to cause limited mobility, impaired growth and development, and body dysfunction (Antono, 2017). When both forms of malnutrition occur simultaneously, the risk of health problems increases even more. DBM in children are a global health issue because they have the potential to have long-term impacts, not only inhibiting growth and development, but also affecting cognitive and immune function, thereby increasing susceptibility to infectious and non-communicable diseases (Astuti et al., 2020). One of the non-communicable diseases relevant to the long-term impact of malnutrition is Acute Myocardial Infarction (AMI).

AMI is a form of coronary artery disease that occurs due to decreased or blocked blood flow to the heart muscle (Salari et al., 2023). A study by Zhu et al., (2014) on 36,803 participants, 14,883 of whom had an AMI, showed that being overweight was significantly associated with an increased risk of AMI. Another study by (Alhuneafat et al., 2022) also confirmed that obesity is an important risk factor for AMI and is related to increased mortality in hospitals. In addition, (Sukmasari & Renyoet, 2023) found that a diet high in fat and sodium, without adequate physical activity, contributes to an increased risk of AMI.

Research that specifically describes the DBM in children with malnutrition and its implications for the risk of AMI in adulthood is not yet available. Therefore, this study was conducted to examine the picture of dual nutritional problems in malnourished children as well as the risk of AMI when the individual enters adulthood.

RESEARCH METHODS

This study is a quantitative study with a *cross-sectional* design and descriptive analysis carried out in March–April 2024 to describe multiple nutritional problems in toddlers and study characteristics that are potentially related to the risk of Acute Myocardial Infarction (AMI) in adulthood. The research sample consisted of 107 toddlers aged 36–59 months who lived in the UPTD area of the Cilembang Health Center, Tasikmalaya City, selected using *purposive sampling* techniques based on Height-for-Age and Weight-for-Height indicators. The research has obtained ethical approval (REC.2024022004/02.11/2025), and data collection was carried out after obtaining *informed consent* from parents of toddlers. The data collected were the characteristics of toddlers including gender, birth history, anthropometry, parental characteristics including parental education, maternal age during pregnancy, income, and maternal nutritional status during pregnancy, and children's nutritional history including history of exclusive breastfeeding, complementary feeding and sanitation. Nutritional status was determined based on the Z-score value, while food consumption data for the past year was obtained through SQ-FFQ and processed using *NutriSurvey* to calculate energy intake, macronutrients, and micronutrients. Energy needs, macronutrients, and micronutrients are calculated using a standard formula, then the nutritional adequacy level is obtained from a comparison of intake and nutritional needs.

All data on characteristics, dietary intake, and anthropometric measurement results were analyzed descriptively and presented in a frequency distribution table to provide a comprehensive picture of dual nutritional conditions in toddlers. The results of this analysis are then used as a basis to understand the long-term implications for the risk of AMI in adulthood, which is then reinforced by the results of a literature review and related research findings.

RESEARCH RESULTS

Characteristics of Toddlers

Table 1. Frequency Distribution of Toddler Characteristics

Characteristics	Frequency (n=107)	Percentage (%)
Gender		
Male	51	47,66
Women	56	52,34
Gestational age		
Preterm (<37 weeks)	26	24,30
Aterm (37-42 weeks)≥	81	75,70

Birth weight history

Low (<2500 g)	10	9,35
Normal (2500 g)≥	97	90,65

History of birth length

Short (<48 cm)	23	21,50
Normal (48 cm)≥	84	78,50

Gender-related characteristics showed that the number of female toddlers experienced more nutritional problems (56 toddlers; 52.34%), 24.30% of toddlers with nutritional problems were born with a gestational age of less than 37 weeks. almost all toddlers have a history of normal birth weight, but 10 toddlers (9.35%) were found with a history of Low Birth Weight (LBW), and as many as 23 toddlers (21.50%) had a history of Short Birth Length (SBL).

