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Clinical Chemistry Biomarker Profiles of Mothers with Stunted Children in Bone Bolango Regency

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ABSTRACT / ABSTRAK

Maternal nutritional status plays a crucial role in child health and development, particularly in relation to stunting. This study aimed to describe the biochemical nutritional profile—including total protein, albumin, globulin, and lipid levels—of mothers with stunted children in Bone Bolango Regency. A descriptive design was employed with 26 mother-child pairs (aged 2–4 years) from Ayula Selatan and Dunggala Villages in September 2024. Blood samples were analyzed at the Integrated Health Laboratory of FSTIK UBMG. The mean values of maternal biomarkers were: total protein (4.5 g/dL), albumin (3.0 g/dL), globulin (1.5 g/dL), total cholesterol (202 mg/dL), triglycerides (165 mg/dL), HDL (63 mg/dL), and LDL (106 mg/dL). These findings suggest that suboptimal maternal biochemical nutritional status may contribute to the risk of stunting in children.

INTRODUCTION

According to the World Health Organization (WHO), undernutrition is grouped into four, namely wasting, stunting, underweight, and micronutrient deficiencies. Based on reports from the Indonesian Ministry of Health and the World Health Organization (WHO), the prevalence of toddlers who are malnourished or vulnerable to malnutrition is still quite high in Indonesia. This condition is caused by various factors, such as lack of nutritious food intake, limited access to healthy food, and lack of nutrition education at the community level. Toddlers who are vulnerable to malnutrition are at risk of experiencing growth disorders, suboptimal cognitive development, decreased immunity, and increased risk of chronic diseases in the future (Annisa Nuradhiani 2023).

Indonesia ranks fifth in the world for stunting, a condition caused by chronic lack of adequate nutrition, from infancy to birth. Stunting, which indicates stunted growth, has the potential to increase the risk of morbidity, mortality, and poor brain development, which can ultimately lead to motor delays and mental retardation. According to data from the World Health Organization (WHO), in 2018, Indonesia ranked third highest and until 2020 became the second highest in stunting cases in the Southeast Asia region, with a prevalence in toddlers

reaching 36.4% in 2017, which then decreased to 30.8% in 2018 (Azriful et al. 2018; Sucipto et al. 2021; Veronica, Ambrosius Purba & Anita Deborah Anwar 2021)

Based on data from the 2022 Indonesian Nutritional Status Survey (SSGI), the prevalence rate (cases) of stunting in Gorontalo Province is still above the threshold set by WHO, which is 23.8% and has the highest percentage in Indonesia. Of the 5 districts in Gorontalo Province, the highest cases of stunting are in Gorontalo Regency with a total of 30.8% (Kebijakan, Kesehatan & Ri 2022).

Child growth is closely related to protein intake. Children's protein needs include tissue maintenance, changes in body composition, and the formation of new tissue. The effect of protein on growth is related to the amount of growth hormone synthesized by protein, so the more growth hormone synthesized by protein, the better the height growth will be [7]. According to Safira's 2024 research, one of the causes of stunting is a chronic lack of protein nutrition (under nutrition) (Safira, Delfian, et al. 2024).

Protein intake can stimulate albumin formation in the liver. Reduction in protein consumption slows down albumin mRNA synthesis which causes low albumin levels. Liver cells secrete albumin normally when protein intake is sufficient. Albumin synthesis in the liver requires a sufficient supply of amino acid components and is activated by binding to tRNA. Albumin synthesis is very responsive to the entry or input of amino acids, especially those from food. Previous studies also showed that if protein intake increases, albumin formation also increases. Albumin synthesis can only be synthesized if there are appropriate nutrients, hormones, and osmotic environments. Colloid osmotic pressure of hepatocyte interstitial fluid is the most important for regulating albumin synthesis. The main factors that affect albumin synthesis are protein-containing food intake, colloid osmotic pressure, the action of certain hormones (eg thyroid hormone and glucocorticoid hormone). Factors that cause decreased albumin levels are protein deficiency, energy deficiency, zinc deficiency, infection and liver disorders (Irna, Sitorus & Flora 2023).

Total protein levels are a real condition of protein status in the body. Lack of consumption of foods containing protein can reduce total protein levels. Pregnant women have sufficient protein intake, but most of the protein sources consumed come from vegetable protein so that it does not affect total protein levels in the body. Other factors that affect total protein levels are body weight, age, growth, hormones, gestational age, nutrition, stress, and fluid loss. The way food is processed is also closely related to the nutritional content of food. Food processing techniques do not cause food to lose a lot of protein, but the temperature in the food processing process affects the structure and amount of protein. Processing chicken meat at a temperature of 40 degrees Celsius will reduce the amount of protein by 9.7%. Cooking temperatures of up to 70-80 degrees Celsius can cause changes in protein shape, resulting in shrinkage and loss of moisture (Dwifitri et al. 2022). This study aims to describe the profile of total protein, albumin, globulin, and lipid profile in mothers with stunted children in Bone Bolango Regency, to understand more about these factors that may contribute to the incidence of stunting.

