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Maternal determinants of stunting: findings from a cross-sectional study in Padang, Indonesia

Marzatia Yulika[1], Nur Afrainin Syah[2]*, Yusrawati Yusrawati[3]

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[1]Masters of Midwifery Study Program, Faculty of Medicine, Universitas Andalas, West Sumatra, Indonesia

[2]Department of Medical Education, Faculty of Medicine Universitas Andalas, West Sumatra, Indonesia

[3]Department of Obstetrics and Gynecology, Faculty of Medicine, Universitas Andalas, West Sumatra, Indonesia

***Correspondence:**
nur@med.unand.ac.id

Abstract

Purpose: This study aims to investigate the influence of maternal factors on stunting in young children aged 24-59 months. **Methods:** This analytical cross-sectional study was conducted in a subdistrict of Padang. The dependent variable was stunting, and the independent variables were maternal factors. The sample number was 155, and it was collected using stratified and consecutive sampling techniques. Chi-square and logistic regression were applied in data analysis. **Results:** The study reveals no significant difference between stunted and non-stunted under-five children in terms of the following maternal factors: age at pregnancy, body mass index (BMI), gestational age, upper arm circumference, height, and education. However, both groups showed a significant difference in terms of the number of children (p = 0.041), parenting style (p = 0.006), and knowledge (p = 0.039). Logistic regression analysis showed that mothers who had poor parenting styles had a 3.186 times higher risk of having children with stunting compared to mothers who had good parenting styles (95% CI: 1.382-7.348). **Conclusion:** The mother's parenting style was the most influential factor in the incidence of stunting among children in Padang City. More effective preventive and intervention measures to overcome the problem of stunting need to pay attention to maternal parenting style, knowledge, and the number of children.

Keywords: maternal factors; maternal knowledge; number of children; parenting styles; stunting

INTRODUCTION

Stunting is a condition where a child's growth is disturbed, so their height does not match their age. Stunting is measured based on the height-for-age index with a z-score of less than -2 Standard Deviations (SD). According to the World Health Organization (WHO), stunting is a chronic health problem if the prevalence is 20% or more. Globally, the incidence of stunting has reached 22.3%, affecting 148.1 million children under five years old. In 2022, 52% came from Asia, and 43% came from Africa. Between 2000 and 2022, the prevalence of stunting in children under five years decreased from 33% to 22.3%, or from 206.4 million to 148.1 million. However, the decrease was much slower in Africa and Southeast Asia [1,2].

The incidence of stunting is a major nutritional problem facing Indonesia. The incidence of stunting in Indonesia in 2022 is 21.6%, which is higher than the WHO limit of 20%. In West Sumatra, the stunting rate increased to 25.2%, a 1.9% rise from 2021. The incidence of stunting also increased in the capital city of West Sumatra, Padang, from 18.9% in 2021 to 19.5%

in 2022. The Indonesian government aims for the prevalence of stunting in Indonesia to decline to 14% by 2024 [3].

Stunting has both immediate and long-term effects, including poor child development and learning capacity, as well as increased morbidity and mortality due to infections and non-communicable diseases such as diabetes, hypertension, and dyslipidemia. Stunted children are more susceptible to accumulating fat, particularly in the central region of the body, as well as lower fat oxidation and energy expenditure, and insulin resistance. This, in turn, increases the risk of becoming overweight or obese later. In females, stunting also affects maternal reproductive outcomes in adulthood [4,5]

The mother's role in the child's growth and development is vital, starting from the preconception, prenatal, and baby-toddler phases. This role is essential because failure to thrive can affect the baby's life in adulthood [6]. The time from conception to the first two years of life is a critical period during which the detrimental effects of malnutrition can be avoided. The first 1,000 days of a child's life are a crucial opportunity to improve their nutritional status. A mother is often the primary caregiver for babies and children. To some extent, the baby's health and well-being depend on the mother's health and well-being [7].

Previous studies identified maternal factors that cause stunting, including poor nutrition during preconception, pregnancy, and breastfeeding, short stature in the mother, infection, early pregnancy, mental health, history of IUGR (Intra Uterine Growth Restriction), preterm birth, short birth spacing, and hypertension [6,8,9]. Other studies found that mothers' education, age, economic status, maternal hemoglobin, maternal Body Mass Index (BMI), birth weight, and birth interval are significant factors in the incidence of stunting in India and several other developing countries such as Pakistan, Ethiopia, Nepal, Myanmar, and Bangladesh [10].