Characteristics of Parents

Table 2. Frequency Distribution of Parental Characteristics

Characteristics	Frequency (n=107)	Percentage (%)
Father's education		
Elementary/equivalent	25	23,36
Junior High School/Equivalent	32	29,91
High School/equivalent	45	42,06
Colleges	5	4,67
Mother's education		
Elementary/equivalent	17	15,89
Junior High School/Equivalent	37	34,58
High School/equivalent	51	47,66
Colleges	2	1,87
Mother's age during pregnancy		
<20 years or >35 years old	24	22,43
20-35 years old	83	77,57
Family income		
<IDR1,000,000	6	5,61
IDR1,000,000-IDR1,500,000	30	28,04
IDR1,500,001-IDR2,000,000	31	28,97
IDR2,000,001-IDR2,500,000	20	18,69
IDR2,500,001-IDR 3,000,000	9	8,41
>IDR 3,000,000	11	10,28

The results of the study in table 2 related to parental education show that most of the fathers and mothers have a history of high school education/equivalent (42.06% and 47.66%). Table 6 shows 24 pregnant mothers at less than 20 years of age (<20 years) or more than 35 years (>35 years). The results of the study in table 6 also show that there are still families with a total family income per month of IDR 1,000,000-IDR 1,500,000 which is relatively low when compared to the regional minimum wage of Tasikmalaya City which is at IDR 2,630,951.

Maternal Nutritional Status During Pregnancy

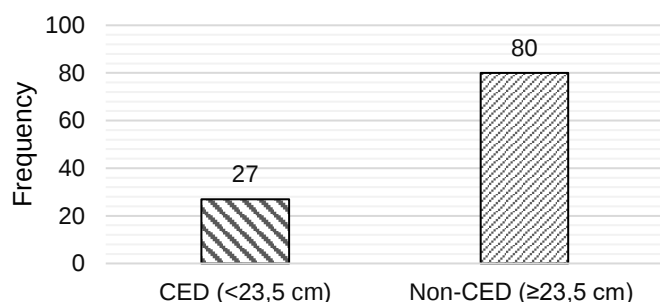


Figure 1. Frequency Distribution of Maternal Nutritional Status History During Pregnancy

The mother's nutritional status history during pregnancy can be known through upper arm circumference measurements. The results of the upper arm circumference measurement of pregnant women carried out in the third trimester listed in the book Maternal and Child Health show that there are still 27 pregnant women who experience Chronic Energy Deficiency (CED) marked by the results of upper arm circumference measurements <23.5 cm.

History of Exclusive Breastfeeding in Toddlers

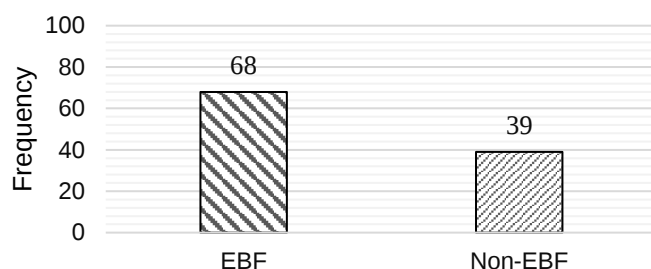


Figure 2. Distribution of Frequency of Exclusive Breastfeeding History in Toddlers

The results of the study on the frequency of Exclusive Breastfeeding (EBF) showed that as many as 68 toddlers (63.55%) had a history of exclusive breastfeeding, while 39 other toddlers had no history of exclusive breastfeeding (Non-EBF).

History of Complementary Feeding to Toddlers

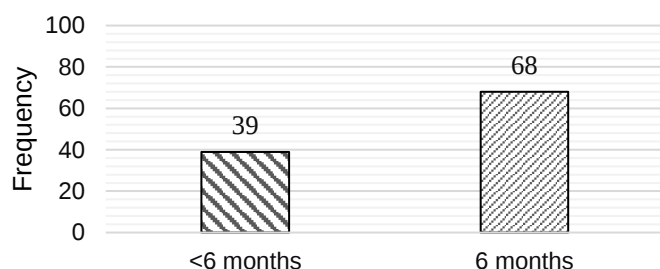


Figure 3. Frequency Distribution of Nursing History of complementary feeding in Toddlers

In figure 3 regarding the history of complementary feeding in toddlers, 39 toddlers (36.45%) were given early complementary feeding (<6 months). The results of this study are not much different from the results of the 2023 Indonesian Health Survey in West Java province regarding the proportion of age at which foods other than breast milk are first introduced. The total percentage of children who are given food other than breast milk under the age of 6 months or early complementary feeding is 33.10% (Badan Kebijakan Pembangunan Kesehatan, 2023).