METHODS

This study uses a quantitative descriptive approach to provide an overview of the total protein profile, albumin, globulin, and lipid profile of mothers with stunted children in Bone Bolango Regency. The population in the study were mothers with stunted children in Bone Bolango Regency. With a sample size of 26 mothers and children (2-4 years). This study was conducted in two villages in Bone Bolango Regency, namely Ayula Selatan Village and Dunggala Village in September 2024. Biomarker analysis was carried out at the Integrated Health Laboratory of the Faculty of Science, Technology and Health Sciences, Bina Mandiri University, Gorontalo.

RESULTS

Table 1. Characteristics of Mother

Characteristics		n	%
Age (years)	15 – 30	16	61,5
	31 – 60	10	38,5
Education Level	Primary School	9	34,0
	Junior High School	8	31,0
	High School	8	31,0
	University	1	4,0
Employment Status	Employed	2	7,7
	Unemployed	24	92,3
Body Mass Index (BMI)	Normal	4	15,0
	Underweight	1	4,0
	Overweight	2	8,0
	Obesity Class I	14	54,0
	Obesity Class II	5	19,0

Source: Primary Data, 2024

Table 1 shows the distribution of respondents' ages aged 15-30 years totaling 16 respondents and respondents aged 31-60 years totaling 10 respondents. In Education, more respondents have elementary school education with a total of 9 respondents and the least Education is Bachelor's Degree with a total of 1 respondent. And for work, most respondents do not have jobs with a total of 24 respondents. Respondents who have Normal BMI are 4 respondents, Underweight is 1 respondent, overweight is 2 respondents, obesity I is 14 respondents and obesity level two is 5 respondents.

Table 2 shows the distribution of total protein levels in mothers who have stunted children, totaling 2 people with normal total protein levels and 24 mothers who have total protein levels below the ideal reference range. The average total protein level in mothers with stunted children is 4.5 g/dL, below the ideal reference range, which is 6.6-7.8 g/dL. Albumin levels in mothers of stunted toddlers totaling 4 people have normal albumin levels. The average albumin level was recorded at 3.0 g/dL, also below the normal reference range which ranges from 3.81-4.65 g/dL. All mothers who have stunted toddlers have abnormal Globulin levels. The average globulin level was found to be 1.5 g/dL, which is below the normal range of 2.8-3.2

g/dL. Total cholesterol levels in mothers of stunted toddlers totaling 12 people in the normal category, and 14 people had abnormal total cholesterol levels. The average total cholesterol level was 202 mg/dL, slightly above the normal limit (<200 mg/dL). There were 16 mothers of stunted toddlers who had normal triglyceride levels and 10 mothers had abnormal triglyceride levels. The average triglyceride level was 165 mg/dL, slightly higher than the established normal limit (<150 mg/dL). The average HDL level was recorded at 63 mg/dL, above the recommended normal limit (>60 mg/dL). There were 18 respondents who had normal LDL levels and 8 respondents had abnormal HDL levels. There were 14 mothers of toddlers who had normal LDL levels and 12 who did not have abnormal LDL. The average LDL level was 106 mg/dL, above the normal limit (<100 mg/dL).

Table 2. Maternal Clinical Biochemistry Parameters

Maternal Clinical Biochemistry Parameters	Normal		Abnormal	
	n	%	n	%
Total Protein Level	2	7,7	24	92,3
Albumin Level	4	15,4	22	84,6
Globulin Level	0	0	26	100
Total Cholesterol Level	12	46,2	14	53,8
Triglyceride Level	16	61,5	10	38,5
High-Density Lipoprotein (HDL) Level	18	69,2	8	30,8
Low-Density Lipoprotein (LDL) Level	14	53,8	12	46,2

Source: Primary Data, 2024

DISCUSSION

Based on the research findings, out of 26 participating mothers, 16 (68%) were between 15–30 years of age, while 10 (32%) were between 31–60 years. Regarding educational background, 9 mothers (34%) had completed elementary school, 8 (31%) had completed junior high school, another 8 (31%) had completed high school, and only 1 (4%) held a bachelor's degree. In terms of employment status, only 2 mothers (8%) had formal jobs, while the remaining 24 (92%) were full-time housewives.

According to the National Population and Family Planning Board (BKKBN), the recommended minimum age for women to marry is 21 years. However, this study found that most mothers of stunted children married between 15–30 years of age. Early marriage is strongly associated with a higher risk of stunting in children, potentially due to the mother's limited knowledge, skills, and psychological readiness, which may adversely impact child-rearing practices (Indriyati, Hairani, & Fakhrizal, 2018). This finding is consistent with Afriani (2022), who emphasized that stunting—defined as height-for-age below the standard—is a manifestation of chronic nutritional deficiencies influenced by maternal health, the prenatal period, and early childhood care. Children born to adolescent mothers face a higher risk of malnutrition due to poor parenting practices and inadequate nutritional knowledge (Afriani & Urwatil Wusqa, 2022).