Many factors contribute to stunting, including both maternal and non-maternal factors, but these factors vary from region to region. Some previous studies in Padang that examined factors related to stunting showed inconsistent findings across different subdistricts, involving both maternal and non-maternal factors [11-13]. We conducted a study in a different area to confirm these conflicting results. Our study focused only on maternal factors and added parenting patterns that have not been widely studied.

Many maternal factors influence the incidence of stunting, and many of these factors can be prevented. Considering the long-term effects that can result from stunting, effective prevention is the best option. Understanding these factors can help in developing targeted prevention and management steps. If improvements in maternal services are the most important determining factor in reducing children's stunting, then identifying which maternal factors should be prioritised is an essential step in developing more feasible intervention policies. Therefore, this study aims to determine the most critical maternal factors associated with stunting and measure the influence of these main factors in Padang.

METHODS

This was a community-based, cross-sectional study that applied an observational, analytical approach. The research was conducted in Lubuk Begalung, Padang, West Sumatra, in 2023. Lubuk Begalung was the area with the highest increase in stunting incidence (2.7%), compared to the average rise of 0.6% in Padang City, according to the 2023 health data for Padang. The sample was selected using a proportional stratified sampling method from five villages in the Lubuk Begalung area to ensure accurate representation. Subsequently, a consecutive sampling was employed. The sample consisted of mothers with toddlers aged 24 to 59 months living in the Pegambiran Health Center working area, Lubuk Begalung District, who were willing to be research respondents, could communicate verbally and non-verbally, and had complete data on their pregnancy examination history in the Mother and Child Health (KIA) book. Initially, 160 participants were included in the study. However, only 155 participants were included in this research after checking for data accuracy and completeness.

Trained enumerators collected data using questionnaires. The questionnaires had been tested for validity and reliability. The questionnaire covered participants' socio-demographic characteristics, their health history, maternal knowledge, and maternal parenting style. The Mother and Child Health (KIA) Books were also examined to verify the maternal health history. The enumerators and researchers cross-checked each questionnaire after it had been filled in.

The dependent variable in this study was the nutritional status of the participants' toddlers, specifically whether they were stunted or not, measured using Height-for-Age Z-scores (HAZ). Enumerators measured the height of toddlers using a standing approach with a microtoise. The independent variables consisted of the mother's age at pregnancy, Body Mass Index (BMI), height, gestational age, upper arm circumference, number of children, maternal

parenting style, maternal knowledge, mother's level of education, and mother's occupation.

The mother's age during pregnancy was identified in the Maternal and Child Health Book (KIA Book) and was grouped into under 20 years, 20–34 years, and over 35 years. The mother's Body Mass Index (BMI) was obtained from the KIA book and was categorized as underweight (less than 18.5 kg/m²), normal weight (18.5–24.9 kg/m²), or overweight (25 kg/m² or greater).

Measurement of the mother's height during pregnancy was also recorded in the KIA Book and was categorised as <150 cm and ≥150 cm. Gestational age at delivery was measured based on interviews and records in the KIA Book, with categories <37 weeks and ≥37 weeks. The mother's upper arm circumference during pregnancy was listed in the KIA book as a sign of nutritional status, with limits of undernutrition (less than 23.5 cm) and normal (greater than or equal to 23.5 cm).

The number of living children owned by the mother was obtained through interviews and grouped into' three children or fewer' and 'three children or more'. The mother's parenting style in caring for children was assessed through a questionnaire and categorized as good or bad. Mothers' knowledge of stunting and toddler nutrition was measured based on questionnaire scores, with results lower than average considered poor and higher than average considered good. We asked about definitions, signs and symptoms, causes, influential factors, impact, and management of stunting. Mothers' education level was divided into two groups, namely low (no school, elementary school, junior high school) and high (high school and university). Mothers' occupations were categorized based on their involvement in economic activities, specifically whether they worked or were housewives.