Risk Factors for *Malnutrition*

Table 4. Macronutrient Adequacy Level based on SQ-FFQ Form

Categories	Nutritional Adequacy Level							
	Energy		Protein		Fat		Carbohydrates	
	n	%	n	%	n	%	n	%
Weight deficit (<70%)	66	61,68	89	83,18	43	40,19	73	68,22
Moderate deficit (70-79%)	11	10,28	11	10,28	17	15,89	12	11,21
Mild deficit (80-89%)	8	7,48	4	3,74	11	10,28	6	5,61
Good (90-119%)	10	9,35	2	1,87	12	11,21	11	10,28
Over (>120%)	12	11,21	1	0,93	24	22,43	5	4,67

The results of the analysis of the level of adequacy of macronutrients based on the Semi Quantitative Food Frequency Questionnaire (SQ-FFQ) Form showed that more than half of the subjects experienced a severe deficit in energy, protein, and carbohydrate intake, while less than half experienced a severe deficit in fat intake.

Table 5. Micronutrient Adequacy Level based on Form SQ-FFQ

Categories	Nutritional Adequacy Level					
	Iron		Calcium		Zinc	
	n	%	n	%	n	%
Weight deficit (<70%)	86	80,37	107	100	48	44,86
Moderate deficit (70-79%)	9	8,41	0	0	7	6,54
Mild deficit (80-89%)	5	4,67	0	0	10	9,35
Good (90-119%)	7	6,54	0	0	24	22,43

The level of micronutrient adequacy based on the results of the SQ-FFQ Form showed that most subjects had a severe deficit in iron intake, all subjects had a severe deficit in calcium intake, and less than half had a severe deficit in zinc intake.

Table 6. Frequency Distribution of Sanitation Conditions in Households

Sanitation	Frequency (n=107)	Percentage (%)
Bathroom		
There	107	100
None	0	0
Septic tank		
There	82	76,64
None	25	23,36
Dishwasher		
There	84	78,50
None	23	21,50
Ventilation		
There	107	100
None	0	0

The results of the study in table 6 show that all respondents have bathrooms and ventilation in their homes, while as many as 25 respondents (23.36%) do not have a septic tank and 23 respondents do not have a dishwasher at home.

Dual Nutrition Problems in Toddlers

Table 7. Frequency Distribution of Nutritional Status of Toddlers with Dual Nutritional Problems

Characteristics	Frequency (n=107)	Percentage (%)
Very short and malnourished	2	1,87
Very short and more nutritious	1	0,93
Short and undernourished	71	66,36
Short and obesity	4	3,74

Very short and undernourished	8	7,48
Short and malnutrition	1	0,93
Short and more nutritious	20	18,69

The results of the study in table 7 show that of 107 toddlers, most of them experienced the characteristics of DBM in the form of short and undernourished as many as 71 toddlers (66.36%). Other characteristics included short and overnutrition as many as 20 toddlers (18.69%), very short and undernourished as many as 8 toddlers (7.48%), short and obese as many as 4 toddlers (3.74%), very short and malnourished as many as 2 toddlers (1.87%), very short and overnutrition as many as 1 toddler (0.93%), and short and malnourished as many as 1 toddler (0.93%).

DISCUSSION

Characteristics of Toddlers

The difference in nutritional problems between boys and girls can be influenced by variations in parenting styles in feeding that are often related to local cultural values. In some cultures, boys are often positioned as potential successors to the family so that they get a larger portion of food and are considered more nutritious than girls. This condition is in line with the findings of (Qolbiyah et al., 2021) who reported that the prevalence of stunting is higher in girls under five due to differences in parenting patterns. However, research by (Samuel et al., 2022) shows that differences in social perceptions regarding parenting do not play a significant role as risk factors for stunting or wasting. The findings show that nutritional problems in toddlers are not solely determined by gender, but by various other factors such as family conditions, quality of diet, infections, and environment, which complexly affect the nutritional status of children.

A child's nutritional status is also closely related to prenatal conditions, including gestational age, birth weight, and birth length. Children born *preterm* have a higher risk of developing growth disorders and chronic diseases as adults. Markopoulou et al., (2019) explain that preterm birth can lead to impaired endothelial structure and function, which has an impact on blood pressure regulation and increases the risk of cardiovascular disease later in life. Similarly, the history of LBW and SBL has been shown to be related to nutritional problems such as stunting, wasting, and underweight. Research by (Swathma et al., 2016) showed that toddlers with a history of SBL had a more than fourfold risk of stunting, while Li et al., (2022) found that children with LBW were at greater risk of stunting and wasting. In addition to causing failure to grow, this condition can also increase susceptibility to infectious diseases and impaired organ development. However, postnatal factors such as inadequate diet, socioeconomic conditions, sanitation, and exposure to infectious diseases also play a major role in determining the nutritional status of toddlers, so that nutritional problems are not only influenced by birth conditions, but also by the interaction of various environmental and health factors (Hossain et al., 2020).