Maternal education is another key determinant of child health. Mothers play a central role in shaping dietary habits, given their responsibility for meal preparation and food selection. Research indicates that mothers with secondary or higher education demonstrate

better parenting practices and make healthier dietary choices for their children, owing to greater access to health and nutrition information (Rahayu et al., 2014). Salsabilah (2022) also highlighted that individuals with lower educational attainment face challenges in receiving and applying nutrition-related information. Higher maternal education contributes to greater receptivity to nutritional knowledge, resulting in healthier dietary behaviors and improved child nutrition (Ainin, Ariyanto, & Kinanthi, 2023). Similarly, Ainin (2023) found that maternal education influences health behaviors and decision-making related to family nutrition, particularly in food quality and adequacy (Salsabila et al., 2022).

Employment status is another maternal factor associated with child stunting. Aldy (2022) reported that employed mothers may have limited time to provide adequate child care, potentially compromising nutritional outcomes. In contrast, Holbala (2022) noted no significant association between maternal employment and stunting. While unemployed mothers may have more time for caregiving, limited economic resources can still negatively impact child nutrition (Holbala, Nur, & Boeky, 2022; Ardini, 2023).

Age classification based on the Indonesian Ministry of Health (2029) categorizes 12–16 years as early adolescence and 17–25 years as late adolescence. Women of reproductive age fall between 15–49 years; however, the optimal reproductive window is 20–35 years (BKKBN, 2016). Adolescents must maintain adequate nutritional status before pregnancy to ensure healthy offspring. Nutritional deficiencies in adolescent girls can impair hypothalamic function, disrupting the release of FSH and LH. Conversely, overnutrition can lead to increased estrogen levels due to excess body fat (Ardini, 2023; Khairani & Ningsih, 2024).

Maternal nutritional status during pregnancy plays a critical role in fetal development. Pregnant women who are healthy and free from nutritional deficiencies are more likely to give birth to healthier infants (Khairani & Ningsih, 2024). In this study, the average total protein level among mothers of stunted children was 4.5 g/dL, which falls below the ideal reference range of 6.6–7.8 g/dL. This may reflect poor nutritional intake, which affects both breast milk quality and child growth. Elevated maternal total cholesterol levels (>200 mg/dL) also suggest dietary imbalance, potentially affecting both maternal nutritional status and the quality of breast milk (Bulu, Jutomo, & Riwu, 2022).

Protein intake plays a key role in growth. According to Rszky et al., insufficient protein consumption increases the likelihood of stunting by 1.6 times. Protein, as a macronutrient, is vital for child growth (Kaneko et al., 2022). In this study, the average albumin level was 3.0 g/dL, below the normal range of 3.81–4.65 g/dL. Although albumin levels are typically maintained through physiological adaptation, consistently low protein intake may impair albumin synthesis, impacting nutrient transport and overall development (Putri et al., 2022). Safitri & Gayatri (2022) also demonstrated a significant correlation between low albumin and inadequate protein intake among pregnant women.

The mean globulin level was 1.5 g/dL, lower than the normal range of 2.8–3.2 g/dL. Globulin comprises various proteins including immunoglobulins and enzymes. Reduced globulin levels may indicate malnutrition, congenital immunodeficiency, or protein loss through renal mechanisms (Safira, Dalfian, et al., 2024).

Total cholesterol averaged 202 mg/dL, slightly exceeding the recommended upper limit (<200 mg/dL). An imbalanced diet in mothers may reduce breast milk quality and affect child growth (Bulu et al., 2022). Both excessive and insufficient cholesterol can be harmful. Low

cholesterol may reflect micronutrient deficiencies and contribute to low birth weight, while excessive fat intake during pregnancy may influence long-term adiposity and metabolic diseases in offspring (Kaneko et al., 2022).

The mean triglyceride level was 165 mg/dL, exceeding the normal limit (<150 mg/dL). Elevated triglycerides may indicate metabolic disturbances such as insulin resistance. Various factors—diet, genetics, stress, liver function—can influence triglyceride levels. Hypertriglyceridemia is a known risk factor for cardiovascular and metabolic diseases (Salim, Wihandani, & Dewi, 2021).

HDL cholesterol averaged 63 mg/dL, exceeding the recommended threshold (>60 mg/dL), which is favorable for cardiovascular health. LDL cholesterol averaged 106 mg/dL, slightly above the ideal limit (<100 mg/dL). While high HDL is protective, elevated LDL may indicate dietary risks. An imbalance in lipid profile, including high saturated fat and cholesterol intake, combined with obesity and physical inactivity, can increase cardiovascular and nutritional risks in mothers (Bulu et al., 2022; Salim et al., 2021).

CONCLUSION

Overall, the results of the study indicate a tendency that maternal nutritional status as measured by clinical chemistry biomarker profiles can affect the incidence of stunting in children. Low levels of total protein, albumin, and globulin, as well as slightly high triglyceride levels, indicate the possibility of maternal malnutrition which has the potential to affect the quality of breast milk and child growth. Targeted nutritional interventions to improve maternal nutritional status, including increasing protein intake and monitoring lipid profiles, are needed to address the problem of stunting in children.

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