Data analysis was conducted using IBM SPSS Statistics 23.0 software. Data analysis included chi-square statistical tests to examine hypotheses related to the relationship between independent and dependent variables. Furthermore, multivariate analysis was performed using logistic regression. Bivariate logistic regression analysis was used to investigate the relationship between the dependent variable and each independent variable. All covariates with a p-value of less than 0.25 in the bivariate analysis were considered for multivariate analysis to control for all possible confounders and to identify predictors of stunting. Multicollinearity among independent variables was checked by examining standard error values and correlation coefficients. The final binary logistic regression model excluded variables with standard errors greater than two and correlation coefficients of more than 50%. Model goodness of fit was tested using the Hosmer-Lemeshow goodness-of-fit test, which yielded a p-value of 0.631, indicating that the model was suitable for the data. Odd ratios with 95% confidence intervals were estimated to measure the strength of the relationships. The level of statistical significance was set at a p-value less than 0.05.

RESULTS

Table 1 shows that 28.4% of toddlers (44 children) experienced stunting. The majority of respondents were between 20-34 years old at pregnancy (84.5%), had a normal BMI (66.5%), were taller than 150 cm (83.9%), had a full-term pregnancy (94.8%), had a normal upper arm circumference (89%), and had less than three children (65.8%). Most of them were not working or housewives (89.7%). More than half of the respondents had a poor parenting style (58.7%) and poor knowledge (51.6%), despite 82.6% having completed high school or higher education.

Table 1. Characteristics of respondents (n=155)

Characteristics of respondents	n (%)
Stunting children	
Yes	44 (28.4)
No	111 (71.6)
Mother's age at pregnancy (years)	
< 20	3 (1.9)
20 – 34	131 (84.5)
≥ 35	21 (13.5)
Mothers' BMI	
Underweight	13 (8.4)
Healthy weight	103 (66.5)
Overweight	39 (25.2)
Mothers' height (cm)	
<150	25 (16.1)
≥ 150	130 (83.9)
Gestational age(weeks)	
<37	8 (5.2)
≥37	147 (94.8)
Upper arm circumference (cm)	
<23	17 (11)
≥23	138 (89)
Number of children	
<3	102 (65.8)
≥3	53 (34.2)
Maternal parenting styles	
Poor	91 (58.7)
Good	64 (41.3)
Maternal knowledge	
Poor	80 (51.6)
Good	75 (48.4)
Mother's level of education	
Low	27 (17.4)
High	128 (82.6)
Mothers' occupation	
Employed	16 (10.3)
Housekeeper	139 (89.7)

Table 2 shows that both groups (mothers with normal toddlers and mothers with stunting toddlers) did not have significant differences in maternal age at pregnancy, body mass index (BMI), maternal height, gestational age, upper arm circumference, maternal education, and occupation. However, both groups showed significant differences in terms of the number of children (p=0.041), maternal parenting style (p=0.006), and maternal knowledge (p=0.039). Among those with stunting children, 47.7% of respondents had three children or more, while in the normal toddler group, only 28.8% of mothers had three children or more. Furthermore, mothers with poor parenting styles were more prevalent in the stunting group (77.3%) compared to the normal group, and more than half of the children with stunting (65.9%) had mothers with poor knowledge.

Table 2. Bivariate analysis of mothers' characteristics on the incidence of stunting

Respondent characteristics	Normal	Stunting	p-value	OR (95% CI)
	n (%)	n (%)		
Age at pregnancy (years)				
< 20	2 (1.8)	1 (2.3)	0.847	1.270 (0.112-14.435)
20 – 34	94 (84.7)	37 (84.1)	-	Reference
≥ 35	15 (13.5)	6 (13.6)	0.975	1.016 (0.366-2.819)
Mothers' BMI				
Underweight	11 (9,9)	2 (4.5)	0.337	0.464 (0.097-2.223)
Healthy weight	74 (66.7)	29 (65.9)	-	Reference
Overweight	26 (23.4)	13 (29`5)	0.547	1.276 (578-2.817)
Mother's height (cm)				
<150	14 (12.6)	11 (25)	0.099	2.310 (0.955-5.585)
≥ 150	97 (87.4)	33 (75.5)		
Gestational age (weeks)				
<37	5 (4.5)	3 (6.8)	0,689	1,551 (0,355 – 6,788)
≥37	106 (95.5)	41 (93.2)		
Upper arm circumference (cm)				
<23	11 (9.9)	6 (13.6)	0,570	1,435 (0,496 – 4,154)
≥23	100 (90.1)	38 (86.4)		
Number of children				
<3	79 (71.2)	23 (52.3)	0.041	2.254 (1.097-4.632)
≥3	32 (28.8)	21 (47.7)		
Maternal parenting styles				
Poor	57 (51.4)	34 (77.3)	0.006	3.221 (1.451-7.149)
Good	54 (48.6)	10 (22.7)		
Maternal knowledge				
Poor	51 (45.9)	29 (65.9)	0.039	2.275 (1.100-4.704)
Good	60 (54.1)	15 (34.1)		
Maternal education				
Low	16 (14.4)	11 (25)	0,183	1.979 (0.834-4.695)
High	95 (85.6)	33 (75)		
Mothers' occupation				
Employed	13 (11.7)	3 (6.8)	0.559	0.552 (0.149-2.039)
Housekeeper	98 (88.3)	41 (93.2)		