Characteristics of Parents

The level of education of the father plays an important role in determining knowledge and understanding related to nutrition, because higher education generally provides better access to health information. Research by Rukmana et al., (2016) showed that fathers with low education levels had a 1.807 times greater risk of having a *stunted* child. Similar findings were reported by (Wijhati et al., 2021) who stated that paternal education was significantly related to the nutritional status of toddlers ($p=0.019$). Better education helps parents absorb information about their diet, food

safety, and nutritional needs during their growing years.

Maternal education is also an important factor in children's growth and development because mothers play a direct role in nurturing, food selection, and providing daily nutritional intake. (Fajrina & Syaifudin, 2016) research showed that mothers with low education had a 3.777 times higher risk of having stunted children (Wijhati et al., 2021) also reported that the mother's education level was related to the nutritional status of toddlers ($p=0.042$), where mothers with higher education tended to have a better understanding of children's health and nutrition, including the importance of dietary variation, proper complementary feeding, and prevention of infectious diseases.

In addition to parental education, gestational age also affects the nutritional status of children. Pregnancy at the age of <20 years or >35 years is classified as risky because it is related to the mother's physical and mental readiness, as well as the function of the reproductive organs that are not optimal or have begun to decline. Research by (Pusmaika et al., 2021) found that mothers who become pregnant at risk age have a 2.73 times higher chance of giving birth to a stunted child. In addition, Ernawati (2018) revealed that mothers who become pregnant at too young or too old have a risk of 4,089 times experiencing CED. At a young age, the mother's nutritional needs are still high for her own growth, while in old age there is a decrease in metabolic function so that the absorption of nutrients is less than optimal (Fitri et al., 2022). This condition has the potential to interfere with fetal nutrition fulfillment and have an impact on the growth of the child in the future.

Family income is an important factor that affects the ability of parents to meet basic needs, including fulfilling adequate nutrition for children. Low incomes limit the availability of nutritious food both in terms of quality and quantity. This is in line with (Yanti, 2023) research which reported the relationship between family income and stunting incidence ($p=0.033$). Research by Mutika & Syamsul (2018) also shows that family income is significantly related to the nutritional status of toddlers ($p=0.000$), where limited family purchasing power is at risk of causing insufficient intake of energy, protein, and important micronutrients for children. Low family income can be one of the factors causing nutritional problems in toddlers, including dual nutrition problems.

Maternal Nutritional Status During Pregnancy

Maternal nutritional status during pregnancy can be one of the factors related to the risk of nutritional problems in toddlers because maternal nutritional status during pregnancy is related to the mother's daily nutritional intake. Poor nutritional intake of pregnant women can affect the insufficient supply of nutrients in the fetus so that it can affect the growth and development of the fetus. This is in line with research conducted by (Zeffira et al., 2022) stating that mothers who have a history of pregnancy experiencing CED have the potential to give birth to babies with LBW who are later at risk of experiencing stunting nutritional problems. Another study by Owa et al., (2017) revealed that the condition of CED during pregnancy can increase the risk of giving birth to children with LBW (AOR=5.3). This can be caused because mothers who experience CED mean that they have experienced malnutrition for a long time so that the nutritional needs for the fetal growth and development process are hampered and the mother is at risk of giving birth to babies with LBW (Jannah & Nadimin, 2021)

History of Exclusive Breastfeeding in Toddlers

Exclusive breastfeeding is breast milk that is given to babies from birth to six months without replacing or supplementing it with other food ingredients (Wijaya,

2019), EBF is the best source of food for babies during the first six months of life because it contains all nutrients such as lactose, protein in the form of casein and whey, essential fatty acids, vitamins, minerals, and natural antibodies needed for the growth and development of children and can help increase the baby's immunity (Susetyowati, 2016). In this study, toddlers who received EBF still experienced DBM. This shows that even though toddlers are given EBF for the first six months, breastfeeding is not always enough to prevent nutritional problems in the future because nutritional problems in toddlers can be caused by other factors such as dietary intake factors, environment, sanitation, and disease history. The results of this study are supported by research by (Hamid et al., 2020) which revealed that EBF is not related to nutritional status according to the weight-for-age indicator, but based on the weight-for-length indicator, exclusive breastfeeding has a relationship with nutritional status. This is due to the presence of other variable factors such as the nutritional status of the mother and other factors that affect the nutritional status of toddlers.

History of Complementary Feeding in Toddlers

Complementary Feeding (CF) is a food given to babies after six months of age accompanied by breastfeeding. CF is given because breast milk can no longer meet the nutritional needs of babies. CF is given with the aim of meeting the nutritional needs of babies, developing the baby's ability to receive various kinds of food with various flavors and textures to be able to accept family food, and developing the baby's oromotor skills in chewing and swallowing food (Rahmawati et al., 2020). Early CF before the age of six months can affect the digestive system of toddlers who are not fully able to digest food and can cause the risk of infection due to unhygienic feeding so that it has an impact on the nutritional status of toddlers. This study is in line with research conducted by (Saleh et al., 2022) that the CF has a relationship with nutritional status. The study also revealed that babies given early CF had a poor nutritional status with a percentage of 48.5%. This is because babies who are less than six months old have not fully matured their digestive tract so they are not ready to be given CF.

The long-term consequences of poor nutritional status due to early CF can have an impact on a person's health until adulthood. Research conducted by (Wang et al., 2016) revealed that early CF may increase the risk of overweight or obesity later in life. This is related to increased calorie and protein intake in infancy, which can be a predictor of weight gain and a greater percentage of body fat in childhood. In addition, early CF can also interfere with the development of the gut microbiome which plays a role in metabolic regulation so that it raises the risk of metabolic diseases. Another study by (Ong et al., 2023) explains that early introduction of CF has an impact on infant weight gain, causing an increase in the child's body adiposity, which is a common cause of cardiometabolic diseases such as type 2 diabetes and cardiovascular later in life.

Risk Factors that Cause Malnutrition

Macronutrients including proteins, fats, and carbohydrates play an important role in supporting children's growth and development. Protein functions in the formation of body tissues and supports essential metabolic processes. Protein deficiency often occurs in conjunction with a deficit of energy and other nutrients, increasing the risk of growth disorders and nutritional problems (Soumokil, 2017). Fat also plays a strategic role as a source of solid energy, a protector of vital organs, and an important component in hormone synthesis (Doloksaribu, 2016). Fat deficit can have an impact

on impaired immunity, skin, and tissue healing processes (Mogensen, 2017). Because fat helps the absorption of vitamins A, D, E, and K, lack of fat intake can worsen vitamin deficiencies and affect children's growth and development (Ernawati et al., 2019). Carbohydrates function as the main source of energy that allows the body to save on the use of protein and fat for other metabolic purposes (Adi, 2016). Imbalance in carbohydrate intake can have an impact on the growth process and body composition of children (Baculu, 2017).

In addition to macronutrients, the fulfillment of micronutrients such as iron, calcium, and zinc plays a major role in supporting children's growth and development (Talpur et al., 2018). Iron is necessary for the formation of hemoglobin and various enzymatic reactions (Animasahun & Itiola, 2021), while its deficiency can affect a child's immunity and psychological development (Mutumba et al., 2023). Calcium plays a role in bone growth, muscle contraction, and blood clotting (Darawati, 2016), while its deficit can lead to impaired bone growth (Shlisky et al., 2022). Zinc has functions on linear growth, neurological development, and immunity, and is often low in children in developing countries (Allai et al., 2021; Monge et al., 2021).

In addition to consumption factors, environmental sanitation is an important determinant of children's nutritional status. Basic sanitation facilities such as proper bathrooms can help reduce the risk of fecal contamination in the home environment and prevent the occurrence of infectious diseases, especially diarrhea, which can interfere with nutrient absorption (Hussain & Biswas, 2024; Aisah et al., 2019). Poor sanitation increases exposure to pathogens and increases the risk of health problems related to nutritional status. The existence of septic tanks, dishwasher facilities, and home ventilation also play an important role in creating a healthy environment. The absence of septic tanks increases the risk of water pollution and the transmission of infectious diseases (Fithra & Siska, 2020; Khan et al., 2021). Inadequate dishwashers can be a source of microbiological contamination that impacts children's health (Deng & Setiarini, 2022; Evans & Redmond, 2019). Meanwhile, good ventilation helps maintain air circulation, suppresses the growth of bacteria and fungi, and reduces the risk of respiratory tract infections that can affect the nutritional status of toddlers (Sinaga et al., 2016).