Table 3 shows significant differences in parenting styles between mothers with normal children and mothers with stunting children, especially in feeding practices. The results revealed that mothers with normal children were more likely to provide food with balanced nutrition, such as vegetables and fruits, every day (OR = 0.188, p = 0.001) and protein-rich foods like chicken, beef, fish, liver, and eggs (OR = 0.238, p = 0.001). These findings suggested that a lack of food diversity and inadequate protein intake were associated with an increased risk of stunting in children.

Other aspects of parenting, such as healthcare practices and psychosocial stimulation, also showed significant differences. Mothers of normal children were more likely to take their children to the integrated health post (Posyandu) according to the specified schedule (OR = 0.452, p = 0.044). They established regular bedtime routines (65.8% vs. 45.5%, OR = 0.434, p = 0.032). Both were important

factors for optimal growth. Hygiene practices, such as ensuring children wear footwear when playing outside (OR = 0.303, p = 0.034) and washing hands before feeding (OR = 0.212, p = 0.010), were also more commonly observed among mothers of normal children.

These results confirmed that a comprehensive parenting strategy, which includes not only adequate nutrition but also hygiene, access to health, and structured daily routines, was essential in supporting optimal child growth and reducing the risk of stunting.

Table 3. Odds ratio and p-value of stunting based on maternal parenting styles items

	Parenting styles items	Normal toddlers (%)	Stunted toddlers (%)	Odds Ratio	p-value
Feeding practices					
1	I allow my child to watch TV, use gadgets (mobile/tablet), or play with toys while eating.	20.7	13.6	0.604	0.429
2	I often feed my child noodles/rice and crackers without protein sources such as tempeh or vegetables.	29.7	22.7	0.695	0.497
3	I often provide my child with vegetables and fruits every day.	64	25	0.188	0.001*
4	If my child refuses to eat the food I prepare, I offer food with different tastes and textures.	69.4	65.9	0.854	0.821
5	I prepare a variety of meals for my child.	77.5	68.2	0.623	0.319
6	I monitor the types and amounts of food my child eats.	81.1	65.9	0.451	0.071
7	I frequently provide my child with protein-rich foods such as chicken, beef, fish, liver, and eggs.	84.7	56.8	0.238	0.001*
8	Besides fruit, I give my child other snacks (bread, biscuits, pudding, etc.).	87.4	81.8	0.649	0.522
9	I prepare my child's meals myself.	92.8	84.1	0.411	0.131
10	When my child is older than 8 months, I provide main meals (porridge, rice, etc.) 3-4 times a day.	93.7	86.4	0.426	0.195
Healthcare practices					
11	I regularly give my child deworming medicine.	35.1	22.7	0.543	0.191
12	I routinely give my child vitamins.	46.8	34.1	0.587	0.206
13	I take my child to the Posyandu (community health post) according to the scheduled visits.	55.9	36.4	0.452	0.044*
Psychosocial stimulation					
14	I encourage my child to sleep on time at night.	65.8	45.5	0.434	0.032*
15	I always encourage my child to have breakfast.	79.3	65.9	0.505	0.124
16	I encourage my child to take naps daily.	76.6	68.2	0.655	0.382
17	I train and supervise my child to eat independently.	82.9	77.3	0.702	0.563
Hygiene practices					
18	I encourage my child to wear footwear while playing outside.	93.7	81.8	0.303	0.034*
19	I teach my child to wash his hands before eating.	100	97.7	N/A	0.284
20	I wash the utensils my child uses.	100	97.7	N/A	0.284
21	I wash my hands before feeding my child.	95.5	81.8	0.212	0.01*