Double Burden of Malnutrition in Toddlers

Double Burden of Malnutrition (DBM) are a multifactorial condition in which various factors contribute to the emergence of multiple nutrition problems. This condition can have a significant impact on children's health in the long term, especially related to growth, development, and quality of life in the future. Toddlers who experience DBM are at risk of facing linear growth disorders that can continue into adulthood, so their height tends to be lower than that of children their age. The growth disorder is also associated with other consequences such as decreased cognitive ability, reduced productivity, and an increased risk of chronic diseases in adulthood.

In addition, DBM in children can affect the structure and function of the body's organs, including the cardiovascular system. An imbalance in the intake of macro and micronutrients in the long term can interfere with organ development, thus affecting the function of the heart and blood vessels. The risk of developing non-communicable diseases such as type 2 diabetes, hypertension, and cardiometabolic disease can increase if an unhealthy diet and lack of physical activity continue from childhood. DBM not only impact current conditions, but also have the potential to trigger long-term health problems that arise in adulthood.

Risk of Acute Myocardial Infarction in Adulthood

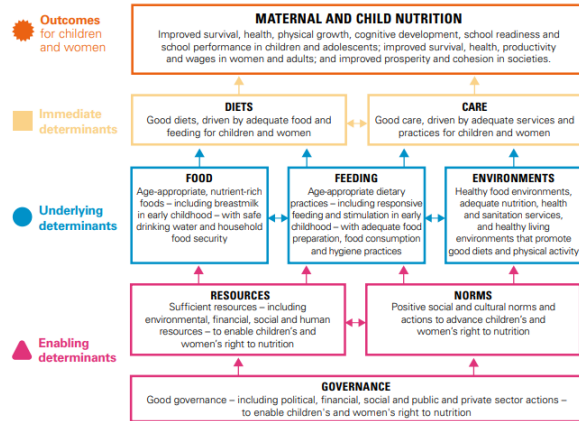


Figure 4. UNICEF's conceptual framework on maternal and child nutrition determinants

Acute Myocardial Infarction (AMI) is one of the cardiovascular diseases with high morbidity and mortality, which is characterized by necrosis of myocardial tissue due to a disturbance of the balance between supply and oxygen needs in the heart. The imbalance is generally triggered by coronary artery blockage or spasm, blood abnormalities, or circulatory changes that cause decreased blood flow to the myocardial (Mythili & Malathi, 2015; Sofiah & Roswah, 2022). Risk factors for AMI include irreversible determinants such as age, sex, race, and hereditary factors, as well as modifiable determinants such as unhealthy diet, smoking, alcohol consumption, obesity, lack of physical activity, and the presence of non-communicable diseases such as hypertension and diabetes mellitus (Budiman et al., 2015). These factors do not appear suddenly, but are influenced by a long process that is interrelated and in accordance with UNICEF's conceptual framework on maternal and child nutrition determinants, which emphasizes the role of direct, indirect, and supporting determinants in shaping long-term nutritional and health status.

Nutritional problems in toddlers have a great influence on the development of organs and cardiovascular systems, so it can increase the risk of AMI in adulthood. Nutritional deficiencies such as stunting and wasting can cause permanent changes in the structure and function of organs including the heart and blood vessels, leading to a decrease in heart muscle mass, metabolic disorders, increased blood pressure, insulin resistance, as well as lipid profile imbalances that contribute to the formation of atherosclerotic plaques (Pereira et al., 2023; Lestari et al., 2023; Samikannu & Palanivelu, 2019). Meanwhile, obesity in toddlers increases the tendency for fat buildup in the coronary arteries which can narrow blood vessels and trigger future AMI (Çelik, 2019). In conditions of dual nutritional problems, the physiological impact on heart health becomes heavier due to the synergistic effects of both conditions, so that children have a higher risk of developing cardiometabolic disorders including AMI in the future. This suggests that nutritional problems in early life not only affect current growth, but also determine susceptibility to severe cardiovascular disease throughout the life cycle.

CONCLUSIONS AND SUGGESTIONS

Research at the UPTD Cilembang Health Center in Tasikmalaya City shows that dual nutrition problems in toddlers are a complex and multifactorial health condition, with the results of the study on 107 toddlers noting that 66% of them experienced a combination of short nutrition and poor nutrition. These conditions have short- and long-term health impacts, including an increased risk of non-communicable diseases such as acute myocardial infarction in adulthood due to permanent changes in the

structure and function of organs, especially the heart and blood vessels. Recommended prevention efforts include improving the nutrition of pregnant women, intensive nutrition education for the elderly, comprehensive nutrition interventions through counseling and supplementary feeding, routine nutrition monitoring, and improving environmental and sanitation quality.

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