* p-value <0.05(significantly associated)

Table 4 shows that there were several gaps in the knowledge aspects identified. Only 21.6% of mothers with normal children and 11.4% of mothers with stunting children were aware of how to assess whether a child is experiencing stunting or not (OR = 0.46, p = 0.21). Additionally, knowledge about the key factors influencing stunting during the first 1,000 days of life differed notably between the two groups (45% vs. 27.3%, OR = 0.45, p = 0.06). Although this difference was not statistically significant, the findings suggest a potential link that requires further investigation.

In contrast, several aspects of knowledge, such as the impact of stunting on children (OR = 0.94, p = 1.00) and the role of infection in the incidence of stunting (OR = 0.70, p = 0.47), did not show significant differences with stunting status. This indicated that although most mothers had a general understanding of stunting, there was still a gap in the application of this knowledge in effective prevention and management actions. Table 5 shows variables included in the final multivariate analysis: maternal parenting styles, knowledge, height, and number of children. Among these four variables, maternal parenting styles and the number of children had the most significant relationship with the occurrence of stunting in toddlers in the Lubuk Begalung area, Padang City, West Sumatra. Mothers with poor parenting styles had a 3.186 times higher risk of having a child with stunting compared to mothers with good parenting practices (95% CI: 1.382-7.348). Mothers with three or more children had a 2.498 times higher risk of having a stunted child compared to mothers with fewer than three children (95% CI: 1.149-5.430).

Table 4. Odds ratio and p-value of stunting based on maternal knowledge items

No.	Knowledge about stunting	Percentage correct (%)		Odds Ratio	p-value
		Normal	Stunting		
1	What is meant by stunting in children?	48.6	45.5	0.880	0.857
2	What are the main causes of stunting in children?	53.2	43.2	0.670	0.347
3	The causes of stunting in children are divided into direct and indirect causes. From the following list, which is a direct cause of stunting?	71.2	59.1	0.585	0.208
4	From the following list, which genetic (hereditary) factors can influence stunting in young children?	31.5	38.6	1.367	0.512
5	How can parents determine whether their child is experiencing stunting?	21.6	11.4	0.465	0.212
6	Which of the following is not a characteristic of a stunted child?	40.5	29.5	0.615	0.275
7	What is the most influential factor in stunting, especially during the first 1000 days of a child's life?	45	27.3	0.458	0.064
8	If a child experiences stunting, can they return to normal?	25.2	31.8	1.383	0.527
9	What are the impacts of stunting on children?	64.9	63.6	0.948	1.000
10	Infectious diseases can cause stunting. From the following list, which diseases can lead to stunting?	71.2	63.6	0.709	0.470
11	What measures can be taken to provide adequate nutrition to prevent stunting?	67.6	52.3	0.526	0.111
12	Besides providing nutritious food, what other actions can be taken to prevent stunting in children?	78.4	75.0	0.828	0.810
13	Stunting can occur in children who experience prolonged malnutrition. At what age should stunting prevention be carried out to achieve optimal results?	51.4	47.7	0.865	0.819
14	Which nutrients in milk support children's bone growth?	70.3	63.6	0.740	0.542
15	From the following statements, which is incorrect regarding stunting?	42.3	40.9	0.943	1.000

Table 5. Results of multivariate logistic regression

Variable	B	S.E	Wald	df	p-value	OR	95%CI
Maternal knowledge	0.696	0.392	3.152	1	0.076	2.005	0.930-4.321
Maternal parenting styles	1.159	0.426	7.391	1	0.007	3.186	1.382-7.348
Maternal height	0.820	0.484	2.864	1	0.091	2.270	0.878-5.864
Number of children	0.915	0.396	5.340	1	0.021	2.498	1.149-5.430

DISCUSSION

The literature discussed ten maternal factors that could serve as determinants of toddler stunting. These factors include the mother's age at pregnancy, BMI, height, gestational age, upper arm circumference, number of children, parenting practices, maternal knowledge, education, and occupation [6-9]. Our study found that maternal parenting style was the most influential factor in stunting compared to other maternal factors. Maternal parenting practice exhibited a strong correlation with the occurrence of stunting in toddlers. This finding is supported by a study conducted in Bogor, West Java, which found that mothers with poor parenting practices had a 1.96 times higher prevalence of having toddlers with stunting compared to mothers with good parenting practices [14]. Other evidence from the Sukabumi Regency of Indonesia also indicated that maternal parenting practices contributed to the high prevalence of stunting in toddlers [15].

Parenting practices greatly affected the nutrition provided to infants and children. These practices were also linked to the stimulation children received. Suboptimal stimulation could hinder a child's growth and development [16,17]. Therefore, stunting prevention efforts should be focused on maternal parenting practices [15].

Good parenting practices were also associated with maternal knowledge. A mother with limited knowledge could lead to poor parenting practices [10]. In our study, we observed that, in addition to parenting practices, maternal knowledge was also related to the occurrence of stunting. Mothers with good nutritional knowledge could provide the necessary nutrition for their child's growth [18]. Mothers bear full responsibility for providing food for their families. Maternal nutritional knowledge influences food selection and dietary variety provided to their toddlers [19]. Information or knowledge about nutrition could be acquired directly or indirectly. It can be obtained directly through healthcare professionals during counseling sessions, or indirectly through the Internet or books [20].

In our research, we also found that mothers with three children or more were another factor associated with stunting. This finding was consistent with studies conducted in Brazil and South Africa, where children living in larger households were more likely to experience stunting. Larger households can lead to resource depletion, reduced availability, and increased competition for food. The size of the family can result in improper food allocation, which negatively impacts the child's health and leads to suboptimal nutritional status. This was also in line with research conducted in Southern Brazil [21], South Africa [22], and Ethiopia [23,24].

Although other studies have indicated a relationship between maternal nutritional status and stunting [25,26,8], our study found no relationship between maternal BMI and upper arm circumference and the occurrence of stunted growth. We also found no connection between maternal factors, such as maternal height, age at pregnancy, and gestational age, and the occurrence of stunting. However, these findings differed from research conducted in Sulawesi [27], Central Java [28], Vietnam [29], and South Asia [30].

Thus, studies have shown that the determinants of stunting vary across the region. In the Lubuk Begalung, Padang region, we found that maternal parenting practice was the most influential determinant. The effectiveness of empowering mothers in infant care through health education, using a modeling approach, is shown to improve infant anthropometric status [31]. Therefore, there is a need to increase knowledge about positive parenting practices among mothers of toddlers and prospective mothers through regular programs by midwives and community health workers. These efforts are expected to enhance optimal parenting practices for toddlers from before birth to later life, thereby preventing stunting.

The strength of our study was the use of multivariate analysis that increased the validity of the findings by identifying dominant factors after controlling for confounding variables. We used a large sample size, validated instruments, and trained data collectors. In addition, stratified random sampling ensured a representative sample of five villages in Lubuk Begalung, making the results relevant to health

policy in the area. However, our studies had some limitations. Our cross-sectional study could not establish causality, and it only identified associations. In interviews, participants might not accurately remember past events or experiences. To strengthen our findings, further studies are needed with a longitudinal design and wider coverage area to support policy.

CONCLUSION

The study highlights that maternal parenting practices have the most significant impact on toddler stunting, with evidence of a higher prevalence of stunting in mothers with poor childcare practices. Suboptimal parenting practices are closely associated with inadequate food intake and a lack of stimulation for child growth and development. Furthermore, maternal nutrition knowledge also plays a crucial role in preventing stunting, as knowledge influences parenting practices. The number of children in a family is also a factor related to stunting, with larger families experiencing resource depletion and inappropriate food allocation. Therefore, efforts to increase knowledge, especially for prospective mothers, adolescent girls, and mothers with lower education levels, about proper parenting practices are needed to prevent stunting.

Body mass index (BMI) and upper arm circumference (UAC), which are significant factors contributing to stunting in previous studies, were not significant in our study. These findings demonstrated the importance of a context-based approach in addressing stunting. Parenting, family planning, and social security programs should be strengthened to ensure family nutritional adequacy.

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